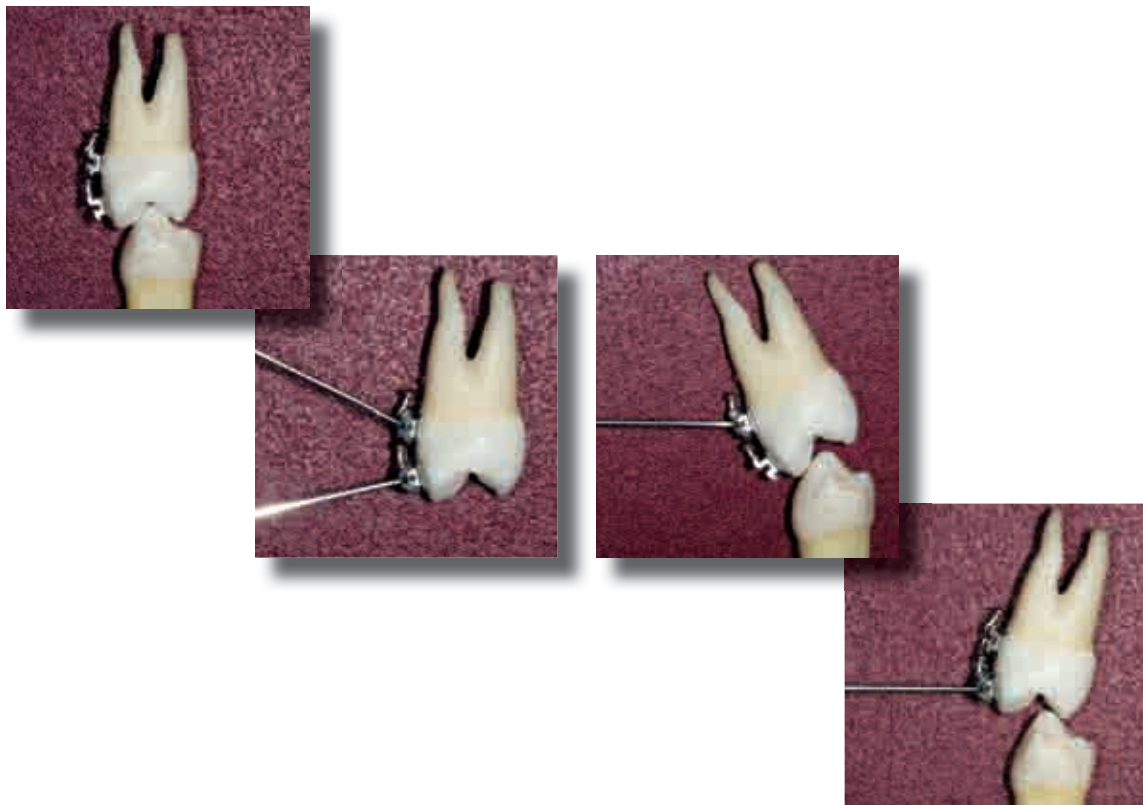


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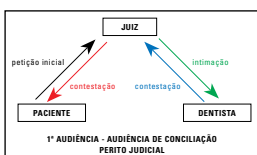
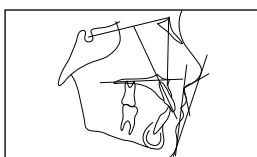
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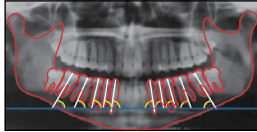
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VARIÁVEL	MORRIDA				TOTAL	p ¹	OR e IC ¹ (95,0%)
	ABERTA ANTERIOR						
	n	%	n	%			
GÊNERO							
Masc.	58	36,0	103	64,0	161	100,0	1,04
Fem.	46	35,1	85	64,9	131	100,0	0,872 (0,64 a 0,69)
TOTAL	104	35,6	188	64,4	292	100,0	1,00
FAIXA ETÁRIA (MESES)							
13 – 24	15	24,2	47	75,8	62	100,0	0,51
25 – 36	89	38,7	141	61,3	230	100,0	0,034* (0,27 a 0,96)
TOTAL	104	35,6	188	64,4	292	100,0	1,00





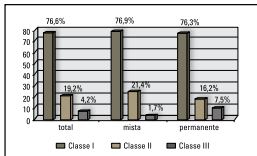
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IDADE (anos)	MEDIA (mm)	ERRO PADRÃO	IC 95% (média)	MIN.-MAX. (mm)
7	43,29	0,92	41,39 – 45,19	31,12 – 51,05
8	43,85	1,07	41,61 – 46,09	31,55 – 51,67
9	42,99	0,98	40,94 – 45,04	35,24 – 52,20
10	43,86	1,77	39,94 – 47,77	36,07 – 55,83
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When compliance fails, which is to blame: the patient or the appliance?

The interpretation of article results

In the early years of my life as an orthodontist I sometimes heard comments about the behavior of patients undergoing treatment. These comments were targeted at patients' compliance in the use of the orthodontic appliance itself or its accessories, such as intermaxillary elastics, headgear, etc.. Such remarks were often uttered disapprovingly. "That's a lousy patient. Never wears his headgear," or "No way, she'll never wear her removable appliance." That's the crux of this editorial. When compliance fails, which is to blame: the patient or the appliance?

This issue is deeply rooted in the scientific method and in the design of different clinical trials as well as in how we read and understand research articles. To illustrate this point, try to envisage the following hypothetical scenario.

A study is conducted to compare the efficacy of two different treatment protocols. A total of 300 patients are involved in the research and are randomly distributed among three groups. One hundred patients for treatment A, 100 for B and 100 in a control group. These treatments could be, for example, (A) new device for Class II correction and (B) extraoral appliance. In this study, 82 patients completed the treatment in group A (new appliance) and 93 in group B (headgear). The hypothetical results, excluding the control group, are gathered in Table 1.

The results of our study show different hypothetical success rates. Treatment A (new appliance) had a success rate of 97.5% while treatment B

(headgear) had a success rate of 92.5%. Now comes the intriguing question: Which is the best treatment in light of these results?

The answer is clear. Treatment B (headgear), with a 92.5% success rate, apparently proved BETTER than treatment A (new appliance), with a 97.5% success rate. That's right, the treatment with the lower success rate was the best treatment for Class II correction. Why?

The number of individuals who completed the treatment in both groups was different. It was smaller in treatment A (new appliance) than in treatment B (headgear). We have compelling reason to take this difference into account as part of the treatment outcomes. In other words, most people give up on the new appliance because it is unsightly, or very uncomfortable, or because it has some negative feature that leads to lower rates of compliance. This fact should always be weighed when comparing treatments, or even when evaluating a series of cases.

TABLE 1 - Results of a hypothetical trial that compares two Class II treatments, one using a new appliance (A) and one using headgear (B). In this example, significant differences were found between the treatments.

TREATMENT*	SUCCESS N (%)	FAILURE N (%)	TOTAL
A (new appliance)	80 (97,5)	2 (2,5)	82 (100)
B (headgear)	86 (92,5)	7 (7,5)	93 (100)

* There are statistically significant differences between hypothetical treatments A and B.

Let's bring another example. Let's say the same results were found by a cancer center when comparing two different chemotherapeutic drugs to treat a certain type of cancer. The group with the highest dropout rate probably used a drug that causes more side effects or complications than the other. It has, therefore, shown higher rates of non-compliance.

If no one can be called a lousy user of chemotherapy, why would someone be a lousy headgear (or other appliance) user? In actuality, they are not. It so happens that different treatments entail different patient responses. For example, many patients simply cannot sleep with the headgear on and refrain from wearing it in social settings. We, as health professionals, are expected to manage a wide variety of patients as well as their ease or difficulty in complying with treatment and we must understand the difficulties faced by patients.

This fact has been historically overlooked in the orthodontic literature worldwide. Scientific methodology provides a specific conduct to address this issue whenever it arises. It is called intention to treat analysis. In this approach, researchers confronted with a given case monitor all patients from the earliest stage of the investigation down to its very end. The stated goals are to highlight and report the reasons for non-completion of therapy

for each subject included in the study. Whenever possible, these cases are to be comprised in the statistical analysis. This research conduct highlights with a greater degree of accuracy the experience of patients undergoing therapy.

Inadequacies or misinterpretation of study outcomes have historically resulted in erroneous treatment and overtreatment indications. Thus, certain diseases treated by dentistry have suffered more than others from our difficulties in reviewing the scientific literature. One such example are temporomandibular disorders (TMD).

The article receiving the seal of the editor in this issue - Orthodontics and temporomandibular disorders, the state of the art -, by Dr. Paul Conti, provides a clear picture of the state of our current knowledge regarding TMD. Today, TMD treatment is straightforward and uncontroversial. Readers of Dr. Conti's article will enjoy a bird's-eye view of the relationship between orthodontics and TMD treatment.

Be critical and good reading.

Jorge Faber
Editor-in-chief
faber@dentalpress.com.br

Orthodontics and temporomandibular disorders: the state of art

Paulo César Rodrigues Conti, DDS, PhD*

It is increasingly common to receive individuals referred by colleagues in the medical field from various specialties, for treatment of pain and or dysfunction of the Temporomandibular Joint (TMJ) and masticatory muscle, known as Temporomandibular Disorders (TMD). These patients are usually teenagers or young adults, who have some type of skeletal or dental malocclusion, and were already assessed for the possible presence of other disturbances with the potential to cause pain or dysfunction in the orofacial area, such as primary headaches, ear infections or sinusitis, among many others.

When examining the patient, the clinician, not uncommonly, will find a malocclusion, with an indication of orthodontic treatment to correct it. At this moment, a storm of thoughts, doubts and fears starts in the head of the professional. Is indicated the treatment of malocclusion for the relief of signs and symptoms of TMD? Is there some kind of appliance or mechanics that should be avoided for these cases? What is the risk of worsening of symptoms with orthodontic therapy?

The literature on the possible relationship between orthodontic treatment, malocclusion and TMD is saturated with research, using different methods and findings are also confused and not representative of the used methodology. One of the most common interpretation mistakes refers to cross-sectional studies, where the individual is examined only once and, sometimes the co-existence of malocclusion and TMD or a history of orthodontic treatment and TMD is detected. Many could conclude that there is a cause-effect relationship between these variables, which should not be

stated, based on this type of observational research. If present (which is not the most common finding in this type of studies^{1,2}), such a relationship would only be an association, precluding any kind of statement which factor preceded (or caused) the other.

Several other problems are also part of this scenario and keep alive the academic discussion. Many orthodontists would report a marked improvement of TMD symptoms immediately after the installation of braces, which would be the effect of "orthodontic treatment". It has been accepted, however, that much of this improvement is due to the act of creating a "new situation" in the oral cavity. That is, the installation of the appliance (and its activation..) triggers a process of cognition, where the new intra oral situation acts as a "warning" for the patient to abandon the habits of clenching teeth and chew gum, and increase adherence to treatment, increasing the success rate of the same. This mechanism is very similar to those caused initially when an occlusal splint is inserted. As seen so far, the difficulties are enormous in relation to methodology and interpretation of results. This process is due, mainly, to the large number of variables involved in this relationship: the orthodontic patient may present several types of initial malocclusion, different methods are used to detect the presence or absence of TMD, and the possible existence of other contributing factors, since it is well known as a multifactorial entity.

The growing concept of Evidence-Based Dentistry (EBD), however, brought important and useful information about this controversy. Systematic reviews, publications with the highest level of scientific evidence, have shown that there are no

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significant association between orthodontics and TMD^{3,4}. This means that individuals undergoing orthodontic treatment do not have higher or lower risk of developing TMJ and/or masticatory muscles signs and symptoms.

These findings are corroborated by a recent article⁵, which reports a longitudinal follow-up of 20 years, where the main goal was to observe if there was any healthy or masticatory gain from the completion of orthodontic treatment. Initially, in 1981, 1081 children were examined, between 11 and 12 years old, and they were re-evaluated after 3, 8 and 20 years. In the last evaluation, the number of subjects studied dropped to 337 participants, usual and acceptable fact in an observational study of long duration. Authors determined the presence and severity of TMD based on the Helkimo's anamnestic questionnaire, associated with standard physical examination. When indicated, orthodontic treatment was carried out by different private practitioners or at the Cardiff School of Dentistry, Great Britain. Psychological and behavioral aspects were also measured by specific inventories. The TMD prevalence, as expected, increased from 3% at baseline to 17% after 8 years, and decreased to 10%, after 20 years. An important finding was that the completion of orthodontic treatment did not interfere with the values of TMD prevalence or incidence (new cases), in any of the evaluation periods. Moreover, the only factors that were considered as predictive for the presence of TMD in adulthood were female gender and the presence of signs and symptoms of TMD in adolescence. According to the authors, the higher prevalence of TMD in women is due to the hormonal changes, a greater sensitivity to external stimuli and the presence of ligamentar hypermobility.

As state before, the method used in the present research to define TMD (anamnestic questionnaire) does not allow sub-classification of the various different types of the disease (articular accompanied or not by disc displacements, muscular, etc.) This fact can be considered a study limitation, be-

cause some studied variables could have influenced individual structures, unable to be measured by a questionnaire. This fact, however, does not interfere with the quality of research or data interpretation, performed adequately by accurate statistical analysis.

The fact of the presence of TMD in the adolescence predict the disease in adulthood alerts us to the need of managing symptoms effectively in this population, in order to decrease future risk. The maintenance of symptoms for long periods often leads to peripheral and central neuronal alterations, which may become irreversible. It should be clear, however, that this control of symptoms should be done using non-invasive and reversible strategies.

After reviewing the above facts, it is clear that one should not suggest orthodontic therapy with the aim of preventing or treating signs and symptoms of TMD. On the other hand, it is understood that conscious and well planned orthodontic treatment should not be seen as the "villain" and the main reason for patients to develop TMD in the future.

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The gene and epigenetics: the dental and maxillofacial characteristics are related to environmental factors

or

The genes do not control everything!

or

Is the genetic determinism over?

Alberto Consolaro*

The word gene was coined in 1909 by Wilhelm Johannsen to replace the concept of units of inheritance called “gemmules”, created by Charles Darwin. Before Darwin, the prevailing concept was the “determinants” created by Weismann. Before these, there was the concept of “pangenes” initially proposed by Hugo de Vries^{9,13}.

The concepts of gemmules, determinants and pangenes had a built-in meaning: *they were preformationists, i.e. everything was predetermined*. However, Johannsen knew this was wrong: the transmissibility of characteristics between generations was not as such, and thus the term gene was created to eliminate this meaning^{9,13}.

The creation and concept of gene ultimately gave rise to the genetic determinism: *the characteristics of live beings are determined by units of inheritance called genes*. This concept was very keen and closed and was finally dogmatically used. The transmissibility of characteristics between generations does not depend *exclusively* on the genes; we should consider the cell as a whole with the cytoplasm, mitochondria and genetic material present in its

structure, as well as the entire organism and the complexity of the environment.

The didactic meaning of the word gene implies translating it as a DNA fragment that stores complete information related to the cell function. In the human body, we have nearly 337g of DNA¹. Some years ago, we assumed that the mankind would have the highest number of genes among all species. Nowadays, we know that we have fewer genes than the rice, the cow or even the rat. We imagined we had 100 thousand genes, yet the current knowledge indicates that we have nearly 25 to 30 thousand. *The low number of genes reveals that the biology is more complicated than many people would like*, as stated by Craig Venter, founder of Celera Genomics, a company that has its own version of the human genome⁸. The onset and end of a gene in the DNA structure may be permeated by another gene that uses only part of this gene. The genes are interspersed and superimposed one over the others, and maybe for this reason there was a feeling of frustration when the sequencing by the human genome project was announced^{1,8,9,13}. Spectacularly, conclusions were expected such as: “... *here are the genes*,

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distributed this way in each chromosome, each with a defined function”.

This project detected the sequencing of the DNA, yet did not describe the onset and end of all genes involved in the formation and functioning of mankind. This is still ongoing, or at least attempting. To demonstrate the complexity of this system, there are also jumping genes that may change their position in the DNA in the context of chromosomes, which are very hard to identify and isolate.

The epigenetics influences the inaccurate transmissibility of dental and maxillofacial characteristics

Many aspects not related to the genes influence the transmissibility of our characteristics. There is no genetic determinism and the importance of the concept of epigenetics has been increasingly highlighted based on the ideas of four renowned geneticists, Lewontin, Keller, Parentoni and Piza^{9,13}:

- 1) the gene-particle does not exist;
- 2) the chromosome works as a whole;
- 3) the cytoplasm plays a more important role than the nucleus in hereditary phenomena. Remember the RNA, mitochondrial DNA, cytoplasmic enzymes and proteins.
- 4) for the cell, the environment is the organism in which it lives; for the organism, the environment is represented by the place where it lives and its variables in the interaction with the outside world.

The epigenetics considers the biochemical factors that turn genes on and off, which is related to the environment of the cells and of the organism as a whole. The genes are often present, yet they are “turned on and off” by enzymes, proteins, hormones and other mediators. The genes may undergo adaptations to conform the cell or organism to the environment. This may occur without alterations in their nucleotides or “letters”, i.e. the genes may be simply

turned off.

The difference between epigenetics and a mutation lies on the fact that the latter changes the sequence of letters or nucleotides of the genes, usually by the action of external factors such as chemical or physical agents during the process of genome reduplication, or by a simple biochemical accident.

The environmental factors are among the epigenetic factors most often cited, including the diet, pollution, drugs and exercises that may modify the pattern of turning the genes on and off during the cell division. In 2001 many frustrations occurred when the sequencing of the human genome was announced. Many responses were expected to diseases such as obesity, diabetes and cancer; however, these responses were not achieved, because the genes represent one of several factors involved. Many other factors related to cell functioning have not been elucidated, yet the epigenetics begins to explain this variability.

The teeth present shape, structure, size, number, shade and position, besides other characteristics that are strongly influenced by environmental factors in the years of extra-uterine life in which the odontogenesis occurs. Four such environmental or epigenetic factors that may be involved in the final determination of dental characteristics are presented below⁴:

- a) growth forces guiding the final format of the jaws. In this process, the position and shape of tooth buds still in the soft tissue stage or undergoing mineralization may be altered. The face formation is initiated in the fourth to eighth week of intrauterine life, called embryonic period. In this period there is intensive cell differentiation and migration. The forces generated during face formation and growth and during the formation of embryonic processes may change the original, genetically determined position of the tooth buds and their harmonious alignment with the deciduous tooth buds,



FIGURE 1 - Epigenetics may explain why the teeth of any given patient are not exactly the same on both sides, although it is highly likely that the genetic information in the DNA determines that they be bilaterally identical. However, this does not occur owing to the influence of environmental factors. Epigenetics must be deeply embedded in the morphological formatting of human teeth.

alveolar ridge and the other permanent teeth. This may occur during the initial period of odontogenesis, still in the dental lamina stage.

The dental lamina is shaped as an epithelial wall connected to the ectodermal lining of the primitive mouth, shaped as a horseshoe. Its internal margin gives rise to the tooth buds as round fruits, initially hanging and then loose. These tooth buds are harmoniously aligned in the mesenchyme around them to form the future dental arch. Forces external to the dental lamina and tooth buds may disarrange them or even displace them upward or downward since the onset of formation, when the mesenchyme has not yet originated the bone:

b) tooth migration in the jaws during the process of tooth eruption. Deviations in the tooth long axis may represent changes in the eruption pathway due to the presence of obstacles such as areas of bone condensation, cortical bone or even other teeth in case of lack of space. This probably prevents the contralateral tooth to be exactly equal in volume, shape and position;

c) environmental influences on the organism, as byproducts of the diet and drugs reaching the tissues through the blood circulation,

variations in body temperature and byproducts of the metabolism. These factors may influence the shade, mineral density, period of formation and tooth eruption;

d) masticatory load, which may influence the shape of the apical third of teeth. During root formation, the tooth erupts by moving toward the occlusal plane. When the teeth occlude with antagonist teeth, the apical third of the root is still being formed. The tip of the developing root presents the dental papilla, Hertwig's epithelial root sheath and the dental follicle, which in combination constitute the "root forming organ". These tissues have soft texture with reduced ability of physical penetration into the bone tissue; however, their chemical mediators induce the bone resorption, providing space for completion of the apical root formation. Nevertheless, in the presence of obstacles such as cortical bone, bone sclerosis, nerves and blood vessels or even other teeth, the shape and period of formation of these embryonic tissues may be altered, giving rise to different and even shorter apical thirds. Probably the original, genetically determined shape was much different than definitely established in the final tooth morphology.

The epigenetics may explain why the teeth of the same individual are not exactly equal at both sides even though the genetic information in the DNA should probably originate bilaterally equal teeth; however, this does not occur due to the action of environmental factors. The epigenetics should be strongly related to the morphological format of human teeth^{5,3}.

Tooth positioning, harmony between the dental arches and between the maxilla and mandible and the skull should be genetically programmed, yet environmental factors such as habits, position, change in the growth pattern alter these relationships that may be genetically well established.

Craig Venter, one of the most prominent researchers in the genome project, made the following statement when questioned about the influence of the environment on the occurrence of diseases (Fioravanti): ... genes and the environment have probably the same importance. In each illness, in each human condition there is a different mix of the influence of these two factors. The biological molecule proves that the environment is really an essential part of life, of biology. They are not separated. The people who only look at genes or only at the environment, start out missing the point. By definition, it has to be the two of them together.

The concepts of pleiotropic gene and polygenic system to understand the characteristics and status of the teeth, maxilla and mandible

The genes and chromosomes involved in the determination of our dental and maxillofacial characteristics are not yet accurately known. It is only suggested that the genes *MSX1* and *PAX9* are involved in the origin of partial anodontia. However, clinically, when the number of teeth is altered e.g. in partial anodontia, other characteristics of the present teeth are also altered, such as crown and root shape,^{4,5,7,10,14} originating the phenomenon of morphological

simplification:

- a) the cusps are shorter and less angled,
- b) the occlusal surface presents fewer pits and fissures,
- c) the mesiodistal diameter is reduced,
- d) the Carabelli tubercles disappear or are reduced in the first molar,
- e) the cingula are reduced or absent in the maxillary anterior teeth,
- f) the distolingual cusp is absent in the maxillary second molar,
- g) the roots are shorter in relation to the crown,
- h) the triangular shape is predominant in patients with partial anodontia.

Probably, other characteristics may also be altered, such as the shade and tooth positioning in the jaws. As a consequence, the jaws may also present alterations in their growth and shape. This relationship between dental and/or maxillomandibular characteristics with the others influencing the shape and function may be explained by the epigenetics and considering two other concepts:

1° - **Pleiotropic gene:** gene responsible for one or more morphological and/or functional characteristics. When one of these characteristics is changed, the others may also be altered, strongly influencing the final phenotype of the structure. Thus, changes in the shape or number of teeth may cause changes in their position and period of eruption, for example.

2° - **Polygenic system:** group of genes that would act harmoniously to determine a group of characteristics. When one of these genes presents modifications, the others would be influenced and would alter the phenotypes of structures influenced by them. Changes in tooth shape may be related to alterations in the shade and number of teeth.

Concluding remarks

The knowledge on dental and maxillofacial

morphology necessarily involves the concepts of epigenetics, pleiotropic gene and polygenic system to explain the relationship between different characteristics, such as the shade, size, number, shape, structure and position of teeth and of the jaws. Knowledge on the etiopathogenesis of dental and maxillofacial developmental disturbances also involves these three concepts.

The analysis of the relationship between dental and maxillofacial morphology, as well as their developmental disorders, also called disgenesias, may give rise to insights to studies on the identification of genes, chromosomes and epigenetic mechanisms responsible for the characteristics of human teeth and jaws.

We should not state that the genome project was a historic landmark, since it is not over yet.

We do not know exactly how many genes we have, in which chromosomes they are located, or their onset and end in the DNA sequence¹¹.

When asked if the human genome might be considered the “book of life” and if the genetic determinism had been knocked, Venter stated⁸: *... the genetic code is not a portrait of a human being, nor the dictionary of life. It holds important parts to our history, important instructions for our cells, about how to modify them. However, you cannot go into a chromosome and find the instructions on how to make a heart, a brain. This discussion has to do with the complexity of the human being. The information is on the following levels, in the interplay between the proteins and between the structures of the cells. All of this is not directly codified in our DNA.*

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- Consultant of the Dental Press Journal of Orthodontics and Facial Orthopedics.
- Has given more than 200 lectures and courses, has had articles published in Orthodontics and Aesthetics journals.



I would like to invite our dear readers to enjoy the knowledge – resulting from his clinical experience and scientific fundamentals – of an icon of Brazilian orthodontics. Prof. Roberto Carlos Bodart Brandão demonstrated, in his answers to the interviewers, profound knowledge and unique confidence while discussing the issues of disjunction, finalization, aesthetic excellence, occlusion, selective grinding and retaining. A sports fanatic, particularly nautical sports, Prof. Roberto regularly goes deep sea fishing, in addition to occasionally practicing windsurf and tennis. Restless, curious and very critical – especially of himself – he looks for his mistakes every day in order not to repeat them. He enjoys technology, but believes his profession is art and background. He also enjoys cooking, especially for family and friends, who are, according to him, his “greatest wealth”. He is the son of Aloayr da Silva Brandão and Wilda Bodart Brandão (he, a general dentist, retired, one of those who worked from 7 am to 9 pm with two jobs and a private practice – tireless; she, a retired grade school teacher, who rose rapidly to become principal of a public school, through her competence and seriousness, a charismatic leader). Dr. Roberto works from his private clinic, located in Vitória/ES, where he works alongside his wife Larissa – also an orthodontist, a graduate from Universidade Federal Fluminense. I wish you all an excellent scientific contact with this five-star orthodontist.

Telma Martins de Araujo

Do you employ expansion followed by contraction – O senhor emprega a expansão seguida de contração, tão defendida na atualidade, como auxiliar na maxillary protraction? Telma Martins de Araujo

The results of the studies have been positive, and I have included this practice in my cases of Class III malocclusion with maxillary retrusion, stimulated especially by the studies of Dr. Liou, who pioneered the technique¹³. As I do not have access the double-hinged expander developed by the author, I use the conventional Haas expander. After the expansion and contraction period (seven weekly cycles), I begin protraction using an orthopedic facemask. The casuistry, while still limited, is positive for this protocol, but we need more long-term studies to consider the stability of those results. The early treatment of Class III is one of the greatest accomplishments of orthodontics, and all effort and knowledge must be applied to correct and control growth, even when we know many cases will end up in surgical procedures, which should be clearly explained to patients and guardians.

What is your experience with non-surgical expansion in adult patients? Telma Martins de Araujo

Scientific evidence shows that closure of the midpalatal suture occurs around the age of 16 for girls and 18 for boys; in the same study, however, open sutures were found in cadavers up to 27 years of age¹⁵. Based on these findings, I adopt a rather uncommon clinical approach for some cases of transverse maxillary deficiency. I usually attempt rapid maxillary expansion in patients up to 23 years old, depending on their individual characteristics. In these patients with posterior crossbite, I evaluate the thickness of the buccal bone plate in the maxillary arch, which should not feature salient root contours to the touch, and check the degree of synostosis of the midpalatal suture, which can be evaluated using occlusal radiography, or even better, through volumetric tomography. I use Dolphin

Imaging software to reconstruct tomographic images; I believe in an improvement in the resolution of these images in the short-term, as they have not yet proven to be reliable. In the cases where the images suggest the suture has not fully closed, I make use of the Hyrax appliance activated four times a day during four or five days. I then reevaluate the patient, and if a diastema has developed between the maxillary central incisors (a clinical sign of expansion), I move on to activation twice a day, following the conventional protocol, until achieving overcorrection of the transverse problem (Fig. 1). I regard late expansion as a valid attempt, with which I have achieved a lot of success, but I know I have not reached the best possible scientific evidence for that practice. If expansion does not occur, the patient is previously informed of the need for surgically assisted rapid maxillary expansion (SARMA). Most patients prefer the clinical treatment, if possible, before the surgical solution.

How do you evaluate the incorporation of torque in posterior teeth, during the initial or advanced stages of treatment, using the same prescription of pre-adjusted brackets or the same pattern of bends on orthodontic arch wires for all patients? Jonas Capelli Junior

This question requires a reflection, and I shall divide the answer into two parts. First, I will discuss the concerns I have with torque during orthodontic treatment. I am very self-critical, and I believe I learn more from my mistakes than with my successes. During my practice, I have observed that incorporating undesirable torques leads to significant delays in treatment, as well as potential iatrogeny. In that context, I recommend all clinicians observe the torques in the posterior teeth of their patients prior to treatment and also after the leveling phase using round arch wires. The torques of posterior teeth are normally just fine in both cases. Therefore, there is no need, in most patients, to incorporate torques, but there is a need to control them. Therefore, we would make a mistake if we incorporated



FIGURE 1 - **A, B, C, D**) 23-year-old patient, with posterior bilateral crossbite associated with a Class II division 1 malocclusion, anterior open bite. **E, F**) Correction of transverse problem through late maxillary disjunction, without surgical assistance, using the Hyrax. **G, H, I**) Result of the disjunction, with bite opening, temporary. **J, K, L**) Final result obtained with fixed appliances. In order to correct the Class II, the maxillary first premolars and mandibular second premolars were extracted for a camouflage effect. **M, N, O, P**) Smile comparison, before and after correction, purely clinical.

root movements where they are not necessary. This observation is far from forgoing the use of rectangular arch wires in treatments, but it defines that their use should be preceded by an important judgment. Prior to setting a rectangular arch, one should question whether there is the need to make root movements in posterior teeth. As the answer is usually no, the arch should be passive in those teeth. This is only effectively achieved if an “arch reading” is done prior to setting. The worst could happen if the torque indicated for a molar were the opposite of that resulting of standard Edgewise bend or a Straight-wire prescription. This simple procedure, of “arch reading”, avoids two serious problems: (1) by incorporating an undesirable buccal root movement in posterior maxillary teeth, this leads to a reduction in periodontal thickness, adding a risk of periodontal recession, and at the same time, contraction of the maxillary arch, possibly resulting in a posterior crossbite; (2) if the movement is lingual by the root of the same teeth, there will be extrusion of the palatal cusp, and consequently an open bite (Fig. 2). For any of these situations, a problem is added or aggravated in the malocclusion, demand-

ing time and mechanical effort that were previously unnecessary².

The second part of the answer concerns the use of pre-adjusted appliances, using an author's judgment as a finished solution. We need only observe the countless number of appliances available in the market, and each author's declarations favoring their own product and pointing out the problems with the competition, to suspect these ready-made solutions. The search for the perfect appliance is limited by the diversity in tooth shapes and dental arches that can be considered normal. A geometric progression would explain the variety of situations and the impossibility of finding a solution that could fit perfectly into a single case. Variation in human occlusion is the rule, and not a given average applied to determine the torque and angling of a prescription. Additionally, there is the variation in the torque result whenever the height in which a bracket is bonded is changed (Fig. 2). The idea of perfect techniques only find space when there is no scientific basis – and that goes both for pre-adjusted appliances and conventional techniques (Edgewise, Ricketts), when critical thinking is not used before

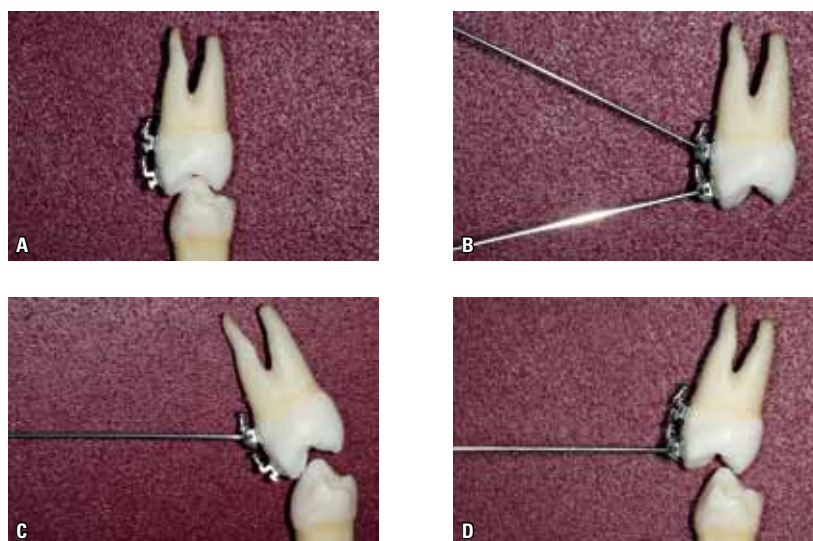


FIGURE 2 - A) Bonding of two same prescription brackets at different heights on a premolar crown. B) Verify the opposite effects of root torques when wires are placed orthogonally to the brackets. C) Root buccal torque effect in the more apical bracket, with a potential contraction of the arch and risk of periodontal recession. D) Opposite effect on the occlusal-bonded racket, root lingual torque, creating premature contact and potential open bite. Although they represent extremes, these figures show how much the effect of torque incorporated into the brackets is dependent on tooth morphology.

any procedure. It is certainly easier to win the lottery than find an appliance that can treat a malocclusion, with quality, in the hands of an orthodontist without the proper qualifications. Professional qualification demands hard training, obtained only in specialization courses with at least 2,000 hours in the classroom. Unfortunately, the lack of management in Brazilian orthodontics has led many to consider normal specialization courses with three days a month, with a class load that until recently would not even be acceptable for refresher courses. What has changed? In the rest of the world, nothing – the number of courses has decreased, with only those with higher quality remaining, prioritizing critical thinking by the orthodontist, and not the technique. In Brazil, there is desperation, excess of dentists, lack of patients, the low compensation and low quality in education... in short, lack of management. That is the great challenge of ABOR – to take the responsibility of managing the field of orthodontics, as happens with medicine in Brazil and orthodontics in the United States, where organized specialists are the managers of their specialties. It is a battle that should be fought by all orthodontists, organized, giving support to ABOR and BBO, as that is the only solution.

Your training was in "standard Edgewise" and, after a few years, you migrated to "Straight-wire". What you would say to orthodontists who still practice only "standard Edgewise" and, likewise, to schools and orthodontists who are educated only in straight-wire? Luiz G. Gandini Junior

Indeed, my initial education was at UFRJ, which has a curriculum based on the Edgewise technique, intensively and extensively reviewed and revised. I believe that is one of the main reasons I am in this privileged position, answering questions made by prominent professionals in Brazilian orthodontics. I have a visceral bond with my professors at UFRJ, of whom I would highlight four names: Professor Alderico Artese, for his innovative and sagacious spirit;

Professor Carlos Teles, for his straight conduct; Professor Ana Maria Bolognese, for her determination towards scientific evidence; and lastly, Professor Nelson Mucha, who is an icon of excellence, who has inspired an entire generation of orthodontists. I definitely believe that students need guidance, a consistent education that combines critical thinking, knowledge and training, aiming for the best possible professional judgment. As such, building an orthodontic plan based on consistent techniques, which require great control over the wire and dental accessories – such as the Edgewise, Ricketts and Segmented Arch techniques – is precious and essential in the education of an orthodontist. In fact, the solution for each problem in orthodontics should lie within the orthodontist, and, to that end, there is the need for a long and thorough education, in addition to dominating a technique, and not being a hostage to it. Unfortunately, recent graduates seek the shortest route, and are led to specialization courses, even Master's degrees, in which they are trained like technicians of a straight-wire factory. When faced with the reality of clinical practice, they discover that, without a solid basis, it is not possible to build a career, and they lose themselves in more courses and new techniques. Five years ago, after 15 years in orthodontics, I opted for the use of pre-adjusted brackets. I don't consider I have changed techniques, as I continue to use loops and resources based on Edgewise. I consider all prescriptions of what is known as "Straight-wire" to be, in fact, variation of the Edgewise technique. With the use of pre-adjusted appliances, I believe I made my clinical life easier, especially in the early stages of treatment, and I have noticed, more than ever, that any prescription has its limits. Certainly, one who is trained only in Edgewise and masters the technique, is able to use any straight wire prescription. The opposite is not true. For all that, I consider it absolutely essential that an orthodontist's initiation be through techniques featuring a scientific basis, exhaustive training and a long history of success, such as the Edgewise technique.

After your doctorate in Araraquara, you began to apply the Segmented Arch Technique. How did that alter your orthodontic life, and what is the role of that philosophy within your practice today? Luiz G. Gandini Junior

I am very thankful to the faculty and friends who welcomed me at Unesp-Araraquara, which was essential to my scientific and personal ascent. Scientifically, I learned and discussed the segmented arch technique (SAT), which was valuable in the understanding I currently have of the biomechanics involved in orthodontics, so that I was able to understand and correct my mistakes. To understand the concept of statically determinate movement and the six geometries of statically indeterminate movement helped me determine the force and momentum produced on each tooth, which can generate desirable and undesirable effects in each activation of the appliance¹⁷. We should consider that much that happens in the use of continuous arches is linked to back-and-forth tooth movements. Thus, in the sequence of wire replacements, we end up fixing the problems we have previously caused, losing time and leading to cases of malpractice. That is eliminated when I apply the concepts

and resources of SAT in tooth movement³. I have incorporated the routine use of a palatal arch and Nance appliance as parts of the two- and three-piece device, using a cantilever, retractions loops, intrusion arch, among other resources, prior to or concomitantly with the use of continuous arches (Fig. 3). The use of the cantilever allows for greater inter-bracket distance and greater activation amplitude using a rectangular loop. Consequently, the force is reduced and control over movement is increased, which quickly corrects the rotation of the canines, without sequelae. In short, after I gained extensive knowledge of SAT, I understand the Edgewise technique much better, and I have more resources to avoid or revert undesirable effects. On the personal side, I learned a lot about teamwork. The attentive manner in which I was treated as a student makes me believe it was a privilege for me to have done my doctorate work in Araraquara. I cannot forget how I was impacted by professor Joel Claudio da Rosa Martins, who gave the sample for my doctorate thesis, and from whom I draw inspiration when I try to be a better professional and when I need to rekindle my dedication and respect for orthodontics.

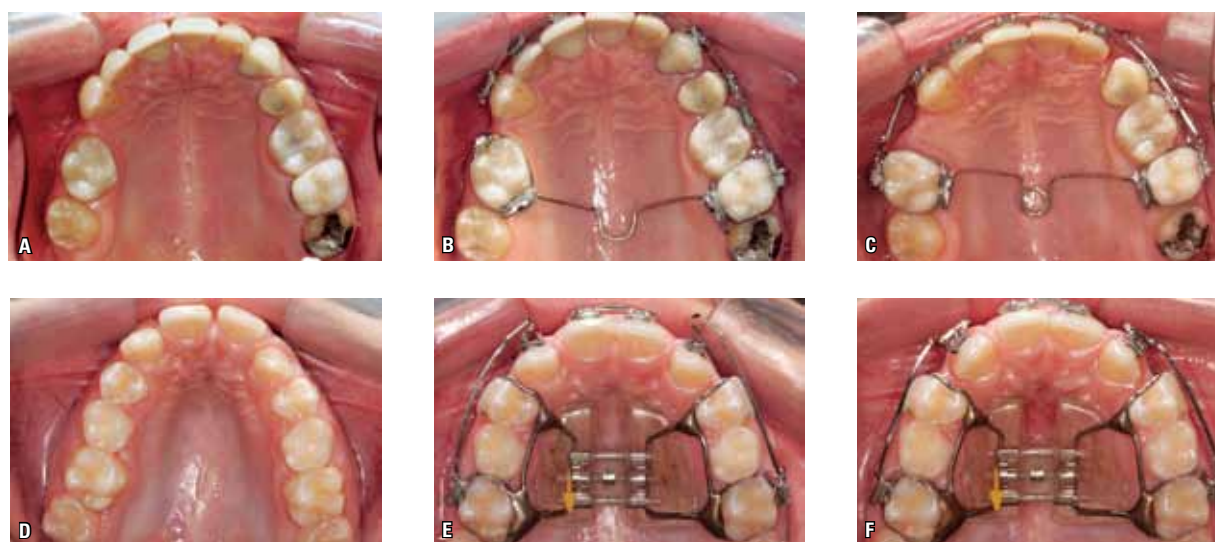


FIGURE 3 - A, B, C) Correction of rotation in tooth 16, with a palatal arch, using the entire maxillary arch as anchorage, optimizing the effect of biomechanics. **D, E, F)** Case of absence of lateral incisors: correction of rotation of canines using rectangular TMA wire in a cantilever with rectangular loop, simultaneous with the mesial movement of the crown and root. The use of these resources prevented the application of excessive and undesirable forces on the incisors.

Assembling an orthodontic appliance is a meticulous procedure that requires care. In your view, what are the most critical points of that stage and which can result in time delays and complications during the finishing phase? Roberto Rocha

Finishing is guided by a philosophical principle that should be within each orthodontist: a treatment should not be planned starting from a malocclusion, but rather with a clear for a perfect occlusion. Improving a malocclusion, straightening teeth, is not the true profession of an orthodontist; reaching an occlusion with adequate aesthetics, function and stability is. Therefore, finishing a treatment begins during planning and appliance assemblage, and not in the last few months of orthodontic treatment. I believe that bonding is one the main determinants of a good finishing phase. Usually, an orthodontist has a formula for bonding with pre-set heights for each tooth, and uses instruments that use the cusp tip or incisal edges of teeth as parameters. It is as we normally learn: 3.5mm for molar, 4mm for premolars, and so on, varying the magnitude of the numbers depending on the instructor or professional. The use of height measurement

instruments makes it much easier, but what truly happens is the establishment of a standard error. It is easy to understand how the error is recurrent, because the parameter is incorrect. What we want to achieve when assembling the appliance is not to level the cusp tips of posterior teeth, but rather to level the marginal crests and contact points. In the case of anterior teeth, in addition to the contact points, we want to define the ideal overbite, incisal exposure and smile curve^{16,27}. Therefore, these should be the parameters to define bonding height, by combining tooth morphology with the ideal occlusion and best possible aesthetics. I have my own way of assembling the appliance, using an essential principle: individualization (Fig. 4). I regard the first molars as the anchor teeth, for their simple roots and crown, and because they are the first to be set with the bands, when I solder the accessories tangent to the occlusal edge of the band, at the same height as the opposite hemi-arch. I then go on to bonding the second premolars with the necessary height difference to level the marginal crests. For example, if I need to extrude these teeth by 1mm, that will be the height difference to the first molar. I can use any instrument to check, without being

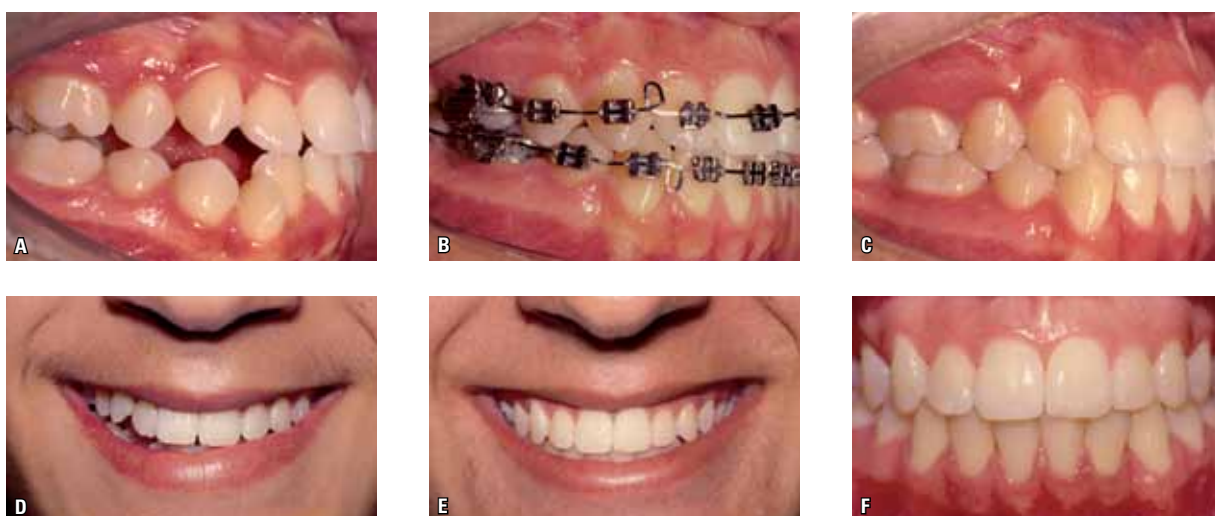


FIGURE 4 - **A, B, C)** Before, during and after evolution of the treatment for dental crowding, in which, although the cusp tips of 16 and 14 were leveled before treatment, there was need for extrusion of 14 to level the marginal crests. **D, E)** Smile, before and after. It can be noticed that the necessary extrusion of the right-side teeth was obtained, so that the smile curve could be corrected, obtaining interproximal contacts parallel to the sagittal plane. **F)** Frontal view of the final occlusion.

limited by fixed numbers, or I can use only my visual perception. Similarly, I use the second premolars as reference to bond the first premolars, based on the ideal contact point – which is the main objective of orthodontics – and not at the buccal cusps, as they are variable and non-crucial to the treatment. The bonding of anterior teeth defines the correction or maintenance of the exposure of these teeth at rest, phonation and during smiling. Therefore, it defines how the overbite should be corrected. At that stage, extra care is required, as the intrusion of anterior maxillary teeth tends to age the face. I work with a perception that defines the dominance of the central incisors in the smile, without forgetting that the smile curve should follow the outline of the lower lip^{10,25}. In cases where there is incisal wear or non-permanent prosthetic work, the gingival contour should be prioritized, with vertical tooth movements without periodontal fibrotomy, as explained in our article published in the Dental Press Journal of Aesthetics²⁸.

In cases where the maxillary lateral incisor is absent, what are your treatment options and suggestions to optimize the outcome? Roberto Rocha

First of all, it is necessary that the patient and guardians be completely informed of the treatment possibilities, as they perception and personal desires are determinant to define the therapeutic approach. Such information is followed by a suggestion, indicating of the three following strategies: implants, self-transplants, or canine mesialization, with defined parameters. In pre-adolescents, especially when there is a gingival smile, I try to discard the implant option, as there is still active vertical growth, and as facial growth continues after the stop of body growth, continuing up to age 23, we would be condemning the patient to spend his teenage and young adult life with edentulous gaps or temporary prosthetics, compromising aesthetics and retention^{11,21}. Moreover, there is the difficulty in determining the end of facial growth, as one mil-

limeter is not much for a treatment, but is a lot for relapse²⁶.

I consider gap closure to be the best option, even if not the absent lateral incisor. I will explain. The option that pleases me the most is the tooth self-transplant. I have recently incorporated it into my clinical practice, based on what the Denmark group have shown, and on the works of professors João Batista Gagno Intra and Armelindo Roldi from the endodontics department at UFES, along with professor Consolaro at FOB-USP^{4,7}. It is actually not a new technique – it is 50 years old, compared to the 25 years osteointegrated implants have been in clinical use. In our specific case, we shall use the best from each conventional option: (a) the canine retains its form and function, in its natural position, as in the implant option; and (b), a tooth is used to construct, either with restorations or prosthetics, the crown of a lateral incisor, which will follow the vertical growth of the face, erupting naturally. It is a simple, although precise, surgical procedure, in which the site is opened using the same drill used for implants, with reduced speed, and whose diameter and depth should be guided by volumetric tomography (Fig. 5). Usually, premolars that have not yet erupted are chosen as donor teeth, with 2/3 or the root (or slightly more) – of those, I consider mandibular teeth to have a more adequate root form. The tooth should be splinted from adjacent teeth, with a low rigidity wire, for one or two months, and force can be applied starting in the fourth month, as recommended by Dr. Paulsen¹⁹. In most cases, there is a progressive closure of the pulp chamber of the transplanted tooth, with no need for endodontic treatment^{4,7,19}. I believe that, with the use of the temporary anchorage devices, the closure of the posterior space of the transplanted tooth is much simpler than the mesialization of canines in the anterior area. Lastly, we remind that an implant requires bone, whereas a self-transplant creates bone.

Whenever the self-transplant is not possible, canine mesialization should be considered. In those



FIGURE 5 - **A, B, C**) Patient with multiple agenesis (teeth 15, 22, 25 and 35) microdontia of tooth 12. **D, E, F**) Opening the space of tooth 22 and closure of the spaces from the maxillary agenesis. **G**) Tomography image used to decide for the transplantation of tooth 44, still occluded, with good root anatomy and 2/3 root formation. **H**) Preparing the receiving area with implant drills, sized based on the tomography. **I**) Tooth 44 positioned in place of tooth 22. **J, K, L**) During tooth movement, 12 months after self-implant (notice root formation under way). **M, N, O, P, Q**) Finalized case, after being subjected to gingivoplasty and new restorations on 12 and 22.

cases, appliance setting should be differentiated in order to optimize the outcome. Special consideration should be given to the gingival contour, and plan canine extrusion – preceded by incisal and palatal wear – and intrusion of the first premolars. Gingivectomy and bone recontouring may be necessary to improve aesthetics and remove accumulated tissue. When the canines have impactful shape and color, the resources of aesthetic dentistry can modify tooth elements in an almost non invasive manner. When canine mesialization is chosen, it is recommended that occlusal adjustment be made, so that there is group function. Thus, the stress is reduced on the maxillary first pre-molar, distributing the progressively lower forces in a posterior aspect, in lateral movements^{2,11,12}.

I do not discard the option of opening spaces for implants – especially in adults, in order to abbreviate treatment – when there is little support for the upper lip or when the treatment simulations with canine mesialization do not please the patient. The selection of the professional who will perform the implant is decisive for the aesthetic success when that strategy is chosen, as a bone or gingival graft may be necessary in order to avoid the dark shadow of the screw and the risk of gingival recession²⁶.

Patients with vertical growth patterns always require a more careful planning, and are more critical with regards to stability. In your understanding, the use of skeletal anchorage devices can reduce the need for extractions in vertical excess cases? Roberto Rocha

I consider vertical problems, especially excess, to be the greatest challenges to an orthodontists, particularly when we consider treatment stability. Studies show a 35% prevalence of open bite relapse, which represents a disaster in clinical practice⁹. What happens most times with relapse is an extrusion of posterior teeth, especially maxillary teeth, reestablishing the occlusal vertical dimension (OVD), which had been changed by the treatment and is dictated by muscle tone.

Indeed, the muscle factor is the determining and limiting factor for our success, and there is no safe evaluation that can indicate whether the dental or skeletal changes we have generated through treatment will be followed by the necessary muscular adaptations⁶. First of all, we must get rid of the illusory view that speech therapies could be effective in this type of muscular adaptation, as there is no scientific principle to support that dogma. Genetic and environmental factors can explain greater or lesser stability. The type of muscle fiber that prevails in the masseter muscle is directly related to an individual's facial pattern: type I fibers prevail in dolichofacial individuals, whereas type II fibers prevail in brachyfacial ones²². Among environmental factors, I find that two protocols have a proven effect: (a) the use of active tips, generating discomfort in the low or protruded tongue posture^{6,9}; and (b) use of Bite-block, which, somehow, tends to increase the tone of mandibular elevator muscles, while at the same time generating intrusion forces on posterior teeth¹. In the clinical approach, the results that show the best efficiency and stability are the cases treated with extractions followed by some form of vertical control, precisely because they do not lead to significant changes in the patient's OVD⁵.

From this evidence, I would not regard the temporary anchorage device (TAD) as eliminating the need for extractions, but rather as an important tool in two strategies: (a) the first, and most evident, is as a vertical control device associated with extractions, making the retraction of anterior teeth more effective, instead of head gear appliances; (b) the second indication is when the retraction of anterior teeth is not recommended, and TADs would work as active elements in the intrusion of posterior teeth. In this case, it should be noted that, the less change in the patient's OVD, the better the prospects for long-term stability – in other words, the prognosis is always better in less extensive open bites (Fig. 6). It is important to highlight that the intrusion movement leads to



FIGURE 6 - Open bite **A)** before, **B)** during leveling, and **C)** after intrusion of maxillary molars using temporary anchorage devices. **D, E)** Biomechanics for the intrusion of posterior teeth with elastic band trespassing the occlusal of the first molars. **F)** Another biomechanics, using palatal mini-implants, after the loss of those placed buccally. **G, H)** Aesthetic evaluation of the exposure of maxillary incisors at rest and during speech, which is essential prior to appliance removal. In this case, for a 45-year-old woman, 3mm exposure of the maxillary incisors is more jovial and attractive. **I, J, K, L)** Final smile and occlusion.

changes in the arrangement of periodontal ligament fibers, which need at least six months for turn-over. Therefore, the mini-implant should be kept for that period, attached to the dental arch, after correcting the open bite. Long-term follow-up studies of severe open bite cases treated only with TAD are not yet reliable to determine any greater or lesser risk for relapse, when compared to ortho-surgical treatment.

Do you believe very long canines compromise the smile? What is your advice, from appliance setting to finalization, with regard to this aspect? Telma Martins de Araujo

This question deserves careful attention. I have written and spoken quite a bit on occlusion and its determinants, and within that context I emphasize the importance of the function of the canines. On the other hand, this gnathologic as-

pect cannot be an instance of “the more, the merrier”, because that is not justifiable. The function of the canine must establish a disocclusion of posterior teeth in mandibular movements, which can be minimal. The practice of extruding canines to obtain guides, without adding other parameters, has produced a few “vampires” by the end of orthodontic treatment. Therefore, from the time the appliance is assembled (ideally preceded by a setup), one should consider that canine shapes with prominent cusps create two problems: the first being a practical one, as the tip of the canine can interfere with the appliance, breaking the arch or blocking tooth movement; as the second being an aesthetic issue²⁴. When setting the appliance, along with leveling the contact points, the smile’s aesthetics should be considered according to priorities: the first one is the dominance of the central incisors, the second is the curvature of the smile following the curvature of the lower lip, and the third is the gingival contour of the central incisors and canines at the same height and the lateral incisor 0.5 to 1mm below. Therefore, in order to reach these objectives, it may be necessary to wear the canine cusp. This makes it possible to minimize the marked anatomy of that tooth and evidence the size and expression of the central incisors, as well as define the smile curvature. Far from neglecting the function of the canine, it is possible to combine its shape with improved aesthetics (Fig. 7).

Should cases finished in Class II or Class III molar relationships get a differentiated occlusal adjustment compared to cases finished in molar relationship? Jonas Capelli Junior

The main objectives are the same: equipotent simultaneous bilateral contacts and immediate disocclusion of posterior teeth in excursive movements, with effective anterior guides^{14,18}. A few considerations are necessary, which differentiate the finalization and occlusal adjustment when the final molar relationship is not molar relationship.

For instance, in the finalization of a Class II malocclusion treated with camouflage (extraction of the maxillary first premolars), the disto-occlusal molar relationship defines that the maxillary first molar must occlude with the mandibular second premolar, which has a smaller vestibulo-lingual size. In that case, the mesial rotation of the maxillary first molar should be regarded as normal, so that there can be contact between the mesio-vestibular cusp of that tooth with the vestibular cusp of the mandibular premolar, thus establishing the desired “A” contact (Fig. 8). Even more complicated is the finalization of cases with Class II molar relationship, which is common in cases of absence of the mandibular second premolars, treated with anchorage loss (Fig. 8). In those cases, there will be intercuspation of the maxillary second premolar between the cusps of the mandibular first molar, which implies the need for change in tooth anatomy, with selective wear, in order to match normally incompatible sizes and shapes, thereby avoiding occlusal trauma with tooth movement and risk of root resorption. Whenever there is contact between premolars and molars, it should be of a lesser magnitude than the contact established between molars (Fig. 9).

What are the requirements to consider in order to achieve excellence in final treatment results? Luiz G. Gandini Junior

I have 11 principles or requirements that I consider essential in order to obtain a good final result, always careful to use protocols based on clinical and scientific evidence.

- Principle 1 – a consistent diagnosis and planning protocol, with clear parameters and reproducible references: always handle the patient in centric relation before and after treatment, and consider the patient’s age in order to define the final incisor exposure at rest, speech, and smile (Fig. 6, 7).
- Principle 2 – analyze the Rectangular Archwire (Ideal or Straight) to personalize the case: avoid undesirable movements that tend to create premature contact, which delays treatment, opens

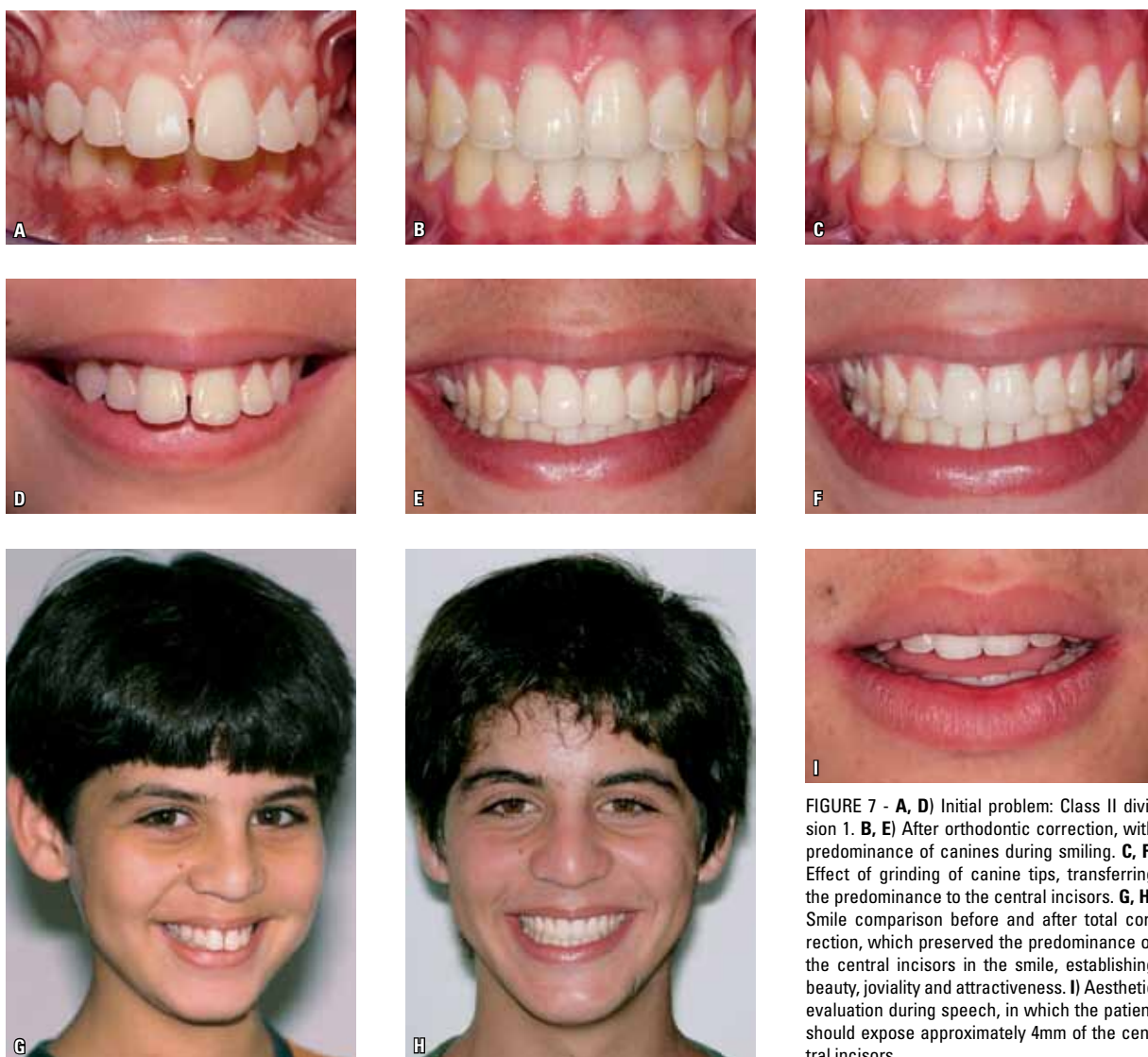


FIGURE 7 - **A, D**) Initial problem: Class II division 1. **B, E**) After orthodontic correction, with predominance of canines during smiling. **C, F**) Effect of grinding of canine tips, transferring the predominance to the central incisors. **G, H**) Smile comparison before and after total correction, which preserved the predominance of the central incisors in the smile, establishing beauty, joviality and attractiveness. **I**) Aesthetic evaluation during speech, in which the patient should expose approximately 4mm of the central incisors.

the bite and predisposes to root resorption through occlusal trauma².

- Principle 3 – know and control dental and periodontal response to torque movement, by increasing or limiting the root effect: avoid periodontal recessions in risk patients, with lesser periodontal thickness, and optimize the desirable response in the whole expanse of the buccal corridor.

- Principle 4 – verify the plausibility of vertical tooth movement and the risk of occlusal trauma, by checking with articulating paper: make tooth

movement possible without causing side effects, and reduce the time of treatment and use of elastic bands (Fig. 15).

- Principle 5 – consider that compensatory treatment (with extractions) requires some adaptations in tooth positions, admitting variations from the ideal: obtain the best intercuspation, and with that, the stability in correcting Angle Classes II and II, and use limits of aesthetic perception by professionals and laypersons (Fig. 8, 9).

- Principle 6 – regard the gingival contour as

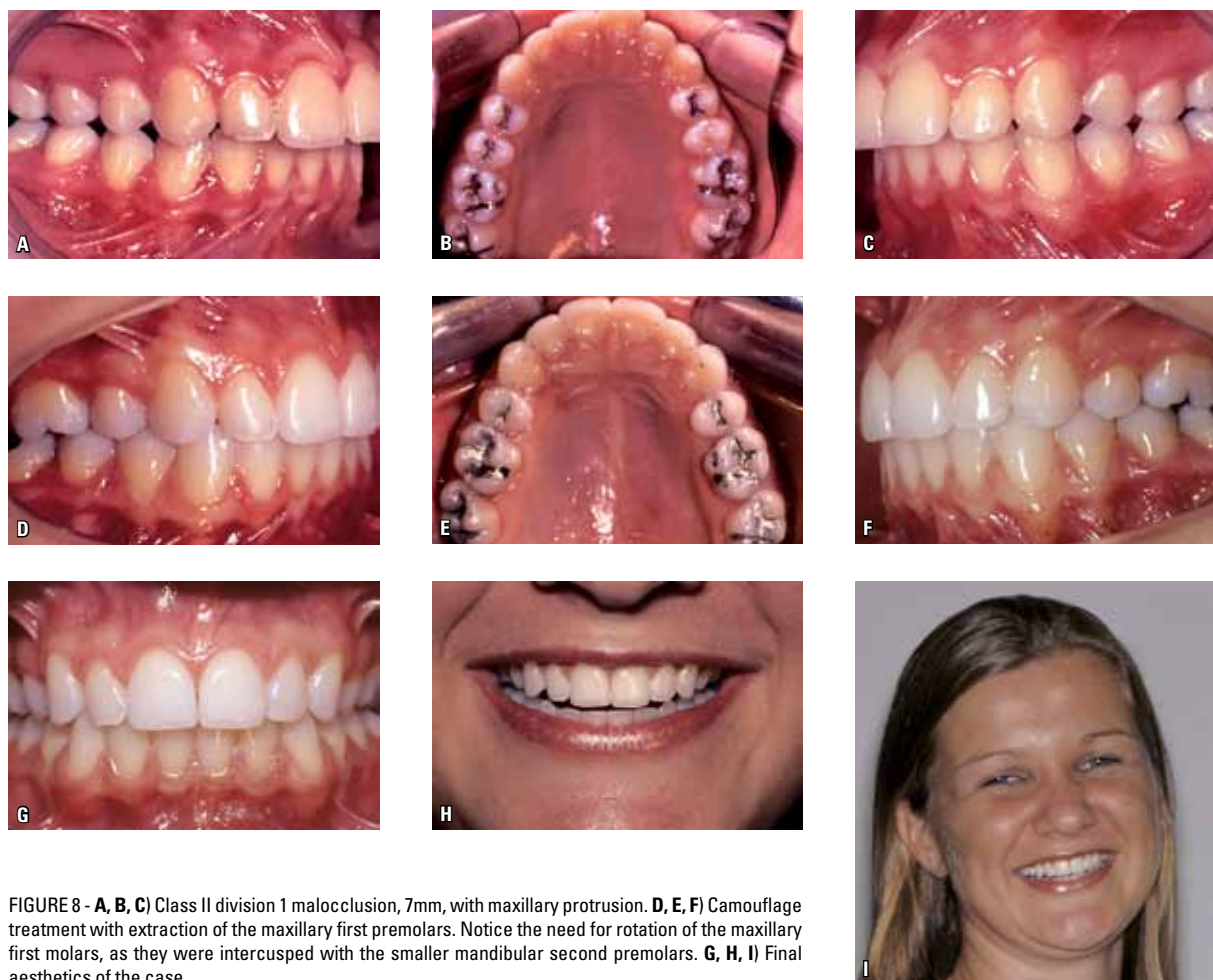


FIGURE 8 - **A, B, C**) Class II division 1 malocclusion, 7mm, with maxillary protrusion. **D, E, F**) Camouflage treatment with extraction of the maxillary first premolars. Notice the need for rotation of the maxillary first molars, as they were intercusped with the smaller mandibular second premolars. **G, H, I**) Final aesthetics of the case.



FIGURE 9 - Young female patient with agenesis of element 45: before (**A**), during (**B**) and after (**C**) orthodontics. Gap closure was chosen, achieving a mesio-occlusion molar relationship (Class III). The intercuspatation of the maxillary second premolar with the mandibular first molar was possible only with selective grinding. **D, E, F**) Evaluation of the final occlusion and contact adjustment.

a priority in mutilated patients or those with dental wear, defining the amplitude of movement and periodontal procedures: achieve excellence in periodontal aesthetics, using the appliance to achieve specific results, expanding the resources of Periodontics¹⁰ (Fig. 10).

- Principle 7 – consider the adequate incisal contour, by relating: (a) dental form and ratios; (b) smile curve; and (c) the height of interproximal contacts. All with the objective of achieving excellence in smile aesthetics, with dominance of the maxillary central incisors, using the appliance and incisal wear with clear objectives, including speech dynamics^{16,24,27} (Fig. 11).

- Principle 8 – consider the standards of excellence in the facial height-width ratio and its correlation with tooth sizes: work together with other

specialties, incorporating parameters and enriching the aesthetic result, in addition to establishing limits to interdental wear (Fig. 12).

- Principle 9 – consider smile amplitude and buccal corridor as aesthetic parameters and markers of tooth positioning in the basal bone: position teeth in the basal bone, giving priority to maxillary disjunction as tool to improve aesthetics and increase stability, and respect the limits of the muscles (Fig. 11).

- Principle 10 – establish axial, bilateral, simultaneous and equipotent forces, without horizontal results. With the objective of reducing treatment relapse, eliminate periodontal risk and meet the expectations of colleagues who send us patients².

- Principle 11 – face new technologies and practices by considering three factors: plausibility, effi-



FIGURE 10 - **A)** Patient recommended for orthodontic correction aiming to improve gingival contour. **B)** Archwire with T loops for asymmetrical intrusion of anterior teeth. **C)** After orthodontics, note the accumulation of gingival tissue. **D, E, F)** Final correction through gingivectomy. **G, H)** Smile comparison, before and after treatment.



FIGURE 11 - A, B, C) Patient featuring a lack of space in the maxillary arch and posterior crossbite. **D, E, F)** Evolution of the correction of the maxillary transverse gap. **G, H, I)** Immediate result of orthodontics, where the occlusion and smile curve were given priority, always considering dental integrity. **J, K, L)** After six months, with the definition of occlusal contacts and the effect of the gingivoplasty on tooth 21, establishing improved stability and aesthetics. **M, N, O)** Before-and-after smile comparison, in which the following aesthetic determinants can be observed: central incisors crown width equal to 80% of their height; contact points height equal to 50% of central incisor clinical crown height, reducing to 10% posterior; lateral incisors height equal to 80% of the central incisors and canines height, with gingival level 1mm below; smile curvature following lower lip contour, with dominance of the central incisors.



FIGURE 12 - **A, B, C**) Evolution of treatment to open spaces in order to achieve a mesio-distal increase in the incisors, followed by restorations. **D, E, F**) Final result, after orthodontics and porcelain veneers. **G, H**) Before-and-after smile comparison, evidencing dental proportions. **I**) Final dental proportions and forms. **J, K**) Before-and-after facial comparison, considering that teeth were increased based on facial proportions, as it was the only available parameter, due to pre-treatment destruction of teeth.

ciency and stability. This is in order not to overvalue what is new, under the risk of forsaking proven studies and practices, and consider that the parameters of success are built on scientific evidence, not words.

I plan to detail these principles in an article soon.

At what times during corrective orthodontic therapy do you recommend selective grinding procedures for occlusal adjustment? Paulo César Rodrigues Conti

As previously described in the article "Occlusal adjustment in Orthodontics: why, when and how?", published by the Dental Press Journal of Orthodontics and Facial Orthopedics, there are three moments in which occlusal adjustment should be considered². The first is prior to setting the appliance, as there are malocclusions, such as functional crossbites, that can be solved with selective grinding, if there is no associated maxillary atresia. The second moment is during orthodontic treatment, in this case associated particularly with vertical tooth movements. We recommend that, prior to performing bends for dental extrusion, especially when associated with intermaxillary elastics, a verification be made using articulating paper (Accufilm®) of the risk of incorporating an occlusal trauma, as it would make movement impractical, in addition to create side effects such as roots resorption and iatrogenic open bites. In those cases, when the need is detected for selective occlusal grinding, the objective is to provide improve quality of dental intercuspation and reduce treatment time, as they make tooth movement biomechanically feasible (Fig. 15). The last opportunity for occlusal adjustment by grinding or addition should be considered six months after fixed appliance have been removed and prior to discontinue the use of the retainer. We should wait until that time to allow natural accommodation by function. Grinding is a refinement of occlusal contacts, which should be simultaneous and equipotent, with A and B or B and C contacts, with stop and balance in each tooth. Normally, it

is a procedure that lasts only 10 to 20 minutes, as the greater and best occlusal adjustment has already been made through the precise movements during corrective orthodontic treatment. Effective anterior guides, with immediate disocclusion in excursive movements, are normally established during the orthodontic phase. The occlusal adjustment should not be seen as the silver bullet for problematic orthodontic treatments, but rather as a way to achieve excellence, with the objective of attaining occlusal balance, and therefore contribute to dental stabilization (Fig. 13). Normally, cases with gaps and undesirable tooth movements after the removal of retainers are related to the lack of occlusal balance and the presence of parafunction.

In your opinion, should small discrepancies (up to 1.5mm) between the centric relation (CR) and habitual maximum intercuspation (HMI) positions be correcting through occlusal adjustment during finalization? Paulo César Rodrigues Conti

There are two different situations that should be observed. First of all, in the population without occlusal pathologies, there is the prevalence of a small difference between CR and HMI positions, approximately 1.5mm, which is considered natural and physiological. Likewise, I do not believe that the CR position is the only acceptable one to finish an orthodontic treatment. On the other hand, the orthodontist needs a parameter for diagnosis and a reference during treatment. For the diagnosis, manipulating the patient in CR may mean the difference between a more or less complex treatment². For instance, a patient with severe Angle Class II malocclusion in HMI, after being manipulated in CR may prove to be a simpler case, avoiding orthognathic surgery to treat it (Fig. 14). Another situation that evidences the importance of patient manipulation in CR is during orthodontic treatment. At each activation of the appliance, the professional creates the occlusal contacts and interferences, which can shift the mandibular posi-



FIGURE 13 - **A)** Initial malocclusion, with dental crowding. **B, C)** Result obtained after orthodontics. **D, E)** Occlusal contacts six months after removal of appliances. **F, G)** Occlusal balance achieved through selective grinding; maxillary retainer use is allowed after this stage.

tion, establishing a new HMI. In other words, it is a new malocclusion at every monthly consultation, leaving the orthodontist lost during treatment. The only reproducible position is CR, and therefore it should be used as guidance for each activation of the appliance. CR is a reference for the orthodontist, and not an obsession^{18,23}.

Therefore, I believe there can be, at the end of treatment, a small discrepancy of up to 1.5mm between CR and HMI, as long as this mandibular shift does not create excessive anterior contact, whose horizontal component would lead to tooth migration. This is an important evaluation prior to removing the retainers, as the check should be made by manipulating the patient in CR and asking him to clench his teeth, while the professional

places a fingertip on the crown of maxillary teeth. If vibration (fremitus) occurs, it is a sign of excessive effort on those teeth, and the contacts should be checked using articulating paper (Accufilm®). In the cases where the anterior deviation of CR to HMI results in excessive horizontal force, even with a deviation lower than 1.5mm, occlusal adjustment in CR should be considered the best path to avoid opening anterior spaces and periodontal recession, as excessive horizontal forces on anterior superior teeth lead to tipping. In the absence of anterior retention, in muscularly competent patients, this strong anterior contact could explain the relapse of mandibular dental crowding. In the cases with small CR-HMI deviations, where there is not a strong anterior contact in HMI, the final adjust-



FIGURE 14 - **A, B, C**) Evaluation of malocclusion in HMI, detecting a severe Class III. **D, E, F**) Evaluation of the same patient in CR, which transforms the case in a simpler treatment, possible to be corrected without surgery. **G, H, I**) Correction under way, based on the use of intermaxillary elastics. **J, K, L**) Final result, including temporary incisal restorations with composite resin.

ment should be made in the latter position, which is the more common situation².

Considering there is an increase in the amount of occlusal contacts after the removal of the orthodontic appliance, how do you see the ever more common use of thermoplastic retainers (acetate plates) as devices for post-treatment maxillary retention? Jonas Capelli Junior

Thermoplastic retainers are plates that cover all teeth, including their occlusal surface. Because they are transparent, patients like them. Orthodontists who use them believe in the need to retain vertical tooth movement, avoiding post-treatment accommodation. What seems an advantage is in fact disastrous when we observe what happens in the six months following appliance removal, as the acetate plate obstructs a significant increase

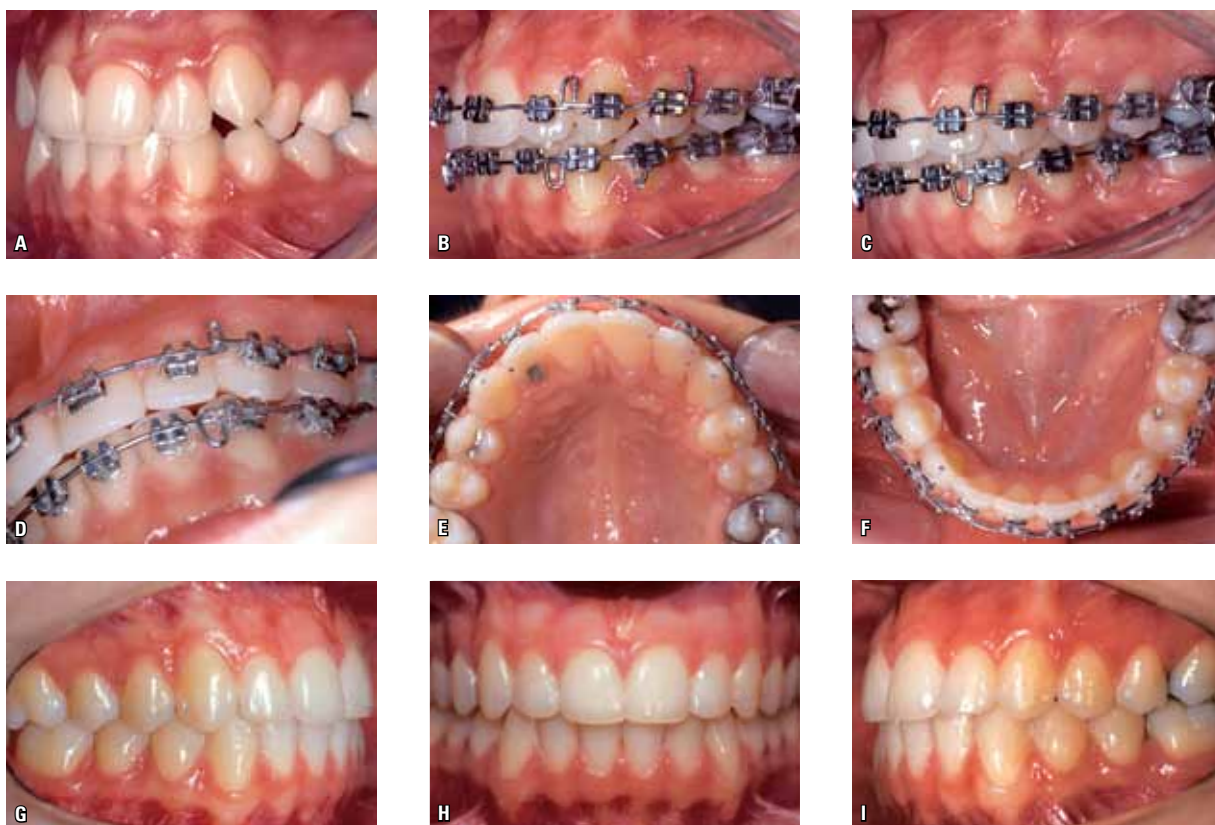


FIGURE 15 - **A)** Patient with Class I malocclusion with crowding. **B, C)** At the beginning of the finalization phase, there is the need for step-bends to improve intercuspal. **D, E, F)** The efficiency of biomechanics was only possible because the premature contact was previously detected, resulting in selective grinding of the distal marginal crest of tooth 22 in order to allow vertical movement. **G, H, I)** Final result, obtained after 26 months of orthodontics, with no time loss and without sequelae.

in the number of occlusal contacts^{8,20}. Physiologic dental movement at the moment of eruption is natural, desirable and necessary, increasing the number of occlusal contacts after the active orthodontic treatment – so that later these contact can be distributed qualitatively, through occlusal adjustment by grinding. In fact, no matter how good the professional and his care during finalization, there will always be room for the normal muscular function to complement dental intercuspal in the most physiological and stable manner. We

cannot forego this help from nature, which establishes a potential continuous eruption of teeth, improving an element's contact with its antagonist. That is the great advantage of using retaining appliances that have no material interposed between the two dental arches. Of course, we are discussing minor post-treatment accommodations, and not an anterior open bite due to lack of finalization. Our choice is usually the wraparound appliance, which has a continuous clip passing distally from the last teeth of the maxillary arch,



FIGURE 16 - **A, D)** Class II division 1 malocclusion in an adult patient. **B, E)** Result of occlusion immediately after treatment. **C, F)** After six months of retention, note the increase of occlusal contact from muscle action. **G, H)** Wraparound-type appliance that enables accommodation after orthodontics, as there are no occlusal interferences. **I)** Final smile.

combined with the arch bonded to the lower canines (Fig. 16). When tooth eruption is stopped with the use of thermoplastic appliances, the need and number of additions increases, through restorations, in an attempt to achieve the necessary contacts for occlusal balance. Therefore, scientific evidence and clinical excellence counter-indicate the use of thermoplastic appliances as retainers after orthodontic treatment, and point to the need to wait for six months using retainers with appli-

ances that do not cause occlusal interference, in order to perform adjustments through grinding, aiming for the best possible occlusal balance².

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Analysis of general dentist orthodontic practice in Brazilian legal system*

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Abstracts

Aim: Due to the conflict, in Brazilian legal system, between legal principle and human person dignity principle in the issue of general dentist orthodontic practice, this paper aimed to analyze laws and courts decisions concerning this matter. **Methods:** Regulations of orthodontic education and practice were sought in Federal Government and professional organizations. Courts decisions were sought in Brazilian Superior Courts utilizing “Orthodontics”, “orthodontic” and “orthodontist” keywords. **Results:** Brazilian laws classify Orthodontic Postgraduation as *stricto sensu* and *lato sensu*, and each of them have their own specific regulations. National Education Guidelines determine that Dental Graduate Course must only teach preventive Orthodontics. Brazilian courts understand that, in order to practice corrective Orthodontics, Orthodontic Postgraduation Course is necessary. **Conclusion:** Dentistry Graduate Courses are only able to teach Preventive Orthodontics; only *stricto sensu* and *lato sensu* Orthodontic Postgraduate courses are able to teach Corrective Orthodontics; it is unacceptable to understand that law permits that general dentists practice Corrective Orthodontics; and general dentists may only practice Preventive and Interceptative Orthodontics.

Keywords: Postgraduate course. General dentist. Legality. Human person dignity.

* Summary of written work requirement to obtain JD degree.

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Editor's abstract

In a first analysis, general dentist orthodontic practice seems to be licit, once the Law n. 5081/66, which regulates Dentistry professional exercise, determines that every dentist may practice everything that was taught in Dentistry Graduation and Postgraduation, and Orthodontics is taught in Dentistry Graduation, as "Dental Orthopedics", since 1856⁶. Besides, Dental Ethics Code forbids that dentists entitle themselves as specialist without Regional Dental Board (CRO) inscription and determines that dentists perpetrate an ethical infringement when announce or make public titles, qualification and specialties that either do not bear or are not recognized by the Federal Dental Board (CFO), but nothing about their practice is mentioned.

Orthodontics is directly related to human health⁵. Every harm that is caused by the wrong conduction of orthodontic treatment is a patient's body violation and it is an injury to his/her psychological and physical integrity, which is one of the aspects of human person dignity⁴. The principle of human person dignity is clearly mentioned as one of the Federal Republic of Brazil basis in the article 1st, III, Federal Constitution (CF). Due to the conflict, in Brazilian legal system, between legal principle and human person dignity principle in the issue of general dentist orthodontic practice, this paper aimed to analyze laws and courts decisions concerning this matter, utilizing the Theory of Juridical Arguing.

Regulation of orthodontic education and practice was sought in Federal Government and professional organizations. Then, they were organized according to the hierarchy of Civil Law System¹, which utilizes a pyramid whose top is the Federal Constitution (The Great Law). Bellow the top, there are the Complementary Laws, the Ordinary Laws and other regulations. Court decisions were sought in Brazilian Super-

rior Courts websites.

The analysis of Brazilian legislation shows that the CFO, responsible to watch and to work for the good reputation of dental profession, understands that the specialties must be practiced by qualified professionals to execute more complex procedures, that is, by professionals who made a Postgraduate course. National Education Guidelines of Dentistry Graduate Courses determine that Dentistry Graduate Courses must emphasize the teaching of Preventive Orthodontics, which is compatible with the contemporary Health Promotion Paradigm. When the Law n. 5081/66 permits that dentists practice all the knowledge obtained in graduate or postgraduate courses, it is implicit that this is valid to courses that are capable to be supervised. When the issue is Corrective Orthodontics, only *stricto sensu* and *lato sensu* Orthodontic Postgraduate Courses have legal documents that offer quality parameters. The analysis of Brazilian Court decisions demonstrates that, even for the Law operators, Orthodontic graduation in authorized Postgraduate Courses is necessary in order to conduct corrective orthodontic treatment.

Utilizing the Theory of Juridical Arguing, the interpretation of legislation and superior court decisions leads to the following conclusions: it is unacceptable to understand that law permits that general dentists practice Corrective Orthodontics; and general dentists may only practice Preventive and Interceptative Orthodontics.

Questions

1) The conclusions of this article lead to the discussion about the distance between legal requirements to obtain the title of "Orthodontist" and the suitable policy to graduate a qualified "Orthodontist". In the authors' view, which policy can be implemented in order to guarantee that qualified Brazilian Orthodontists are graduated?

First of all, it is necessary that Federal Dental Board (CFO) regulates and the dental community recognizes and accepts the importance of the Specialist in Orthodontics. As this article demonstrated, the CFO interpretation that “general dentist is authorized to practice Corrective Orthodontics” is unfair and has not any scientific or legal foundation. This CFO policy makes the differentiation between the “Specialist in Orthodontics” and the “general dentist who practices Corrective Orthodontist” very difficult either in advertisement or in remuneration issues.

Once the specialty is valorized, the professional is stimulated to pursuit qualification and to seek adequate Orthodontic Graduation. This would lead to a decreasing demand of “Courses that only teach how to bond brackets and align teeth” and an increasing demand of “Courses that graduate professionals capable of treating malocclusions”.

Finally, it is important that Orthodontic Graduation Courses are rigorously supervised, mainly in their competence to graduate professionals who are capable to: (1) diagnose and treat with scientific basis; and (2) offer high quality orthodontic treatment, evaluated by objective grading, as the Brazilian Board of Orthodontics and Dentofacial Orthopedics (BBO) one.

2) In Brazil, which institution is competent to regulate the quality of *lato sensu* postgraduate courses with the goal of appropriate Orthodontic Specialist qualification?

The legislation of Brazilian *lato sensu* postgraduation has many interpretation gaps. As the legal documents about this issue are generic, conglomerating Human, Biologic and Exact Sciences, it is very difficult that actual cases are fairly resolved based only on an ordinary literal interpretation of a law. Following the “Theory of Juridical Arguing”, which is used by judges in

judicial decisions, the answer to this question is described below.

Considering that:

Lato sensu Orthodontic Postgraduation is related to health and the article 197th of Federal Constitution establishes that the Government must regulate, supervise and control health actions and services.

As the Resolution n. 1/07 of the National Council of Education is generic when states that “*lato sensu* postgraduate courses, for each area, are supervised by the competent institutions”, this gap is fulfilled with the Federal Dental Board (CFO), which was instituted by the Law n. 4324/64 and is part of the Government that regulates Dentistry.

1) The Decision n. 27/03 of CFO designated the Brazilian Association of Orthodontics and Dentofacial Orthopedics (ABOR) the consultant entity of CFO in the issues pertaining Orthodontics.

2) The ABOR founded the Brazilian Board of Orthodontics and Dentofacial Orthopedics (BBO) in the 2nd ABOR Congress, in 1999.

3) The BBO follows the model of the American Board of Orthodontics (founded in 1929) and has scientific parameters to certificate orthodontists who treat their cases with excellence.

It can be concluded that the competent institution to regulate the quality of the *lato sensu* orthodontic postgraduate courses is the CFO, following the counseling of ABOR and BBO.

3) Which are the other issues about Orthodontics legal practice that can be analyzed by studies like this one?

This was the first study of three, which utilized both “Law Science” and “Evidence-based Orthodontics” to fulfill the gaps of Brazilian legislation about Orthodontic practice. Laws

and court decisions must be interpreted in a manner to bring justice to competent professionals and to the patients.

The other two articles were already accepted by the “Revista Dental Press de Ortodontia e Ortopedia Facial”. The first one³ analyses if the conclusions of this article are compatible with the policy of foreign countries; and the second one², already published, discusses the conse-

quences of this article in the remuneration of dental health insurance companies.

More studies that utilize the tools of “Law Science” in the resolution of legal doubts of orthodontists must be done in order to valorize and give legal support to the professionals who seek to, with Orthodontics, bring esthetics, function, health and stability in the treatment of their patients.

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Comparative evaluation among facial attractiveness and subjective analysis of Facial Pattern

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Abstract

Aim: To study two subjective facial analysis commonly used on orthodontic diagnosis and to verify the association between the evaluation of facial attractiveness and Facial Pattern definition.

Methods: Two hundred and eight standardized face photographs (104 in lateral view and 104 in frontal view) of 104 randomly chosen individuals were used in the present study. They were classified as “pleasant”, “acceptable” and “not pleasant” by two distinct groups: “Lay people” and “Orthodontists”. The individuals were either classified according to their Facial Pattern using lateral view images. **Results and Conclusion:** After statistical analysis, it was noted a strong positive concordance between facial attractiveness in lateral view and Facial Pattern, however, frontal view attractiveness classification did not have good concordance with Facial Pattern, tending to have good attractiveness classification even in Facial Pattern II.

Keywords: Orthodontics. Diagnosis. Facial analysis. Photograph.

Prevalence of malocclusion in children aged 12 to 36 months in João Pessoa, Paraíba state

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Abstract

Aim: This study aimed to verify the prevalence of malocclusion in children aged 12 to 36 months, attending public daycare centers in the city of João Pessoa, Paraíba. **Methods:** The sample consisted of 292 children, 161 boys (55.1%) and 131 girls (44.9%) randomly selected from various daycare centers. They were all examined in their daycare centers environments under natural illumination and the findings entered into a pre-structured form, carried out by one calibrated examiner ($Kappa = 0.85$), concerning overbite, overjet, anterior open bite and posterior crossbite. The data were analyzed through the statistical program SPSS. **Results and Conclusions:** The prevalence of malocclusion in the sample was 40.7%, with anterior open bite detected in 35.6%, posterior crossbite in 5.1%, and moderate overjet and overbite in 35.5% and 24.7%, respectively. With the development of the occlusion, the prevalence of anterior open bite increased, with the results draw attention to the magnitude of the problem in childhood. **Keywords:** Epidemiology. Malocclusion. Infant. Child, preschool.

Inter-relationship between the upper lip and the maxillary positioning with upper incisors in adult patients

Luciano Del Santo*, Marco Aurélio Bachega**, Marinho Del Santo Jr.***

Abstract

Introduction: Professional evaluations and lay person evaluations as well do not show a clear relationship between hard tissue and soft tissue profiles in orthodontic patients. However, there are concrete evidences that the orthodontist can change the facial profile of the patients.

Aim: This research project aimed to measure the contribution of the bone structure of the maxilla and the upper incisors inclination to the upper lip profile. **Methods:** A sample of 147 adult patients, 58 male and 89 female, aged from 15 to 49 years, the most of them Caucasians, was retrospectively selected from the private practice of one of the authors. It was assumed that the esthetic facial profile depends of the hard tissues that support it besides its own features as thickness, strength and composition. The present research model was not set to control the intrinsic features of the soft tissue. To compose the Ricketts and Burstone esthetic lines, the main cephalometric variables were SNA and U1PP, when concomitantly considered. **Results:** The regression coefficients, although statistically significant, did not contributed expressively to explain the regard variables, the pre-defined esthetic lines. Furthermore, the results suggested a negative correlation between the maxillary position (SNA) and the anteroposterior inclination of the upper incisors (U1PP), possibly due to the compensatory action of the lips and the tongue. **Conclusion:** The results did not presented conclusive scientific evidences about the contribution of the hard tissues for the soft tissue facial profiles.

Keywords: Facial profile. Labial profile. Upper lip.

Civil liability of dental surgeons: the importance of technical experts

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Abstracts

Introduction: dental surgeons may be subject to responsibilities that encompass penal, civil, ethical and administrative obligations during the practice of their profession. As such, if results are verified to have been harmful to the patient – either by imprudence, ineptitude or negligence – the dental surgeon will be subject to the penalties set forth in the Brazilian Civil Code, which include repairing the damage and compensating the victim according to the harm caused. In civil lawsuits, the parties can hire technical experts to provide scientific and technical information on the issue at hand to their respective attorneys. **Objective:** to inform on the importance of technical experts in civil lawsuits, giving the parties a better understanding of the technical, ethical and legal aspects in these proceedings. **Conclusion:** there is need for greater knowledge on the part of dentistry professionals of the ethical and legal aspects that guide their profession.

Keywords: Civil liability. Dentistry. Forensics.

INTRODUCTION

In the course of their labor activities, in addition to the responsibility common to all people as citizens, workers also bear a specific responsibility: to answer for their acts while in the practice of their profession.

For the health professions in particular, this obligation to answer for acts which happened during the practice of the profession (professional liability) is represented in four spheres: penal, civil, administrative and ethical²⁵.

The popularization of cure methods and the awareness of suffered damages have led to a significant increase in the number of patients seek-

ing relief for harm resulting from professional liability. Nevertheless, it is observed that Brazilian jurists have not examined in depth the question of the civil liability of dentists¹⁹. This position leads to the thought that, in the matter of human life, there is no room for small faults¹⁷.

And, in the current market reality – highly competitive and often aiming solely for profit – an increase can be observed in the number of lawsuits against health professionals. With dentistry being intrinsically connected to public healthcare, violating its requirements would certainly represent a crime²⁷.

The so-called healthcare marketplace, previ-

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ously considered to be “untouchable”, nowadays receives numerous complaints, both from users and other professionals. In 2004, the São Paulo State Consumer Advocate Agency (Procon-SP) fielded a total of 345,447 consultations, of which 84% were referred to or solved by companies without charges being filed, 11% were not subject to the agency’s mandate, and the remaining 5% were considered to be well-founded complaints, and resulted in administrative proceedings at Procon⁹.

In 2005, Procon-SP received a total of 359,811 complaints, with healthcare-related complaints comprising 4.70% of that number – more than 12,000 complaints²³.

As an example, in a survey conducted in the city of Bauru, São Paulo State, during the first semester of 2006, 6,447 complaints were filed concerning the services field (which includes the healthcare field), from a total of 11,956 records at Procon-Bauru⁵.

The issue is almost always dealt as a mere appendix in works discussing the civil liability of physicians, ignoring the fact that the numerous peculiarities of this profession, which is becoming ever more sophisticated with technological and scientific advances, will have a unique and decisive influence is the judicial outcome of each concrete case¹⁴.

By definition, the term liability (responsibility) originates from the Latin term *re-spondere*, meaning the reconciliation, the obligation by the causing agent of the damage to repair it³⁰. Currently, judicial liability is generically divided into civil and penal liability, with the possibility, in both, of using the services of a legal expert, as established into law.

Civil liability may be defined as the duty to compensate the damage caused to another, by the practice of an illicit act or by failing to observe the set of rules that guide daily life¹¹. Its proximate cause is the interest in reestablishing the legal balance that was altered or undone by the offense,

through pecuniary compensation²⁵.

Human actions must always be in accordance with legal principles. Therefore, any acts that defy a legal rule are illegal, as they go against the Law. And, according to Brazilian Civil Law, any act based upon the Law is considered to be licit; meanwhile, an illicit act is one that goes against the Law, by deviating from legal guidelines, becoming a crime which can be civil or criminal, depending on the law that is broken by the act in question⁷.

The following make up the civil procedures: the plaintiff (who initiates the action before a court), the defendant (against whom the action is directed), the attorneys, the judge, and the technical experts²⁰.

The technical expert, as the main focus of this article, is seen as an aide to the part in question, with an obligation to agree with, criticize or request that information be added to the report made by the official expert; it is up to the judge, through the principle of free motivated conviction, to analyze the arguments of the technical expert¹⁸. It is also important to emphasize that the technical assistant acts in the benefit of one of the parts in the case, unlike the official expert, who must be impartial.

Thus, the objective of this literature review is to instruct students, dentistry professionals and attorneys on the civil liability of dentists, and emphasize the importance of the presence of technical experts in civil lawsuits involving the field of dentistry.

LITERATURE REVIEW

Civil liability is an ever more present theme in Brazilian law. This is due to significant advances in legislation, with important changes in the acknowledgement of the populace as true citizens, especially in the aftermath of the 1988 constitution, which instituted, among other guarantees, the right to healthcare. It confirmed the citizenry as participative entities in the social realm, lead-

ing all to pursue their rights with greater fervor. Consequently, there was a great increase in the number of lawsuits seeking redress for damages caused by healthcare professionals³⁰.

Moreover, with the advent of statute 8078, from September 11th 1990, known as the Consumer Defense Code, dentists came to be considered service providers. This increased discussion on the issue and increased the number of cases referred to the judiciary system seeking compensation for damages caused by professional malpractice⁸.

The Consumer Defense Code defines service as “any payment-based activity executed in the consumer marketplace”, thus encompassing the practice of dentists²⁹.

Such damages are obligations derived from illicit acts through actions, intentional or unintentional, practiced as infractions of a given conduct to be followed¹². In that sense, according to article 927 of the Brazilian Civil Code (2002) “whoever, through an illicit act, causes damages to another, is obligated to rectify it”³.

Therefore, every harmed party has the right to seek reparation of the injuries inflicted upon them, which makes the professional-patient relationship even more delicate: nowadays, most procedures performed by dentists are subject to quality analysis, leaving these professionals with the possibility of answering for their acts in civil court²².

On subjective and objective liability

Civil liability is divided into objective and subjective liability³⁰.

Subjective liability is founded on the concept that, in order for the causing agent of the harm to be held responsible, it is essential to prove fault – in other words, the agent must act out of his own will and conscience¹⁶.

Fault always presupposes the violation of a pre-existing obligation. If that obligation is set under contract, it is a contractual fault; if based

on the general guidelines of the Law, which commands respect towards the person and goods of others, it is considered an extra-contractual fault²¹.

The law, however, also imposes upon certain people and in given situations, the duty to repair a given damage caused without fault. When that happens, it is said that the liability is legal or objective, because it does not require fault and is satisfied only with the damage and causal nexus¹⁹.

Upon analysis, the legal framing of liability in dentistry is classified as subjective, according to the Consumer Defense Code (1990), which expresses in article 14: “The supplier of services is responsible, regardless of culpability, for the redress of damages caused to consumers for defects related to the rendering of services as well as for incomplete or improper information about their use and risks. §4. The personal responsibility of independent professionals shall be determined upon verification of the fault”.

Civil liability lawsuit

A lawsuit consists of the instrument or process used to solve conflicts of interest regulated by existing law between different persons, named parties (plaintiff and defendant)¹¹. Civil liability lawsuits usually are lengthy processes, lasting from a few months to years, as in most cases they require specialized forensic analysis¹⁵.

The Brazilian Civil Procedure Code (Statute no. 5869, from January 11, 1973) describes in its Title 7, chapter III, articles 276 to 278, all the pertinent phases of a civil suit⁴, as we have summarized in the illustrations contained in figures 1 and 2.

In the initial petition, the plaintiff, represented by an attorney, exposes the problem and formulates the inquiries⁴. In general, the plaintiff must prove the causal nexus between the act practiced by the other part and the damage suffered¹⁶. With that document, the judge will summon the defendant, setting a conciliation hearing to take place within 30 days. If a settlement is not possible, a

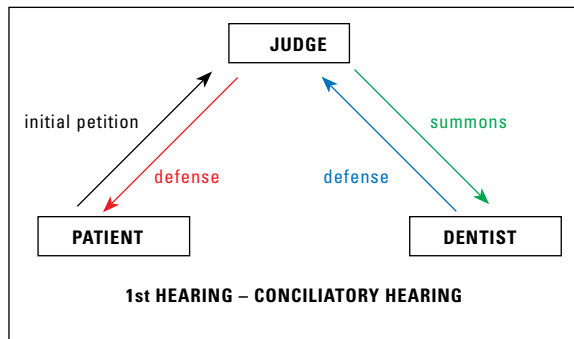


FIGURE 1 - Civil procedure protocol (initial stage).

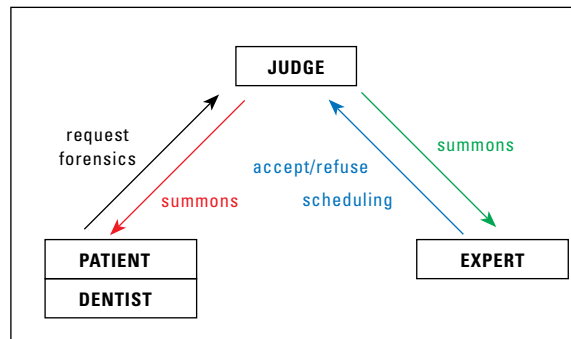


FIGURE 2 - Civil procedure protocol – dental forensic analysis.

written or oral response will be presented by the defendant's attorney, using documents or inquiries, defending against the accusation being made⁴.

In case forensic analysis is required, the judge will name an expert, who in turn will file a report⁴. It is important to remember that the judge can call for an analysis even without a request from either of the litigating parties. In addition to the expert appointed by the judge, the litigating parties may name their own technical experts, who will observe the forensic analysis and will present their own technical reports, which will be added to the record⁶.

After all evidence is examined, the judge will issue a sentence according to his/her conviction, which is not required to reach the same conclusion as the forensic examination⁴. Based on this sentence, the losing party may appeal to a competent court.

Technical assistance

In the system of the Civil Procedure Code (1973), the parties are free to name their own technical experts – one per party, out of their own free will¹⁵.

Thus, technical assistant is the label that civil procedure law gives to professionals who are experts in a given field, appointed and hired by one of the parties to help establish forensic proof. In theory, they have the same privileges as official forensic experts – such as interviewing witnesses,

requesting documents, and obtaining information – with differences only with regard to timeframe, as the technical assistant has only 10 days after the official expert's report is filed¹³.

The expert should preferably be a forensic dentistry expert, given all the procedures involved as well as the need for knowledge of juridical aspects required in forensic analysis, in addition to the help of an attorney in drafting documents and structuring the defense of the party.

The Civil Procedure Code (1973), in its Title I, chapter V, section II, article 50, which deals with technical assistance, confirms the possibility of third parties acting in the suit, as assistants to one of the parties, as long as they have interest in seeking a favorable verdict for the party in question⁴.

DISCUSSION

Knowing the rights and obligations, as well as abiding by the Code of Ethics, are fundamental conditions for the successful practice of any profession, including those related to healthcare and society, such as medicine and dentistry¹.

In the course of performing their routine activities, workers have, in addition to the responsibility common to all persons as citizens, a specific responsibility: to answer for acts committed during the practice of their profession²⁴.

The moment a dentist admits someone as a patient, a contract for services rendered is established between the two parties, which could be

interpreted as a performance obligation or a relative obligation. A performance obligation is that in which the creditor has the right to demand a result from the debtor, whereas with a relative obligation the debtor is required only to use normal prudence and diligence when performing a given service in order to obtain a result, without, however, entailing an obligation to obtain such a result²⁵.

Lately, dentistry has been classified as a performance obligation, as many professionals promise “miraculous” results, few unsuccessful treatments are divulged, and inadequate advertising ploys are used (such as “before and after” portraits). This leads the patient to believe that the entire procedure will always be successful and does not depend on other factors (such as biological responses and patient compliance).

Long gone is the time when the professional-patient relationship was based entirely on trust, without so much questioning and demands from the patient²². Nowadays, there is no question that patients are aware and knowledgeable of the contract relationship that is established with dentistry professionals², as well as having greater demands regarding the services to be rendered.

Motivated by their social circle or even by the news media, a significant part of these patients/clients often pursue some sort of monetary compensation in cases of errors resulting from the fault of a dentist, seeking redress in the court system. The judiciary process, however, can often lack the technical and scientific control that rules the field of dentistry, as well as any other field of healthcare³⁰.

Therefore, dental surgeons must perform their entire work based on a coherent and diligent technique, remembering that, in a lawsuit, dental appointment records are the primary evidence²⁸.

If harm is confirmed and the dentist is subject to a civil lawsuit, it is time to locate the documentation of the patient who has filed the suit, and hire a good attorney and technical assistant with

experience in the field of forensic dentistry.

The dentist and patient may be legally represented by any dentist, according to Statute no. 5081 (1966), which regulates the practice of dentistry, and establishes in article 6 that they are competent to conduct legal dental forensic analysis in civil, criminal, labor and administrative courts.

With regard to the documentation, all evidence to be presented by the professional must have been previously accrued and produced on occasion, or else it will not serve their purpose²⁴. The professional must build up the patient's records over time. Otherwise, forged records or those containing only notes regarding costs and payments, interspersed with scant information about the actual treatment, will be irrelevant⁹.

Therefore, dental appointment records must contain all occurrences, their consequences verified over the treatment period, as well as all measures taken, as the lack of information or errors in the documentation will compromise its legal validity.

Records containing details of the anamnesis, clinical sheet, treatment plan, prescriptions, notes, models, x-rays and post-op and/or hygiene recommendations can be kept by any and every professional²⁶.

Thus, all recommendations regarding dental documentation, as well as a faithful account of the facts that transpired, will be evaluated by the technical assistant, who can consult experts in the field of suit, in order to pursue a better position for the client's defense. Nevertheless, knowledge of Brazilian legislation, of the specific ethics code and professional rights, as well as practical experience in the area, are recommended requisites when choosing a forensic dentistry professional.

Still, with regard to technical assistance, there are several suggestions directed specifically to attorneys, with the intent of aiding their actions regarding the experts, in accordance to the new civil procedures for expert evidence¹⁸:

- Try to contact the technical assistant prior to the proceedings, as he/she can become a technical consultant in all stages of the suit, given the possible lack of knowledge by the attorney of the technical aspects of dentistry.
- Act prior to the appointment of the official expert, thus allowing the technical assistant to become familiar with the case, survey the data and suggest queries.
- Notify the technical assistant regarding the appointment of the official expert, including his/her name, address and phone number, so that the assistant can contact the expert more easily in order to exchange information and make any possible requests.
- Ask the technical assistant about the fees usually charged by the official experts in similar situations. Costs can be based on set fees or local customs.
- Do not comment officially on any actions by the official expert without first consulting the technical assistant, as there are often issues restricted to their professional field.
- Notify the technical assistance of the payment of the fees charged by the official expert, after which forensics can begin at any time.
- Alert the technical assistant to the start of forensics, providing the full content of the order, as judges often fix a date and time for the inspection, which the technical assistant should preferably attend.
- Inform the technical assistant of the publishing of any order related to forensic evidence,

directly or indirectly.

- Immediately provide information to the technical assistant regarding the forensic report when issued by the official expert.
- Become aware of, and pass on to the technical assistant, the contents of the findings of the other party's technical assistant regarding the forensic report filed by the official expert.
- Discuss the content of the opinion of the forensic report, as the technical assistant's work should follow a line of thought and strategy developed by the attorney for the proceedings.

FINAL CONSIDERATIONS

It can be concluded that forensic technical assistants play a vital role in professional liability suits, by providing technical, biological and legal information. Forensic dentistry professionals should preferably be selected as technical assistants, because their role is not limited to technical knowledge of the field.

Moreover, it is observed that the guidance of a technical assistant may bring advantages to dental surgeons, such as: improved organization of patient dental documentation, better awareness of rights and obligations, and above all, greater job security.

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Orthopedic treatment with the Herbst appliance: Do vertical changes occur in facial growth pattern?

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Abstract

Objective: This prospective study featured 32 adolescents with Class II, division 1 malocclusion in conjunction with mandibular retrognathia, treated using the Herbst appliance, built on metal bands and crowns, with the objective of cephalometrically evaluating any possible changes in facial growth pattern. **Methodology:** lateral cephalometric radiographs were taken at the beginning of treatment (T1) and immediately after 12 months of treatment, with the aforementioned orthopedic appliance (T2). The Jarabak ratio and Ricketts VERT index (modified) were used to determine facial pattern at T1 and T2. **Results:** using the Jarabak ratio, the results showed that 27 cases (84.4%) featured hypodivergent patterns at T1 and remained so at T2. Five cases (15.6%) featured a neutral pattern at T1 and did not change at T2. When the Ricketts VERT index (modified) was evaluated, no changes were observed in the facial patterns of 31 patients. Facial type changed in only one case. **Conclusion:** based on the obtained results, it can be concluded that, after 12 months of treatment with the Herbst appliance, no vertical changes occurred in the facial growth pattern of the studied patients.

Keywords: Herbst appliance. Cephalometrics. Facial type.

INTRODUCTION

The Herbst appliance is a bilateral telescopic mechanism, anchored on the maxillary and mandibular arches, that keeps the mandible in a continuous anterior position during all mandibular functions¹⁴. This treatment method does not depend on patient compliance, and among other applications, it was used for TMD treatment, such as clicking or bruxism¹⁴. Although this appliance was proposed since the early 20th century,

there were scarce references to it in orthodontic literature, until it was reintroduced as a treatment method in 1979¹⁴.

According to an evaluation conducted by six of the largest laboratories in the United States, this orthopedic functional appliance has increased in popularity among¹². In Brazil, its use increased significantly, especially after the courses presented by professor Hans Pancherz, from Germany.

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This treatment method has proved to be effective in correcting Class II malocclusions^{1,2,13,14,21,24}. In addition to the possible stimulating effect on mandibular growth, Herbst-based treatment results in a redirection of maxillary growth, mesial movement of mandibular teeth, and distal movement of maxillary teeth^{13,25}. These factors combined are part of the mechanisms for Class II correction.

With this in mind, attention to the vertical relationship of apical bases and the manner in which different facial growth patterns respond to functional appliance therapy are extremely important for the success of Class II treatment^{15,21,23}. Thus, it is vitally important to evaluate the vertical effects of this treatment method on the patient's facial pattern. The vertical relationship between the maxilla and the mandible may be affected by the dentoalveolar effects of the Herbst appliance, especially in patients with increased anterior facial height, resulting in compromised facial aesthetics¹⁵. On the other hand, one study revealed no significant changes in the vertical growth pattern of patients with neutral and hypodivergent growth patterns²³.

Some publications^{11,23,24,25,29} describe different types of anchorage systems. Depending on the patient's facial type at the beginning of treatment, clinicians must be aware of the different dentofacial changes induced in the vertical plane by the different Herbst appliance designs²³.

The objective of this study was to cephalometrically evaluate the possible vertical effects on the vertical facial pattern in a group of adolescents with mandibular retrognathia, treated with the Herbst orthopedic appliance.

MATERIAL AND METHODS

Material

the study included 32 caucasian Brazilian adolescents, of both genders (16 male and 16 female), who were treated with the Herbst orthopedic appliance to correct Angle Class II, di-

vision 1 malocclusion in conjunction with mandibular retrognathia. Mean pre-treatment age (T1) was 12 years and 10 months $\pm$ 1 year and 2 months (varying from 10 years and 11 months to 15 years and 10 months of age).

The sample included patients with the following features: (1) clinical aspect of mandibular retrognathia, with ANB angle equal or greater than 4°; (2) Class II, division 1 malocclusion, permanent dentition and absence of anterior open bite; (3) at the stage of sesamoid bone appearance (S – Björk-Helm stage 3) until immediately after pubertal peak, having reached the beginning of the ossification of the metacarpophalangeal joint of the third finger (FM₃ cap – Björk-Helm stage 4°), as shown in hand and wrist radiographs.

The Committee for Ethics in Research of the Federal University of São Paulo/São Paulo Hospital analyzed and approved the research project on June 12, 2000 (Ref. CEP no. 679/00).

All patients were treated with the modified Herbst appliance, with stainless steel crowns on the maxillary first molars and mandibular first pre-molars, orthodontic bands on the maxillary first premolars and first mandibular molars, a Hyrax expander attached to the maxillary crowns and bands, and a Nance appliance attached to the mandibular crowns and bands (Fig. 1). Occlusal supports were used in cases where the maxillary and/or mandibular second molars were present. Rapid maxillary expansion was necessary in all patients, due to transverse maxillary deficiency present in Class II malocclusions^{1,2,27}. Rapid maxillary expansion occurred, on average, in the first two weeks after placement of the Herbst appliance. Advancements of up to 6mm were performed at the beginning of treatment. Whenever necessary, additional advancements were done during the third month. Asymmetrical mandibular advancements were performed in some cases, with the objective of correcting skeletal midline deviation^{1,2}.



FIGURE 1 - Intraoral photos of the sequence of treatment with the Herbst appliances using stainless steel bands and crowns.

In all 32 patients, Herbst therapy resulted in Class I or overcorrected Class I occlusal relationship.

Methods

The adolescents were evaluated using lateral cephalometric radiographs, immediately prior to the start of treatment (T1) and after Herbst orthopedic appliance therapy (T2), worn during 12 months to correct Angle Class II, division 1 malocclusion associated to mandibular retrognathia. The head cephalogrametric radiographs were taken using always the same cephalostat

(B.F. Wehmer, USA) and a GE[®] x-ray machine (General Electrics, USA), in right lateral norm and centric occlusion. Cephalometric radiographs were manually traced on acetate paper, copying anatomical details of interest for the cephalometric tracing. To measure cephalometric variables, a protractor and a metric ruler were used, with 0.5° and 0.5mm increments, respectively. A few variables of Jarabak's cephalometric analysis²⁶ were used. Both the Jarabak²⁶ ratio and Ricketts VERT index⁴ (modified) were used to evaluate the facial growth pattern of the sampled patients.

Cephalometric variables of Jarabak's analysis²⁶

The following linear cephalometric landmarks were used: S-N, (anterior cranial base, determined by connecting points sella to nasion), S-Ar (posterior cranial base, determined by connecting points sella to articulare), Ar-Goc (mandibular ramus plane, determined by connecting points articulare to constructed gonion), Me-Goc (mandibular plane, determined by connecting points menton to constructed gonion), S-Goc (posterior facial height, determined by connecting points sella to constructed gonion), N-Me (anterior facial height, determined by connecting points nasion to menton), S-Gnc (facial longitude, determined by connecting points sella and constructed gnatio) and N-Goc (facial depth, determined by connecting points nasion and constructed gonion) (Fig. 2).

Jarabak Ratio²⁶ (FHR)

Several analysis are currently used to aid in

the diagnosis of growth direction. Facial morphology has been characterized²⁶ based on three distinct patterns defined by the Facial Height Ratio (FHR) or Jarabak Ratio, meaning: Anterior Facial Height (S-Goc) divided by Posterior Facial Height (N-Me), multiplied by 100. Thus, a percentage is obtained which is representative in describing facial morphology (Fig. 3).

$$(FHR) = (S-Goc/N-Me) \times 100$$

Whenever the percentage is lower than 59%, it is classified as a hyperdivergent growth pattern; when it stands between 59% and 63%, it is considered a neutral growth pattern; and when higher than 63%, as a hypodivergent growth pattern.

Ricketts VERT index¹⁹

Applying the Ricketts¹⁹ method, three facial types can be observed: mesofacial, dolichofacial and brachyfacial, depending on whether the di-



FIGURE 2 - Cephalometric variables of Jarabak's analysis.



FIGURE 3 - Cephalometric variables used in the Jarabak Ratio.

rection of facial growth is downward or forward; that is, more vertical or horizontal, respectively. In this work, the Ricketts VERT index⁴ (modified) was used, further subdividing dolichofacial and brachyfacial types into slight, medium and severe. Facial type is defined based on determining the VERT (amount of facial growth), using the following variables: facial axis angle – angle formed by the nasion-basion (N-Ba) plane and the facial axis (Pt-Gn); facial angle (depth) – angle formed by the Frankfort (Po-Or) and Facial planes (N-P); mandibular plane angle – angle formed by the mandibular (Go-Me) and Frankfort planes (Po-Or); lower facial height – angle formed by the Xi-ANS and Xi-Pm lines; mandibular arch – angle formed by the codylar axis (Xi-DC) and the mandibular body axis (Xi-Pm) (Fig. 4).

After the calculations required to determine VERT were performed, as described in the literature^{19,28}, the patients were classified according to panel 1.

Statistical method

Primarily applied tests showed a symmetric distribution of measured values. For this reason, parametric tests were applied for statistical analysis.

In order to evaluate possible differences between linear and angular cephalometric measurements at the beginning (T1) and at the end of treatment (T2), a paired t-test was applied. Levels of significance were established at $p \leq 0.001$, $p \leq 0.01$ and $p \leq 0.05$.

Method error

In order to evaluate method precision, radiographs of 16 patients from the studied sample ($n = 32$) were selected at random. All radiographs were traced and measured again by a single operator one month after the initial tracing. A paired t-test was then applied to evaluate systematic error. Using the difference between the first and



FIGURE 4 - CCephalometric variables used in the Ricketts⁴ VERT index (modified).

FACIAL TYPE	VERT
severe brachyfacial	+ 2.0
medium brachyfacial	+ 1.0
slight brachyfacial	+ 0.5
mesofacial	0
slight dolichofacial	- 0.5
medium dolichofacial	- 1.0
severe dolichofacial	- 2.0

PANEL 1 - Relationship between the Ricketts⁴ VERT index (modified) and facial type

second measurement of each radiograph, Dahlberg's formula was applied to estimate casual error¹⁰. The formula applied was $E = \sqrt{\sum d^2 / 2n}$, where d is the difference in measurements and n is the number of re-traced cases from the sample.

RESULTS

Systematic error was not significant in any of the cases. Casual error is shown on tables 1 and 2.

At T1, according to the criteria by Siriawat

& Jarabak²⁶, 27 patients showed hypodivergent growth pattern (84.4%), while 5 presented a neutral pattern (15.6%). At T1, the Ricketts VERT index⁴ (modified) showed the following distribution: 16 mesofacial (50%), 5 medium brachyfacial (15.6%), 5 slight dolichofacial (15.6%), 4 slight brachyfacial (12.5%), 1 severe dolichofacial (3.1%), and 1 severe brachyfacial (3.1%).

Not a single case, according to the Siriawat & Jarabak²⁶ evaluation, showed changes in facial pattern between T1 and T2. Evaluating the Ricketts VERT index⁴ (modified), in only one patient did the pattern change from mesofacial in T1 to slight brachyfacial in T2.

All linear measurements of the Siriawat & Jarabak²⁶ analysis showed statistical differences between T1 and T2 ($p < 0.001$) (Table 1). The variables used to find the Ricketts VERT index⁴ (modified) showed the following results between T1 and T2: facial plane angle (n.s.); facial angle

($p < 0.001$); mandibular plane angle (n.s.); lower facial height ($p < 0.001$); mandibular arch (n.s.) (Table 2).

DISCUSSION

Any possible vertical changes resulting from antero-posterior corrections in the apical bases are a reason for concern when planning an orthodontic treatment, as facial types are unchangeable¹⁹. This means no changes take place throughout the patient's entire life – it is a natural individual trait. On the other hand, a study⁹ evidenced a general trend of counterclockwise rotation of the face between childhood and adolescence in all three facial types. These facial types, however, change easily, becoming more vertical if certain precautions are not taken during planning for biomechanical treatment. Thus, it is believed that the maintenance of the patient's facial type is a factor of post-treatment

TABLE 1 - Mean, standard deviation (s.d.) of the linear cephalometric variables (mm) at T1 and T2 (comparison of quantitative evaluations with paired t-tests) and casual error (T1 and T2).

		T1	T2	SIGNIFICANCE (P)	DAHLBERG'S FORMULA CASUAL ERROR	
					T1	T2
S-N	mean	72.42	73.72	< 0.001 ***	0.45	0.34
	s.d.	3.75	3.91			
S-Ar	mean	36.13	37.27	< 0.001 ***	0.55	0.48
	s.d.	3.37	3.56			
Ar-Goc	mean	45.31	47.28	< 0.001 ***	0.52	0.41
	s.d.	4.13	4.18			
Me-Goc	mean	70.14	72.86	< 0.001 ***	0.61	0.41
	s.d.	4.12	3.91			
S-Goc	mean	77.80	80.52	< 0.001 ***	0.54	0.43
	s.d.	5.12	5.66			
N-Me	mean	118.36	121.61	< 0.001 ***	0.40	0.41
	s.d.	6.06	6.31			
S-Gnc	mean	126.56	131.38	< 0.001 ***	0.45	0.52
	s.d.	6.19	6.45			
N-Goc	mean	119.89	122.38	< 0.001 ***	0.33	0.39

*** statistically significant at 0.1%.

TABLE 2 - Mean, standard deviation (s.d.) of the angular cephalometric variables (degrees at T1 and T2 (comparison of quantitative evaluations with paired t-tests) and casual error (T1 and T2).

		T1	T2	SIGNIFICANCE (P)	DAHLBERG'S FORMULA CASUAL ERROR	
					T1	T2
facial plane angle	mean	89.27	89.41	0.534 n.s.	0.47	0.56
	s.d.	3.39	3.67			
facial angle (depth)	mean	88.16	89.11	***	0.61	0.53
	s.d.	3.13	3.49			
mandibular plane angle	mean	23.69	23.67	0.909 n.s.	0.64	0.75
	s.d.	4.24	4.38			
anterior facial height	mean	46.23	46.88	***	0.43	0.53
	s.d.	3.99	4.08			
mandibular arch	mean	32.66	32.66	1.000 n.s.	0.61	0.51
	s.d.	4.01	3.88			

n.s. = non-significant.

*** statistically significant at 0.1%.

stability, as neuromuscular balance will be preserved in these circumstances²⁸.

In the present work, 27 of the 32 patients (84.4%) presented patterns with a predominant tendency for horizontal growth²⁶. The Ricketts VERT index⁴ (modified) showed that 26 of the 32 patients (81.2%) featured predominantly balanced patterns (50%) or with a tendency towards horizontal growth (31.2%). Six patients from the sample (18.7%) had vertical growth patterns. The same interpretation was not found for all patients between the two different methods used to determine facial type, which corroborates the results of another previous study²². In reality, the two methods feature different and complementary approaches. The higher prevalence of hypodivergent patterns found in the present sample does not corroborate the study³ that found a higher prevalence of neutral facial growth patterns in a group with Class II, division 1 malocclusion. It also did not confirm the results of a study⁸ in São Paulo that evaluated lateral cephalometric radiographs of a group of 157 consecutive adolescents with Class II, division 1 malocclusion and mandibular retrognathia, with

mean age of 11 years and 3 months (± 1 year and 5 months) and ANB angle $\geq 4^\circ$. The authors⁸ verified that, according to the Ricketts VERT index⁴, most adolescents featured dolichofacial type (48%), followed by mesofacial type (33%), and less frequently brachyfacial type (19%). This difference is due to the fact that in the present study, the prognosis for long-term stability was taken into consideration when selecting patients. This factor seems to depend on a favorable post-treatment growth pattern¹⁶. Thus, patients with anterior open bite, which is more frequent in vertical patterns⁵, were excluded from the sample.

Clinically evaluated sagittal, vertical and transverse changes were quite evident in patients in the present study during the first months of treatment using the Herbst appliance. Whenever the Herbst appliance is set on bands and crowns, mandibular advancement, which corresponds to the therapeutic position imposed by a constructive bite, creates a disocclusion in the posterior area. This disocclusion is compensated during the first months of treatment, as a result of vertical alveolar growth, which is expressed by the absence of vertical occlusal contacts. At that

time, the necessary occlusal supports are made on the second molars, in order to avoid a differentiated extrusion of these teeth. In the present study, it was observed that, although these adaptive changes in dentoalveolar growth had taken place, they did not negatively influence facial type between T1 and T2.

Another aspect to consider is the crossbite that occurred at the time the Herbst appliance was placed. A great part of Class II malocclusions with retrognathic mandibles show transverse deficiencies in the maxilla, evidenced by the sagittal advancement promoted by the Herbst appliance. Moreover, maxillary expansion reduced occlusal interference and functional changes, as the wider portion of the lower arch was placed anteriorly.

On average, one week after appliance placement the Hyrax expander began to be activated, resulting in opening of the midpalatal suture, in a pre-established protocol of one complete turn in the first day and a half-turn in the following days, until overcorrection was achieved. During this stage, the bite was opened, occasionally diminishing the effect of the initial constructive bite.

With regard to the time of treatment, the patients began this study during their pubertal growth spurt, as evaluated by hand and wrist x-rays. However, clinicians should remember that there is great individual variation in skeletal and dental responses with this method of treatment¹⁷.

In the present study, no cases showed changes in facial patterns between T1 and T2, according to the criteria set by Siriwat & Jarabak²⁶. Studies were found in the literature which used different methods regarding treatment duration and type of Herbst appliance, thus hindering a comparison with the present results. In a study using the Herbst appliance in normo-hypodivergent patients, the authors²³ did not find significant changes in the vertical growth pattern, which agrees with the results of the present study. During a similar observation time of 12 months, another investigation²⁴, which used the version

of the Herbst appliance on acrylic splints, had similar results as the present study. It is important to note that this other study could have had different results, as this type of appliance does not allow dentoalveolar growth during the active phase of treatment with the Herbst, because it covers the occlusal surfaces. Other studies^{15,20,25}, using different designs of the Herbst appliance, did not show changes in the mandibular plane angle, either. Evaluating the Ricketts VERT index⁴ (modified), only one patient (3.1%) showed changes between T1 and T2 to a more horizontal pattern. Case no. 8 had a slight increase in the facial plane, facial depth and mandibular arch angles, going from mesofacial at T1 to slight brachyfacial at T2, and corroborating the results of a previous study²³. However, in that investigation the authors used the Herbst appliance in conjunction with an acrylic splint and high-traction extraoral anchorage. In the present sample, no deleterious effects of the treatment were found on patients – although few patients had a vertical growth pattern at T1, according to the Ricketts VERT index⁴ (modified) (6 cases = 18.75%), and some of them had overbite and excessive facial height. The increase in anterior facial height occurs with parallel downward growth of the mandibular plane¹⁵. Treatment with the Herbst appliance has shown an increase in condylar growth in the desired therapeutic sagittal direction²¹, coinciding with the direction of condylar growth in hyperdivergent individuals⁶, without resulting in downward and backward rotation of the mandible²⁰. Thus, individuals with a high mandibular plane angle have a good prognosis with Herbst therapy. Significant increases ($p < 0.001$) were found in the results of this study for anterior facial height (N-Me), lower facial height (Xi-ENA.Xi-Pm) and posterior facial height (S-Goc) (Tables 1, 2), without altering the patient's facial pattern, according to the criteria of Siriwat & Jarabak²⁶ and the Ricketts VERT index⁴ (modified). It makes sense, especially because the

increase in anterior facial height during Herbst use is due to the geometric effect of anterior repositioning of the mandible and increase in mandibular length²⁰ ($p < 0.001$ – Goc-Me) (Table 1).

Some studies have shown that vertical development of the ramus increases during treatment with an activator³⁰ and Herbst¹⁸. It is important to note that in the present study, growth of the posterior cranial base (S-Ar) in conjunction with mandibular ramus growth (Ar-Goc) increased significantly ($p < 0.001$) between T1 and T2, contributing to the increase in posterior facial height. The measurements S-Gnc and N-Goc also underwent significant modifications ($p < 0.001$) due to the increase in anterior and posterior facial height. Because a control group was not used, due to the timely age of the patients during the time of treatment, it becomes difficult to ascertain which effects were the result of the treatment or of natural growth. Treatment with the Herbst appliance would be more useful in Class II cases with lack of vertical development in anterior facial height¹⁵. On the other hand, the results of one study²¹ showed that the skeletal and dental changes that contributed to correcting Class II did not depend on the vertical relationship of the apical bases.

Although no significant vertical changes occurred with the correction of Class II in the treated cases, it is extremely important to have a longitudinal follow-up of this group of adolescents, to evaluate the stability of obtained results.

Finally, all patients in this work were subjected to a second phase of orthodontic treatment, with the placement of upper and lower fixed appliances, with the objective of refining the occlusion. After that stage, new evaluations will be made in order to verify facial pattern stability of the studied patients from beginning to end of orthodontic treatment.

CONCLUSION

Based on the obtained results, it can be concluded that, after 12 months of treatment with the Herbst appliance, no vertical changes occurred which altered the facial growth patterns of the studied patients.

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Effects of the jasper jumper appliance in the treatment of Class II malocclusion

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ABSTRACT

Introduction: The Jasper Jumper is a fixed functional appliance which keeps the mandible in a protruded position by applying continuous light forces. Even though previous studies have revealed the clinical outcome of the appliance, there is still some debate about how much correction is achieved by skeletal changes vs. dentoalveolar changes. **Objective:** The objective of this study was to evaluate the skeletal and dentoalveolar effects of the treatment of Class II malocclusion with the Jasper Jumper appliance associated with fixed orthodontic appliances, compared to an untreated control group. **Material and Methods:** The sample comprised 47 subjects, divided into two groups: Group 1, with 25 patients at a mean initial age of 12.72 years, treated with the Jasper Jumper appliance for a mean period of 2.15 years; and Group 2 (Control), included 22 subjects at a mean initial age of 12.67 years, who were not submitted to any type of orthodontic treatment and presenting Class II malocclusion, observed by a mean period of 2.12 years. Lateral cephalograms before and after orthodontic treatment for group 1 and during the observational period for group 2 were evaluated. Initial and final dentoskeletal cephalometric variables and changes with treatment were compared between the groups by independent t tests. **Results:** When compared to the control group, the Jasper Jumper group presented greater restriction of anterior displacement of the maxilla and a greater maxillary retrusion, improvement of maxillomandibular relationship, reduction of facial convexity, greater protrusion and intrusion of mandibular incisors and a greater extrusion of mandibular molars, besides a greater reduction of overjet and overbite and improvement of molar relationship. **Conclusion:** The correction of the Class II in the group treated with the Jasper Jumper and fixed appliances was mainly due to restriction of maxillary growth, protrusion and intrusion of mandibular incisors and extrusion of mandibular molars.

Key-words: Class II malocclusion. Cephalometrics. Functional Appliance.

INTRODUCTION

When analyzing the prevalence of malocclusion, Class I is present in 55% of the Brazilian population and Class II, in 42%²⁵. The latter is

characterized by an anteroposterior discrepancy of skeletal bases, negatively influencing esthetics and self-esteem of patients, justifying the percentage of Class II patients who look for orthodontic

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treatment. Freitas et al.⁹ verified that 54% of male patients and 58% of female patients that search for solutions for their dentoskeletal problems presented a Class II malocclusion. This malocclusion can be early detected, and compromises not only esthetics, but also some essential functions, like mastication, swallowing and speech².

Recent orthodontic researches concern mainly on the orthodontic treatment effects and not on the severity of malocclusion and the efficiency of treatment protocols²⁷. This refers especially to the treatment of Class II malocclusion. For a treatment protocol to be efficient, it is not only desirable that it corrects a malocclusion, but that this correction is performed in a reasonable period of time, with the least patient and professional fatigue and respecting biological integrity⁷. Besides, the obtained result should be excellent. According to Baccetti et al.³, this malocclusion can be early diagnosed by the presence of a distal step in the deciduous second molars, Class II canine relationship and accentuated overjet, and it does not self-correct. Henriques et al.¹⁰ verified that the Class II skeletal discrepancy was maintained from the mixed to the permanent dentition. During this period, no self-correction of this malocclusion was observed, but an increase in overjet, due to a retrusion of mandibular incisors.

The actual tendency for correction of the Class II malocclusion without extractions, is the use of fixed functional orthopedic appliances that do not need patient compliance^{13,24}. The Herbst appliance and its variations is the most used and investigated in the last years. Its effects in Class II treatment are: restriction of the anterior displacement of the maxilla; significant mandibular protrusion; intrusion and distalization of maxillary molars; distalization and extrusion of maxillary incisors; anterior movement of mandibular teeth through the alveolar bone (molars and incisors); intrusion of mandibular incisors and extrusion of mandibular molars, and a significant improvement of the

maxillomandibular relationship^{23,24}. However, the Herbst appliance has a relatively high cost.

More recently, in 1987, the Jasper Jumper was developed by James Jasper, with a mechanism similar to the Herbst appliance, with a lower cost¹³. This appliance consists of a new flexible device for mandibular advancement, composed by two flexible force modules that minimizes the problems caused by the rigidity of the Herbst appliance, providing the patient more freedom of mandibular movements, reducing the total treatment time, because the Jasper Jumper is used together with fixed appliances. This way, the treatment is accomplished in only one phase, not needing two phases, one orthopedic and other orthodontic, as it occurs with most of functional orthopedic appliances¹³.

The Jasper Jumper is relatively new, and not much has been published regarding its use, mainly when compared to the vast literature regarding the Herbst appliance. However, there is a great agreement among studies regarding the effects of the Jasper Jumper¹³. These are similar to the effects promoted by the Herbst appliance, due to the equivalent action mechanism²⁴.

The main expected results with the use of the Jasper Jumper in Class II malocclusion cases are: restriction of the anterior displacement of the maxilla¹⁸ and a significant mandibular protrusion¹, however other studies did not demonstrate any significant change in mandibular growth^{5,22}, an intrusion and distalization of maxillary molars⁵; distalization of maxillary incisors^{1,4,5} and extrusion⁵; a slight tendency of clockwise rotation of the mandible^{4,18}; anterior movement of mandibular teeth in the alveolar bone (molars and incisors)^{1,4,5}; intrusion of mandibular incisors⁴; extrusion of mandibular molars^{4,5}; expansion of maxillary molars (when not using anchorage). There is a significant improvement of the maxillomandibular relationship²².

The dental changes result in a clockwise rotation of the occlusal plane¹⁸, without a rotation of

the mandibular plane⁵. Normally, there are no significant vertical changes^{1,5,18}. Therefore, the correction of a Class II malocclusion is accomplished mainly due to dentoalveolar changes instead of skeletal changes, despite the use of methods to minimize these effects and to increase the skeletal effects^{1,5,18}.

The present study aimed to cephalometrically evaluate the skeletal and dentoalveolar changes in Class II malocclusion patients treated with the Jasper Jumper appliance, associated to fixed orthodontic appliances, and compare it to an untreated control group.

MATERIAL AND METHODS

Material

The sample comprised 94 lateral cephalograms of 47 young subjects, divided into 2 groups:

Group 1 – Jasper Jumper

Comprised by 25 patients, 13 males and 12 females, with initial Class II division 1 malocclusion and a mean initial age of 12.72 years (S.D. = 1.20), treated with the Jasper Jumper associated to fixed orthodontic appliances, for a mean total period of 2.15 years (S.D. = 0.29). All patients were treated in the Orthodontics Department of the Bauru Dental School, University of São Paulo, by orthodontic graduate students.

Group 2 – Control Group

Comprised by 22 patients, 12 males and 10 females, with untreated Class II division 1 malocclusion, at a mean initial age of 12.67 years (S.D. = 0.75) and observed for a mean period of 2.12 years (S.D. = 1.63).

These subjects were selected from the longitudinal sample of the Growth Center of the Bauru Dental School, University of São Paulo. All subjects were indicated for orthodontic treatment; however some of them opted for a late treatment or were not interested in treatment, enabling the formation of this control group.

The Jasper Jumper appliance

The Jasper Jumper appliance was developed by James Jasper¹³, and consists of a bilateral flexible spring that exert continuous light forces to both arches. The upper end of the spring is attached posteriorly to the maxillary arch by a ball pin that is placed through the distal attachment of the spring and then extends anteriorly through the face-bow tube on the upper first molar band. The lower end of the spring is blocked by a small teflon ball positioned in the mandibular arch.

The Jasper Jumper is selected according to the manufacturer's instructions and it is available in seven lengths, ranging from 26 mm to 38 mm, in 2 mm increments (Figure 1).

For orthodontic therapy, 0.022" x 0.030" Roth pre-adjusted brackets (Morelli, Sorocaba, SP) were used. All patients used a transpalatal arch to enhance maxillary anchorage, maximize the skeletal and minimize the dental effects. Both arches were leveled and the 0.018" x 0.025" stainless steel arch wires were engaged just before the insertion of the Jasper Jumpers. Both arches were cinched back to minimize the adverse effects of the functional appliance and to prevent slippage.

During appliance installation, bayonet bends are placed in the rectangular arch, distal to the mandibular canines and small teflon balls are slipped over the arch wire to provide an anterior stop. Anterior lingual crown torque is placed in the mandibular arch wire to minimize incisor

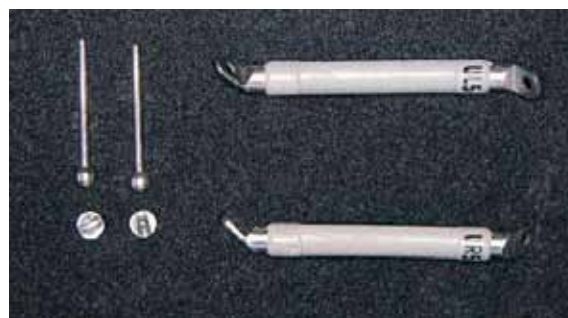


FIGURE 1 - Components of the Jasper Jumper appliance.

proclination. Subsequently, the Jasper Jumper flexible springs were selected and installed to correct the anteroposterior discrepancy.

The size of the Jasper Jumper was selected accordingly to the length between the extra-oral tube entrance and the distal of the lower teflon ball. To obtain the spring size, 12 mm was added to this length (4 mm to compensate the tube length plus 4 mm of space that must exist between the pin-ball and the distal of the tube plus 4 mm that correspond to the appliance activation) (Figure 2). When the obtained length was an odd value, the next greater spring length was selected. The brackets of the lower first premolars were removed to allow a greater freedom of mandibular movement. In some patients, the lower first and second premolars brackets were removed. The pin-balls were placed through the distal hole in the force module and inserted into the face-bow tube on the maxillary first molar band, allowing the Jasper Jumper installation associated to the fixed appliance (Figure 3).

The patients were coached to practice opening and closing movements slowly at first and told to avoid excessive wide opening during eating and yawning. The clinician warned the patient against biting on the jumpers, as this would result in breakage.

The mean percentage of breakage to the present sample was 35.14%. The earliest breakage occurred after 2 months of appliance installation and the latest breakage occurred after 9 months.

The appliance activations were performed by including new teflon balls in the lower arch.

After a mean period of 0.61 years of treatment, the maxillomandibular relation was overcorrected. The Jasper Jumper appliance was removed and treatment finishing and dental intercuspation were performed. During the finishing stage, all patients were submitted to an active retention protocol with Class II elastics for 10 hours/day. However, in some patients the Class II elastics were used for a longer period of time. After fixed appliances removal, a modified Hawley retainer was used in the maxillary arch and a 3 x 3 fixed retainer was bonded in the mandibular arch. A modified Bionator was used in a night-time wear protocol as active retention. This appliance exhibited less acrylic resin in the posterior region, without mandibular incisors coverage, and was used during one year.

Methods

Lateral cephalograms were evaluated before (T1) and after (T2) orthodontic treatment for each subject. The cephalograms were taken with lips in rest position and in centric occlusion.

Lateral cephalograms were manually traced, landmarks were digitized for a single investigator (RPH) and measurements were obtained with Dentofacial Planner 7.02 (Dentofacial Planner Software, Toronto, Ontario, Canada), which corrected the radiographic magnification (6 and 9.8%).



FIGURE 2 - Selection of the length of the Jasper Jumper appliance. In the example, the distance was 20 mm; adding to the recommended 12 mm = 32 mm (Jasper Jumper size 4).



FIGURE 3 - The Jasper Jumper installed.



FIGURE 4 - The Jasper Jumper installed.

Error study

After a month interval from the first measurement, thirty randomly selected cephalograms were retraced and re-measured by the same examiner (RPH). Casual errors were calculated according to Dahlberg's formula⁶ ($Se^2 = \Sigma d^2 / 2n$) where Se^2 is the error variance and d is the difference between the two determinations of the same variable, and the systematic errors were evaluated with dependent t tests, for $P < .05$.

Statistical analysis

Inter-group compatibility for sex distribution and initial severity of Class II molar relationship were performed by Chi square tests. Inter-group compatibility for initial and final ages and treatment/observation time were performed by independent t tests.

Inter-group comparison of pretreatment (T1), posttreatment (T2) and changes between T1 and T2 (T2-T1) were performed by independent t tests.

All statistical analysis was performed with the use of Statistica software (Statistica for Windows, Release 6.0, Copyright Statsoft Inc., 2001). Results were considered significant for $P < 0.05$.

RESULTS

Table 1 shows the results of intraexaminer systematic and casual errors, performed by dependent t tests and Dahlberg formula⁶, respectively. The errors verified are within acceptable values and can provide reliable results.

Table 2 presents the results of inter-group compatibility of initial and final ages and mean time of evaluation.

Table 3 shows results of Chi-square test for inter-group comparison of sex distribution. Table 4 shows results of Chi-square test for inter-group comparison of initial severity of the Class II molar relationship.

Results of inter-group comparison at pretreatment stage are shown in Table 5.

Table 6 presents the results of inter-group

comparison of changes in cephalometric variables during treatment and observation time.

Table 7 shows the results of inter-group comparison of cephalometric variables at posttreatment stage.

DISCUSSION

Sample

The groups were similar regarding several parameters that could influence this comparison. Thus, a compatible control Class II group was used to evaluate the Jasper Jumper treatment changes. The control group was important to distinguish the treatment effects from the craniofacial growth changes. Besides, the groups were compatible regarding other parameters such as pretreatment age, treatment duration, severity of the anteroposterior malocclusion, gender distribution and initial cephalometric characteristics.

To improve inter-group compatibility Class II, division 2 patients were excluded. The possible influence of inherent characteristics of these patients on results and treatment time determined their sample exclusion¹⁹. Class II subdivision patients were also excluded because unilateral Class I molar relationship could also influence results and treatment time. Besides, studies that evaluated Class II subdivision malocclusion demonstrated that the main components of this malocclusion are dentoalveolar¹², requiring asymmetric mechanics or extraction protocols, that certainly are not the purpose of the present investigation.

Although sample size was not ideal, the number of subjects can be considered satisfactory to produce reliable results because similar studies with functional fixed appliances also used samples of similar sizes or smaller^{17,18,20,30}.

Inter-group Compatibility

The groups were similar regarding pre and posttreatment ages, treatment duration and gender distributions (Tables 2 and 3).

The inter-group compatibilities regarding ini-

TABLE 1 - Results of t test and Dahlberg's formula⁶, applied to variables to estimate systematic and casual errors, respectively.

VARIABLES	1ª MEASURE- MENT (n = 30) Mean (s.d.)	2ª MEASURE- MENT (n = 30) Mean (s.d.)	DAHL- BERG	P
MAXILLARY COMPONENT				
SNA (°)	84.13 (2.01)	83.94 (1.99)	0.69	0.357
Co-A (mm)	87.13 (3.17)	86.37 (3.42)	0.70	0.187
A-Nperp (mm)	1.76 (2.86)	2.17 (2.80)	0.48	0.288
MANDIBULAR COMPONENT				
SNB (°)	78.51 (2.64)	77.90 (2.19)	0.88	0.167
Co-Gn (mm)	106.46 (4.73)	107.30 (4.36)	0.72	0.238
Go-Gn (mm)	70.51 (3.19)	71.32 (3.88)	0.56	0.190
P-Nperp (mm)	-2.53 (4.71)	-3.49 (4.29)	0.75	0.183
MAXILLOMANDIBULAR RELATIONSHIP				
ANB (°)	5.34 (3.08)	4.91 (2.96)	0.41	0.291
NAP (°)	9.87 (4.38)	8.65 (4.16)	0.93	0.136
Wits (mm)	1.47 (1.90)	0.76 (1.62)	0.84	0.062
VERTICAL COMPONENT				
FMA (°)	23.92 (4.85)	24.38 (4.93)	1.02	0.358
SN.GoGn (°)	30.45 (4.21)	30.92 (4.05)	1.01	0.330
LAFH (mm)	60.35 (4.73)	61.17 (4.11)	0.67	0.238
SN.PP (°)	7.23 (4.66)	6.18 (4.38)	0.96	0.186
SN.Ocl (°)	17.39 (3.90)	18.22 (3.77)	0.87	0.202
S-Go (mm)	70.42 (4.11)	69.15 (4.58)	0.70	0.131
MAXILLARY DENTOALVEOLAR COMPONENT				
1.PP (°)	114.29 (5.40)	113.63 (5.64)	1.25	0.322
1-PP (mm)	25.48 (4.28)	26.19 (4.35)	0.45	0.262
1.NA (°)	23.41 (5.60)	22.05 (5.79)	1.18	0.179
1-NA (mm)	3.71 (2.59)	4.52 (2.84)	0.43	0.113
6-PP (mm)	20.67 (3.19)	19.81 (3.56)	0.59	0.164
MANDIBULAR DENTOALVEOLAR COMPONENT				
IMPA (°)	96.09 (5.12)	98.43 (5.39)	1.36	0.045*
1.NB (°)	29.36 (5.21)	31.98 (5.80)	1.47	0.035*
1-NB (mm)	5.26 (2.49)	5.87 (3.01)	0.62	0.198
1-GoMe (mm)	37.49 (2.74)	38.02 (2.18)	0.58	0.205
6-GoMe (mm)	27.67 (2.33)	28.41 (2.25)	0.94	0.107
DENTAL RELATIONSHIPS				
Overjet (mm)	4.35 (2.19)	3.94 (2.56)	0.37	0.253
Overbite (mm)	3.89 (1.97)	3.22 (2.68)	0.41	0.137
Molar Rel. (mm)	1.15 (1.82)	0.98 (1.34)	0.25	0.340

* Statistically significant for P < 0.05.

TABLE 2 - Inter-group comparison of initial and final ages and evaluation time (independent t tests).

VARIABLES (Years)	GROUP 1 JASPER JUMPER (n = 25)		GROUP 2 CONTROL (n = 22)		P
	Mean	s.d.	Mean	s.d.	
Initial Age	12.72	1.20	12.67	0.75	0.869
Final Age	14.87	1.20	14.79	1.70	0.856
Evaluation Time	2.15	0.29	2.12	1.63	0.936

TABLE 3 - Inter-group comparison of sex distribution (Chi-square).

GROUPS	MASCULINE	FEMININE	TOTAL
1 (Jasper Jumper)	13	12	25
2 (Control)	12	10	22
TOTAL	25	22	47
X ² = 0.03 df = 1 P = 0.861			

TABLE 4 - Inter-group comparison of initial severity of the Class II molar relationship (Chi-square test).

GROUPS	1/2-CUSP CLASS II	3/4-CUSP CLASS II	FULL-CUSP CLASS II	TOTAL
1 (Jasper Jumper)	4	9	12	25
2 (Control)	10	5	7	22
TOTAL	14	14	19	47
X ² = 3.47 df = 2 P = 0.176				

tial age and treatment time were essential because these factors might influence the intensity of growth and chephalometric changes, influencing favorably or not the Class II malocclusion correction⁸.

Initial malocclusion severity was verified in the study models. The Chi-square test demonstrated no inter-group differences regarding initial anteroposterior malocclusion severity distributions (Table 4). Although the experimental

TABLE 5 - Inter-group comparison of cephalometric variables at pre-treatment stage (T1) (independent t tests).

VARIABLES	GROUP 1 JASPER JUMPER (n = 25)	GROUP 2 CONTROL (n = 22)	P
	Mean (s.d.)	média (s.d.)	
MAXILLARY COMPONENT			
SNA (°)	82.60 (3.36)	81.93 (3.15)	0.486
Co-A (mm)	85.34 (4.44)	86.01 (4.65)	0.616
A-Nperp (mm)	1.17 (3.80)	1.19 (2.85)	0.984
MANDIBULAR COMPONENT			
SNB (°)	77.30 (2.39)	77.70 (3.76)	0.665
Co-Gn (mm)	106.30 (4.99)	106.04 (6.09)	0.871
Go-Gn (mm)	70.56 (3.83)	69.43 (4.30)	0.349
P-Nperp (mm)	-4.83 (4.89)	-3.35 (4.33)	0.281
MAXILLOMANDIBULAR RELATIONSHIP			
ANB (°)	5.30 (3.06)	4.23 (1.97)	0.167
NAP (°)	8.76 (7.66)	7.17 (5.28)	0.417
Wits (mm)	1.62 (2.45)	-0.45 (2.43)	0.005*
VERTICAL COMPONENT			
FMA (°)	24.62 (3.92)	23.80 (2.72)	0.419
SN.GoGn (°)	31.12 (4.05)	30.86 (4.76)	0.840
LAFH (mm)	61.27 (4.93)	59.75 (4.10)	0.262
SN.PP (°)	4.06 (16.36)	8.05 (3.49)	0.267
SN.Ocl (°)	18.92 (3.77)	19.58 (5.75)	0.643
S-Go (mm)	69.38 (5.09)	68.86 (5.44)	0.736
MAXILLARY DENTOALVEOLAR COMPONENT			
1.PP (°)	110.63 (7.11)	113.26 (5.60)	0.494
1-PP (mm)	25.95 (4.48)	25.97 (2.57)	0.981
1.NA (°)	23.95 (7.50)	23.27 (6.53)	0.745
1-NA (mm)	4.49 (2.86)	3.32 (1.94)	0.112
6-PP (mm)	19.22 (8.56)	20.13 (2.13)	0.629
MANDIBULAR DENTOALVEOLAR COMPONENT			
IMPA (°)	97.66 (7.39)	94.77 (4.68)	0.121
1.NB (°)	28.22 (5.80)	25.58 (5.01)	0.104
1-NB (mm)	4.98 (2.11)	3.94 (1.54)	0.064
1-GoMe (mm)	38.18 (2.83)	37.18 (2.57)	0.212
6-GoMe (mm)	27.71 (2.25)	27.25 (2.20)	0.478
DENTAL RELATIONSHIPS			
Overjet (mm)	6.14 (2.30)	4.68 (1.52)	0.015*
Overbite (mm)	4.99 (1.69)	4.78 (1.73)	0.676
Molar Rel. (mm)	-1.33 (1.22)	0.71 (1.13)	0.000*

* Statistically significant for P<0.05.

TABLE 6 - Results of intergroup comparison of cephalometric changes (independent t tests).

VARIABLES	GROUP 1 JASPER JUMPER (n = 25)	GROUP 2 CONTROL (n = 22)	P
	Mean (s.d.)	Mean (s.d.)	
MAXILLARY COMPONENT			
SNA (°)	-1.42 (2.31)	0.73 (2.59)	0.004*
Co-A (mm)	0.58 (2.20)	2.95 (2.59)	0.001*
A-Nperp (mm)	-1.28 (2.89)	0.78 (3.29)	0.026*
MANDIBULAR COMPONENT			
SNB (°)	0.02 (1.07)	0.48 (2.19)	0.350
Co-Gn (mm)	4.17 (2.91)	4.11 (3.55)	0.950
Go-Gn (mm)	2.86 (2.46)	3.10 (2.19)	0.722
P-Nperp (mm)	-0.06 (4.34)	0.92 (4.97)	0.473
MAXILLOMANDIBULAR RELATIONSHIP			
ANB (°)	-1.42 (1.67)	0.23 (1.36)	0.000*
NAP (°)	-3.20 (3.76)	0.53 (3.11)	0.000*
Wits (mm)	-1.72 (3.10)	1.15 (2.29)	0.000*
VERTICAL COMPONENT			
FMA (°)	0.78 (2.62)	-0.02 (1.91)	0.239
SN.GoGn (°)	0.70 (1.83)	-0.28 (2.30)	0.110
LAFH (mm)	4.30 (2.65)	2.86 (2.58)	0.068
SN.PP (°)	3.56 (15.72)	0.17 (1.90)	0.320
SN.Ocl (°)	-0.13 (2.75)	-1.48 (3.86)	0.169
S-Go (mm)	3.73 (2.57)	2.78 (3.13)	0.262
MAXILLARY DENTOALVEOLAR COMPONENT			
1.PP (°)	0.54 (17.22)	0.31 (3.45)	0.952
1-PP (mm)	2.18 (3.71)	0.61 (1.17)	0.064
1.NA (°)	-1.62 (8.35)	-0.60 (3.58)	0.598
1-NA (mm)	-0.61 (3.03)	-0.21 (1.31)	0.571
6-PP (mm)	1.89 (8.99)	1.66 (1.22)	0.904
MANDIBULAR DENTOALVEOLAR COMPONENT			
IMPA (°)	2.43 (5.95)	-0.10 (4.14)	0.102
1.NB (°)	3.28 (5.75)	0.39 (4.36)	0.061
1-NB (mm)	1.63 (1.56)	0.38 (1.54)	0.008*
1-GoMe (mm)	0.47 (1.32)	1.51 (1.99)	0.039*
6-GoMe (mm)	3.26 (1.24)	1.17 (1.85)	0.000*
DENTAL RELATIONSHIPS			
Overjet (mm)	-3.70 (2.38)	-0.08 (1.39)	0.000*
Overbite (mm)	-2.90 (1.33)	-0.60 (1.90)	0.000*
Molar Rel. (mm)	3.42 (1.18)	-0.24 (1.42)	0.000*

* Statistically significant for P<0.05.

TABLE 7 - Inter-group comparison of cephalometric variables at post-treatment stage (T2) (independent t tests).

VARIABLES	GROUP 1 JASPER JUMPER (n = 25)	GROUP 2 CONTROL (n = 22)	P
	Mean (s.d.)	média (s.d.)	
MAXILLARY COMPONENT			
SNA (°)	81.18 (3.28)	82.67 (3.35)	0.132
Co-A (mm)	85.92 (4.95)	88.96 (4.21)	0.029*
A-Nperp (mm)	-0.11 (4.79)	1.97 (3.27)	0.091
MANDIBULAR COMPONENT			
SNB (°)	77.32 (2.59)	78.18 (3.79)	0.363
Co-Gn (mm)	110.47 (5.31)	110.15 (6.45)	0.852
Go-Gn (mm)	73.42 (3.98)	72.54 (4.16)	0.463
P-Nperp (mm)	-4.89 (6.35)	-2.43 (5.86)	0.176
MAXILLOMANDIBULAR RELATIONSHIP			
ANB (°)	3.88 (2.80)	4.46 (1.34)	0.378
NAP (°)	5.56 (7.44)	7.70 (3.91)	0.234
Wits (mm)	-0.10 (2.88)	0.70 (2.63)	0.329
VERTICAL COMPONENT			
FMA (°)	25.41 (4.72)	23.78 (3.19)	0.180
SN.GoGn (°)	31.82 (4.34)	30.58 (4.89)	0.361
LAFH (mm)	65.57 (4.66)	62.62 (4.91)	0.040*
SN.PP (°)	7.63 (3.06)	8.23 (3.41)	0.525
SN.Ocl (°)	18.79 (3.75)	18.09 (4.82)	0.579
S-Go (mm)	73.12 (5.48)	71.65 (5.34)	0.359
MAXILLARY DENTOALVEOLAR COMPONENT			
1.PP (°)	111.18 (6.22)	113.58 (6.90)	0.215
1-PP (mm)	28.14 (2.95)	26.59 (2.85)	0.075
1.NA (°)	22.32 (7.88)	22.67 (6.70)	0.871
1-NA (mm)	3.88 (3.05)	3.10 (1.95)	0.312
6-PP (mm)	21.12 (3.72)	21.80 (2.13)	0.455
MANDIBULAR DENTOALVEOLAR COMPONENT			
IMPA (°)	100.10 (6.93)	94.67 (4.48)	0.003*
1.NB (°)	32.51 (5.78)	25.97 (4.98)	0.001*
1-NB (mm)	6.62 (2.63)	4.33 (2.06)	0.001*
1-GoMe (mm)	38.66 (2.82)	38.69 (2.73)	0.965
6-GoMe (mm)	30.98 (2.27)	28.42 (2.43)	0.000*
DENTAL RELATIONSHIPS			
Overjet (mm)	2.44 (0.57)	4.60 (1.87)	0.000*
Overbite (mm)	2.08 (0.81)	4.17 (1.52)	0.000*
Molar Rel. (mm)	2.08 (0.64)	0.47 (1.42)	0.000*

* Statistically significant for P<0.05.

group (Jasper Jumper) exhibited more subjects presenting full cusp and $\frac{3}{4}$ cusp Class II molar relation, this difference between groups were not statistically significant. The number of severe Class II subjects included in the control group was smaller than in the experimental group because, due to ethical concerns, patients with severe Class II could not be observed without intervention until 15 years-old. Possibly, they would be in a favorable age to begin treatment⁶. Moreover, a similar study¹¹ also used control groups with milder Class II characteristics than the experimental group.

Initial Cephalometric Characteristics

In a gold-standard study, groups that will be compared should exhibit similar cephalometric Class II characteristics at the pretreatment stage (T1).

In the present study, 26 of 29 variables evaluated exhibited no inter-group differences at pretreatment. Thus, there were no inter-group differences in 89.65% of the cephalometric variables analyzed at T1. Probably, these small differences were result of a control group with milder cephalometric Class II characteristics than experimental group at the pretreatment stage.

Subjects from experimental and control groups presented similarity in their cephalometric characteristics regarding maxillary and mandibular components, growth pattern, maxillary and mandibular dentoalveolar components (Table 5).

During the maxillomandibular component analysis, only the Wits measurement exhibited significant differences between experimental and control groups at T1 (Table 5). The dental component exhibited significant inter-group differences in the amount of initial overjet and molar relation (Table 5), when evaluated at T1.

The experimental group had a significantly greater maxillomandibular discrepancy when compared to the control group, resulting in a

significantly greater overjet and molar relation discrepancy. This fact may be justified due to the milder severity of initial malocclusion of subjects from the control group, with few subjects presenting full-cusp Class II. Since control group comprised Class II patients, not submitted to orthodontic intervention, this group exhibited subjects with milder Class II malocclusions. Patients with severe Class II malocclusions, if present in this group, could not be observed longitudinally without intervention due to ethical concerns. Other studies have also used control groups with milder Class II cephalometric characteristics than the experimental group^{11,19,21}.

Inter-group Comparisons

Maxillary Component

There were significant differences between the groups for the variables that described the maxillary component (Table 6). The inter-group comparisons showed that the Jasper Jumper therapy resulted in significant retrusion and forward growth restriction in the maxillary complex.

The Jasper Jumper appliance promoted greater restriction in maxillary forward displacement when compared to the normal growth changes. This result is in agreement with previous studies that also found significant restriction of maxillary growth during Jasper Jumper therapy^{1,4,5,14,17-21,26}.

Some similar investigations found some restrictive effect, particularly when SNA angle was evaluated. The studies pointed out that this restrictive effect could be related to some changes that are similarly observed when extra-oral appliances are used for Class II malocclusion correction as maxillary molars distalization and intrusion^{4,17,18}. This phenomenon is described as the "headgear effect."

During treatment with Jasper Jumper associated to fixed appliances, the maxillary and mandibular teeth were engaged in a thick and rectangular wire, forming one unit¹⁸. As a result, when the distal directed force of the Jasper Jumper

caused upper molar intrusion and distalization, the consequent effects on the upper anterior region were incisor elongation and uprighting. The overall result was a clockwise rotation of the palatal plane^{17,18}. The distal directed force of the Jasper Jumper possibly induced retrusion and forward growth restriction of the maxillary complex during treatment.

At the end of active treatment, the effective length of the maxilla was significant greater in the control group. However, the maxillary complex positioning was similar between groups (Table 7).

Mandibular Component

No significant inter-group differences were found for the mandibular component analysis (Table 6). There was no mandibular protrusion or increments in mandibular size due to treatment. The mandibular changes were inherent to the mandibular normal growth, corroborating previous reports^{4,5,16,19-22}. However, some studies described some mandibular protrusion during treatment with Jasper Jumper appliances^{1,14,17,26,29,30}.

The treatment with orthopedic appliances typically results in a temporary and rapid change in mandibular posture. Mandibular condyle growth in the direction of the glenoid fossa compensates this rapid change in mandibular posture¹⁵. Voudouris and Kuftinec²⁸ related that the mandibular protrusion due to the functional appliance approach stretches the retrodiscal tissues, stimulating bone remodeling of this anatomic region. After appliance removal, the stimulation loses intensity until it reaches basal levels. This fact may explain the lack of significant changes in the mandibular component of the experimental group when compared to the control group (Table 7).

Maxillomandibular Relationship

During treatment, the maxillomandibular relationship, evaluated by ANB angle and Wits ap-

praisal, showed significant improvement. There was a significant reduction in facial convexity in the experimental group when compared to the control (Table 6), in accordance to previous reports^{5,17-22,26,29,30}.

The maxillomandibular relationship changes observed in the experimental group seem to have resulted primarily from restriction in maxillary forward displacement, as previously discussed, to mandibular normal growth changes and also to some dentoalveolar effects¹⁹.

However, there were no differences between the groups regarding maxillomandibular relationship after treatment (Table 7). This fact may have occurred because the experimental group exhibited a more severe discrepancy in the maxillomandibular relationship at pretreatment.

Vertical Component

This study demonstrated that Jasper Jumper appliances do not change the craniofacial growth pattern (Table 6). The growth pattern remained relatively stable in both groups.

Previous findings indicate that the Jasper Jumper may induce vertical changes and clockwise mandibular rotation^{4,17-19,21,29}, however, other studies did not show significant changes on growth pattern^{1,16,20,22}, confirming the results of the present study.

A significant increase in the lower anterior face height (LAFH) was observed in the experimental group (Table 7). The LAFH was significantly greater in patients treated with Jasper Jumper when compared to the control group.

The LAFH was greater (but not statistically significant) in the experimental group at T1 and had a significantly greater increase during treatment when compared to the control group.

Maxillary Dentoalveolar Component

The amount of changes in the maxillary dentoalveolar component were similar in both groups. None of the variables that described this compo-

nent exhibited significant differences between experimental and control groups (Table 6).

Retrusion of the upper incisors was not observed in the experimental group. However, other previous studies related significantly maxillary incisor retrusion during Jasper Jumper therapy^{4,17-19,21,29,30}. Perhaps, the greater maxillary retrusion of the experimental group when compared to the control group influenced the positioning of the NA line and, consequently, the linear evaluation of the maxillary incisor²¹. Some studies also verified no significant retrusion and palatal tipping of maxillary incisors after treatment with Jasper Jumper and fixed appliances^{5,22,26}. Besides, the lack of maxillary incisor tipping changes may be attributed to the anterior torque incorporated in the Roth pre-adjusted brackets²¹.

Some other authors found significant extrusion of maxillary central incisors and intrusion of upper first molars in patients treated with Jasper Jumper appliance^{4,5,17,19}, however, this was not confirmed in this research. Perhaps, the transpalatal arch may have inhibited maxillary molar intrusion. The present study demonstrated a greater extrusion of maxillary incisors of 1.5 mm in the experimental group when compared to the control group (Table 6).

There were not significant inter-group differences in mean values obtained for the variables that described the maxillary dentoalveolar component after treatment (Table 7).

Mandibular Dentoalveolar Component

The mandibular incisors presented more buccal inclination during treatment with the Jasper Jumper, but the differences between experimental and control groups were not statistically significant (Table 6). However, after treatment the mandibular incisors were more proclined in the experimental group than in the control group (Table 7).

The present findings regarding mandibular incisor inclination after treatment with Jasper Jumper appliance agree with previous reports²¹.

Probably, the tendency of mandibular incisor proclination during treatment was minimized due to the anterior lingual crown torque placed in the mandibular arch wire^{14,19,22}. Covell Jr et al.⁵ observed mandibular incisor proclination after fixed appliances removal. Thus, the author stated that fixed appliances do not improve mandibular incisor inclination. Stucki and Ingervall²⁶ noted a significant incisor proclination during Jasper Jumper therapy, however, the authors verified some incisor uprighting after appliance removal. According to the authors, only 30% of incisor proclination that occurred during Jasper Jumper treatment remained after fixed appliances removal²⁶. The residual effect of the treatment consists in moderate mandibular incisor proclination. In the present study, this phenomenon may also have occurred due this natural tendency of relapse in incisors inclination²⁶.

The mandibular incisors were significantly protruded during treatment (Table 6). After treatment, mandibular incisors were more protruded in the experimental group (Table 7). These findings are in line with previous reports^{1,4,5,16-19,21,22,26,29,30}.

Vertical development of mandibular incisors was inhibited during treatment, with significant differences between experimental and control groups (Table 6). The intrusion of mandibular incisors occurred because the Jasper Jumper appliances apply downward and forward forces to the mandibular dentition¹⁷. Mandibular incisor intrusion during Jasper Jumper treatment was also reported by some authors^{4,5,17,18,20,26,30}.

The experimental group exhibited statistically significant greater extrusion of mandibular molars during treatment (Table 6). However, after treatment, the mandibular molars in the experimental group were not more extruded than in the control group (Table 7).

The mandibular molar extrusion noted in the experimental group during treatment was expected because previous reports also described these effects after Jasper Jumper therapy^{4,5,17-19,26,29,30}.

Dental Relationships

During treatment, the experimental group (Jasper Jumper) exhibited significant decreases in overbite and overjet and significant molar relation improvement, when compared to the control group (Table 6).

The overjet correction using Jasper Jumper appliances was previously reported^{4,5,17-21,26,29,30}.

In the experimental group, the overjet correction was obtained due to restriction of forward displacement of the maxilla, mandibular incisor protrusion and mandibular normal growth.

The pretreatment overbite was similarly increased in both groups at T1, however, after treatment with the Jasper Jumper, the patients that comprised the experimental group exhibited significant decreases in the overbite, resulting in its normalization. The mandibular incisor intrusion may have contributed to overbite correction in the experimental group^{20,29,30}. Besides, the mandibular molar extrusion during treatment may also have contributed to overbite correction.

At T2, the control group exhibited significantly greater overjet and overbite (Table 7). The molar relation was significantly better in the experimental group (Table 7). These results were expected because both groups exhibited Class II malocclusion at pretreatment, but only the experimental group had the molar relation corrected by Jasper Jumper appliances. Consequently, there were overjet and overbite decreases.

CLINICAL CONSIDERATIONS

The present study has shown that the Jasper Jumper is an efficient protocol to Class II, division 1 malocclusion correction. The results revealed that the appliance corrected Class II discrepancies mostly through dentoalveolar changes^{1,4,5,16-18,20,22}. Because of its predominantly dentoalveolar effects, the Jasper Jumper can also be used in non-growing Class II patients^{18,21}.

The inter-group comparisons showed that the Jasper Jumper therapy resulted in significant

retrusion and forward growth restriction of the maxillary complex and other significant dentoalveolar changes. The mandibular incisors were significantly protruded and mandibular molars were extruded during treatment. Based on the current results, it can be inferred that Jasper Jumper appliances should be mainly indicated in Class II malocclusions presenting maxillary protrusion.

The treatment planning consists in one of the most important phases during an orthodontic approach. The numerous studies that evaluated the effects of different appliances must be used to help clinicians in the decision of which treatment protocol would be more adequate for specific malocclusions.

CONCLUSIONS

In comparison to the control group, the Jasper Jumper group presented a greater restriction of the anterior displacement of the maxilla and a greater maxillary retrusion, improvement of the maxillomandibular relationship, reduction of the facial convexity, greater protrusion and intrusion of the mandibular incisors and greater extrusion of mandibular molars, apart from a greater reduction of overjet and overbite and greater improvement of the molar relationship.

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Evaluation of the mesiodistal angulations of lower canines, pre-molars and molars with and without lower third molars

Rodrigo Castellazzi Sella*, Marcos Rogério de Mendonça**, Osmar Aparecido Cuoghi**

Abstract

Objectives: The purpose of the present research was to compare the normal average values of the mesiodistal axial angulation, proposed by Ursi in 1989, with the mesiodistal axial angulation of canine teeth, pre-molars and lower molars in individuals with and without the presence of the third lower molars and ages between 18 and 25 years. Additionally, the values of the mesiodistal axial angulation of these teeth were compared in these two situations. **Methods:** Forty panoramic x-rays were used from individuals of both sexes who had not received orthodontic treatment. These subjects were divided into two groups: Group I, containing 20 x-rays that didn't present third lower molars and Group II, formed of 20 x-rays with the presence of the third lower molars. **Results and Conclusions:** Through statistical analysis of the results, it was concluded that both Groups exhibited lower pre-molars and molars with enhanced angulation in the mesial direction, when compared to normal occlusion. On the other hand, the mesiodistal axial angulation of lower canine teeth was shown to be similar to the angulation presented in cases of normal occlusion. The two Groups, when compared together, exhibited similar angular values of the canine teeth, pre-molars and lower molars, indicating that the presence of the third molars didn't exercise an influence on these dental angulations.

Keywords: Third molar. Panoramic radiography. Dental angulation. Tooth movement.

INTRODUCTION

Throughout orthodontic history, different ways of obtaining the correct angulation of teeth at the end of orthodontic treatment have been used. Initially, angulations were obtained with artistic bends in the wires, followed by solder-

ing angulated brackets to the bands, according to Holdaway¹³ and ending with the most recent evolution for achieving this purpose in Orthodontics: completely preadjusted brackets developed by Andrews², which have built-in necessary requirements for obtaining the "six keys for normal oc-

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clusion,” disposing, in most cases, of the majority of archwire bends.

The constant search for the appropriate mesiodistal angulation of teeth occurred because tooth positioning is an extremely important factor for the stability of the stomathognathic system by optimizing occlusal forces in normal function^{21,22}.

In this sense, the anterior force component is intimately related to well defined contact points, dependent of a correct axial angulation and of the occlusal relationship of one tooth against two teeth. Therefore, the appropriate axial angulation should be included in the orthodontic treatment objectives, because an accurate angulation is directly related to dental alignment, apart from being a determinant factor for long term maintenance of the results reached with treatment^{8,11}.

The orthopantomograph, commonly known as panoramic x-ray constitutes an auxiliary diagnostic method, allowing the visualization of a series of anatomical structures and relevant factors for dentistry, in a manner that its denomination suggests a general panoramic view of the stomatognathic system. The simplicity in equipment operation and the increased amount of information obtained, combined with patient comfort and minimal amount of exposure to radiation, makes the panoramic x-ray an instrument well used in dentistry, and especially in orthodontics, which developed methods to use them for the evaluation of mesiodistal angulations of teeth^{26,28}.

On the other hand, the third molars are being a very discussed subject in dentistry. Robinson (1859, apud Southard²³) affirmed that the irregularities in tooth positioning are, frequently, the result of the pressure exerted by the third molars. Ever since, these teeth have generated a lot of controversies, in the clinical-scientific context, as for the most appropriate procedure when they are present.

There are two theories concerning the development of the third molars. The first and older

theory, affirms that these teeth are capable of causing interferences, generating certain irregularities in the positioning of the adjacent teeth^{3,15,16,29}. However, the second theory defends the fact that the third molars do not have the capacity to provide so many harmful effects^{1,14,18,19,20,23,24,30}.

Despite the great number of studies on this subject, there are many uncertainties regarding the appropriate treatment of the countless situations and if the presence of the third molars is capable of causing alterations in the position of other teeth.

In this context, there is a shortage of publications that relate the possible variation that the presence or absence of third molars can cause in the mesiodistal angulation of the adjacent teeth, which motivated the elaboration of the present research.

Third molars

The literature review regarding the presence, the development and the influence of the third molars demonstrates several controversies because there are two distinct reasoning lines that concern the development of these teeth.

In 1989, Richardson¹⁹ inferred that the pressure exerted in the posterior area and the presence of the third molar can constitute the cause of late crowding in the lower arch, but she explained that there are other etiological factors involved. Five years later, the same author explained that late mandibular growth, maturation of the soft tissues, periodontal forces, dental and skeletal structures, as well as, occlusal factors and growth pattern are the multifactorial essence for the alteration of the position of lower teeth²⁰.

The prevalence of the idea involving the influence of third molars on the position of adjacent teeth was evidenced in a study by Laskin.¹⁵ In a research with more than 600 orthodontists and 700 dental surgeons, he concluded that 65% of the professionals shared the opinion that the third molars can produce lower anterior crowding.

MESIODISTAL ANGULATION

Orthodontic treatment objectives depend on some factors and among them is the correct mesiodistal angulation of teeth, described by Andrews in his classic article² published in 1972. The long axis of teeth, when correctly positioned, supply appropriate conditions to reach occlusal balance and is an important requirement for obtaining stable results generated by the treatment^{9,12}.

Therefore, the search for dental mesiodistal angulations similar to those of “normal” occlusion is due to the fact that this occlusion presents harmony between the stomathognathic system components²⁸. In these cases, the long axis of teeth come, in agreement with its location in the arch, with the roots distally angulated in different levels². The space for each tooth varies according to these angulations, which generate tight interdental contacts, as well as, an harmonic relationship in the anteroposterior direction².

Ursi's²⁸ 1989 research evaluated a sample of 42 young Brazilian adults with “normal” occlusion, leukoderms, with ages between 12 and 17 years. The panoramic x-ray was described as a reliable method for obtaining angular measurements and a pattern for the axial mesiodistal angulations was established.

On the other hand, considering the dynamics of the stomathognathic system, the occlusal forces should be directed towards the long axis of the teeth²⁵. A portion of these forces is eliminated by the anterior component, beginning in the posterior teeth^{8,11}. Complete neutralization happens exactly in the midline, with the force coming from the opposite side of the arch¹¹. An appropriate dissipation of the occlusal forces depends on the dental angulations and on the inclined planes of the occlusal surfaces^{8,11,21}.

When the mesiodistal angulations are inadequate, there is an increased possibility of space reopening of orthodontically closed spaces, due to the incorrect root parallelism^{9,12,13,25}. The increase in these angulations can, still, compensate certain

dental size discrepancies between arches and optimize the alignment stability of lower anterior teeth²⁷.

As for the stability of tooth position obtained by orthodontic treatment and relapse, Ferrario et al.¹⁰ explained that changes in dental angulation related to age can be an effect of a progressive mesial displacement.

The search for clinically obtaining the correct mesiodistal axial angulation involved since alterations in bracket positioning^{13,22}, to building in these changes in the bracket^{5,22}. Researches that compared the effectiveness of techniques⁴, investigations concerning the mesiodistal position of permanent upper incisors in the mixed dentition phase⁶, and studies that evaluated the achievement of correct axial angulations comparing it at the beginning and at the end of treatment¹⁷, enforce the importance of the subject.

However, this important factor involved with occlusal stability is little discussed regarding the possibility of alterations related to the presence of third molars, which was the fact that motivated the development of this research.

PROPOSITION

The purpose of this research is to compare the normal mean values of the dental mesiodistal angulation, proposed by Ursi²⁸, to the mesiodistal angulation of lower canines, pre-molars and molars in individuals with and without lower third molars, as well as to compare the values of the mesiodistal angulation of lower canines, pre-molars and molars in those two clinical situations.

MATERIALS AND METHODS

For this study, the sample consisted of 40 panoramic x-rays of Brazilian subjects with a mean age of 22.35 years, range 18-25, that had not received orthodontic treatment and presented all teeth, except for the 20 patients that were missing their third molars due to agenesis. The x-rays were distributed into two groups; Group I consist-

ing of 20 x-rays with absence of the lower third molars due to agenesis (Figure 1), while Group II consisted of 20 x-rays with the presence of the lower third molars (Figure 2). Figures 1 and 2 presents panoramic radiographs of individuals from Groups I and II, respectively, and allow for visualization of both analysed conditions.

It is important to point out that all subjects presented malocclusions. In Group I, 12 exhibited Class I malocclusion (six women and six men) and eight presented Class II malocclusion (five women and three men).

Considering the five Class II women, three exhibited a Class II, division 1 malocclusion and two presented a Class II, division 2 malocclusion. On the other hand, the three Class II men exhibited Class II, division 1 malocclusion.

Additionally, in Group II, 10 subjects presented Class I malocclusion (six women and four men) and the other half had a Class II malocclusion (four women and six men).

Considering the Class II women, two exhibited Class II, division 1 malocclusion and two presented Class II, division 2 malocclusion. On the other hand, evaluating the six Class II men, four exhibited Class II, division 1 malocclusion and only two presented Class II, division 2 malocclusion.

All the x-rays were obtained in the same x-ray unit (Rotograph Plus, Del Medical Imaging Corp, USA) and by a single operator.

Radiographs were traced using: Ultraphan® acetate paper with 21.0cm in length and 14.5cm in width and thickness of 0.07mm, transparent adhesive tape, mechanical pencil with a 0.5mm lead, soft white eraser and a millimeter ruler.

During selection of x-rays for Group II, it was established that the third molars should present root development at least in the F development stage according to Demirjian et. al.⁷ (root length equal to the crown length - 1:1 proportion). This stage was chosen because the tooth presents great part of its root development and high eruption potential, apart from sample quantification and standardization for Group II.

To determine the 1:1 minimum proportion between root and crown length, first a line was drawn in the lower third molar occlusal area joining the mesial and distal cusps. Then the mesial and distal limits were established, perpendicular to the occlusal plane and the long axis of the tooth was also perpendicular to the occlusal plane, crossing the midpoint of the mesiodistal width of the crown. According to the definition of the D development stage by Demirjian et. al.⁷, the crown reaches its complete formation when the cemento-enamel junction is formed. In this way, the determination of the cemento-enamel junction and root limits, parallel to the occlusal plane, allowed the measurement of the crown and root lengths along the long axis (Figure 3).

The crown and root lengths were measured



FIGURE 1 - Panoramic x-ray belonging to Group I (without lower third molars).



FIGURE 2 - Panoramic x-ray belonging to Group II (with lower third molars).

directly on the x-rays, with a digimatic caliper, Mitutoyo Sul Americana Ltda, with certificate 500-143B.

A sheet of acetate paper with 21.0cm in length and 14.5cm in width and 0.07mm thickness was placed over each x-ray. The dentoalveolar and skeletal structures drawn on the x-rays, according to Tavano et al.²⁶, were the external mandibular contour, mental foramen and the contours of the lower canines, pre-molars and molars. Later, the central points of the right (rMF) and left mental foramen (lMF) were marked.

The intermental line (IM) was the reference used to perform the angular measurements of the lower teeth in the panoramic x-rays, which, according to Tavano et al.²⁶ should pass through the center of the mental foramina (Figure 4).

To determine the long axes of the single-rooted teeth (canine, first and second pre-molars), the longest image of the root canal was used, while the long axes of the double-rooted teeth (first and second molars) followed the average image of the mesial and distal root canals, according to Ursi et al.²⁸ (Figures 4 and 5).

The angles formed by IM and the long axis of the teeth (Figure 3) were:

$\hat{A}_{33}$ and $\hat{A}_{43}$ – angles formed by the intersection of the long axes of the lower left and right canines, respectively, with the intermental line.

$\hat{A}_{34}$ and $\hat{A}_{44}$ – angles formed by the intersection of the long axes of the lower left and right first premolars, respectively, with the intermental line.

$\hat{A}_{35}$ and $\hat{A}_{45}$ – angles formed by the intersection of the long axes of the lower left and right second premolars, respectively, with the intermental line.

$\hat{A}_{36}$ and $\hat{A}_{46}$ – angles formed by the intersection of the long axes of the lower left and right first molars, respectively, with the intermental line.

$\hat{A}_{37}$ and $\hat{A}_{47}$ – angles formed by the intersection of the long axes of the lower left and right second molars, respectively, with the intermental line

The tracings were made by the researcher and checked by two other professionals. Then the tracings were digitized with a scanner and the angles $\hat{A}_{43'}$, $\hat{A}_{33'}$, $\hat{A}_{44'}$, $\hat{A}_{34'}$, $\hat{A}_{45'}$, $\hat{A}_{35'}$, $\hat{A}_{46'}$, $\hat{A}_{36'}$, $\hat{A}_{47'}$ and $\hat{A}_{37'}$ formed by the intersection of the long axes of the teeth with the intermental line¹³ were determined using an AutoCAD program.

Statistical analysis

The means were independently compared between the Groups, in other words, Group I x Con-

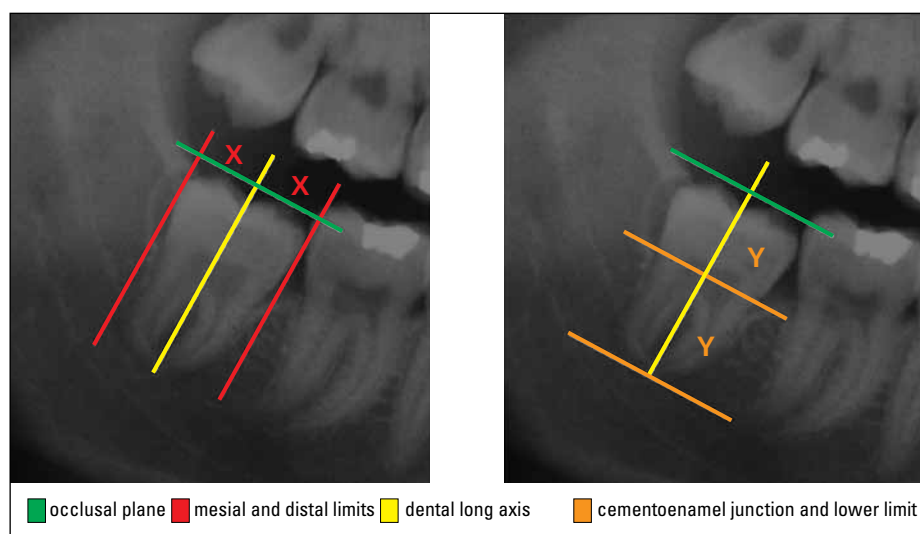


FIGURE 3 - Method used for selection of the x-rays with the presence of lower third molars (Group II).

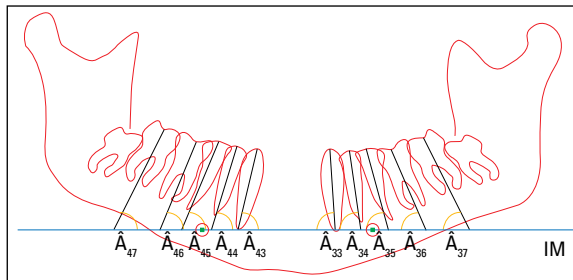


FIGURE 4 - Tracing depicting points rMF and IMF, as well as the intermental line (IM) and the dental long axes of Group II (with lower third molars).

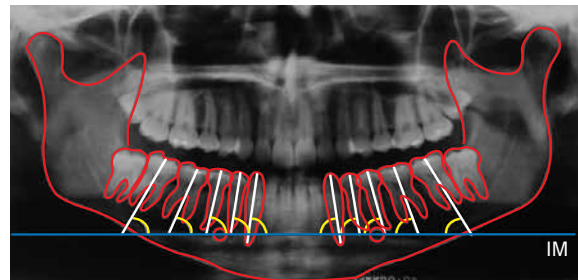


FIGURE 5 - Panoramic X-ray from Group II (with lower third molars) with a tracing that delimits dentoalveolar and skeletal structures, points rMF and IMF, the intermental line (IM), long axes of the teeth and angles formed by the intermental line and the long axes of the teeth.

trol Group, Group II x Control Group and Group I x Group II. For this comparison, the Student "t" test was used with a significance level established at 5%.

Method of error assessment

The error of the method was verified by the random selection of 10 panoramic x-rays from Group I and 10 panoramic x-rays from Group II that were drawn and measured twice by the same operator at different times. With this repetition, random and systematic errors were obtained.

The random error was determined by the Dahlberg formula: $S_e^2 = \sum d^2 / 2n$, while the systematic error was determined by the Student's "t" test.

RESULTS

Previously to the specific results of the research, Tables 1 and 2 demonstrate the data used to establish the possibility of a method error.

Considering the investigation of Pedrin et al.,¹⁷ the Dahlberg values were recognized as significant when above 1.5 degrees.

The analysis of Tables 1 and 2 confirms that the results obtained with the method used in this study were shown to be within acceptable parameters, therefore, it did not compromise the reliability of our conclusions.

Tables 3 and 4 provide the mean values and standard deviations obtained for canines, pre-mo-

lars and molars in Groups I and II, respectively, while Table 5 presents the means of Groups I, II and Control Group.

Tables 6 and 7 exhibit the normal mean values of each tooth, extracted from Ursi,²⁸ and used in this research as the Control Group values, as well as the means of the values obtained in Groups I and II, and their p values.

Finally, Table 8 presents the angular value means for each tooth and the comparison of the values obtained for Groups I and II, as well as the p values, considering any value of $p < 0.05$ as being statistically significant.

DISCUSSION

The present research was concerned in evaluating not only the angular positioning of the first and second molars, pre-molars and canines, but also in enlarging the knowledge regarding the occlusion, independent of the treatment accomplishment.

The third molars seem to exert influence on the development of the dental arches, which doesn't justify the removal of the dental germ or extraction of this tooth, unless in exceptional circumstances³.

The possibility of the third molars to cause alterations to the other teeth and the doubt about different dental angulations involving individuals with and without lower third molars motivated

TABLE 1 - Means and standard deviations of the differences, "t" values (systematic error), p values and Dahlberg values (casual error) obtained in Group I (with lower third molars).

TOOTH	MEAN	s.d.	t	P	DAHLBERG
47	0,87	0,48	-4,02	0,99	0,98
46	1,05	0,59	-2,34	0,98	1,43
45	0,88	0,76	-2,53	0,98	1,31
44	1,13	0,39	-2,93	0,99	1,42
43	0,92	0,47	-3,83	0,99	1,05
33	1,03	0,55	-2,64	0,99	1,34
34	1,06	0,49	-2,75	0,99	1,36
35	1,03	0,60	-2,45	0,98	1,39
36	1,05	0,56	-2,52	0,98	1,38
37	0,95	0,34	-5,03	0,99	1,01

TABLE 2 - Means and standard deviations of the differences, "t" values (systematic error), p values and Dahlberg values (casual error) obtained in Group II (with lower third molars).

TOOTH	MEAN	s.d.	t	P	DAHLBERG
47	0,95	0,34	-5,03	0,99	1,01
46	0,93	0,62	-2,84	0,99	1,23
45	1,05	0,56	-2,52	0,98	1,38
44	1,06	0,49	-2,75	0,99	1,36
43	1,05	0,59	-2,34	0,98	1,43
33	1,13	0,39	-2,93	0,99	1,42
34	0,88	0,76	-2,53	0,98	1,31
35	1,03	0,60	-2,45	0,98	1,39
36	0,92	0,47	-3,83	0,99	1,05
37	0,87	0,48	-4,02	0,99	0,98

TABLE 3 - Means and standard deviations of the mesiodistal angulations of lower canines, pre-molar and molars for Group I (without lower third molars).

TOOTH	PANORÂMICO X-RAYS (n)	MEAN	s.d.
47	20	58,72	5,15
46	20	65,36	5,50
45	20	75,73	4,11
44	20	82,14	4,65
43	20	87,96	5,69
33	20	84,60	5,77
34	20	82,28	4,19
35	20	73,58	4,26
36	20	67,24	4,93
37	20	60,93	5,70

TABLE 4 - Means and standard deviations of the mesiodistal angulations of lower canines, pre-molar and molars of Group II (with lower third molars).

TOOTH	PANORÂMICO X-RAYS (n)	MEAN	s.d.
47	20	61,63	7,45
46	20	68,06	6,09
45	20	73,89	5,33
44	20	81,67	3,49
43	20	85,76	3,44
33	20	84,84	5,70
34	20	82,14	4,66
35	20	73,49	5,85
36	20	68,97	6,61
37	20	62,79	7,93

the elaboration of this investigation.

First, the values obtained in Groups I and II were compared individually with the normal mean values from Ursi²⁸, which were used as a Control Group.

Additionally, in accordance to the method used, smaller angular values than those shown by the Control Group represent a situation of accentuated crown angulation in mesial direction.

The results of the comparison among angular values from Groups I and Control demonstrated that there is a statistically significant difference ($p < 0.05$) for pre-molars and molars (Graph 1).

In a similar way, the angular values regarding Group II, when compared to the Control Group, exhibited a statistically significant difference ($p < 0.05$) for pre-molars and molars (Graph 2).

In both Groups I and II, the angles obtained

TABLE 5 - Means of the mesiodistal angulations of lower canines, pre-molars and molars of Groups I, II and Control.

TOOTH	MEAN GI	MEAN GII	MEAN CONTROL GROUP
47	58,72	61,63	74,92
46	65,36	68,06	82,64
45	75,73	73,89	88,47
44	82,14	81,67	86,42
43	87,96	85,76	88,02
33	84,60	84,84	86,11
34	82,28	82,14	85,57
35	73,58	73,49	88,69
36	67,24	68,97	85,50
37	60,93	62,79	76,92

TABLE 6 - Normal mean values (Control Group) for the mesiodistal angulations of each tooth individually, mean values obtained in Group I (without lower third molars) and p values.

TOOTH	MEAN CONTROL GROUP	MEAN GI	P
47	74,92	58,72	0,0001*
46	82,64	65,36	0,0001*
45	88,47	75,73	0,0001*
44	86,42	82,14	0,0001*
43	88,02	87,96	0,95
33	86,11	84,60	0,25
34	85,57	82,28	0,0001*
35	88,69	73,58	0,0001*
36	85,50	67,24	0,0001*
37	76,92	60,93	0,0001*

*Statistically significant difference $p < 0.05$

TABLE 7 - Normal mean values (Control Group) for the mesiodistal angulations of each tooth individually, mean values obtained in Group II (with lower third molars) and p values.

TOOTH	MEAN CONTROL GROUP	MEAN GII	P
47	74,92	61,63	0,0001*
46	82,64	68,06	0,0001*
45	88,47	73,89	0,0001*
44	86,42	81,67	0,0001*
43	88,02	85,76	0,02
33	86,11	84,84	0,32
34	85,57	82,14	0,0001*
35	88,69	73,49	0,0001*
36	85,50	68,97	0,0001*
37	76,92	62,79	0,0001*

*Statistically significant difference $p < 0.05$

TABLE 8 - Mean values obtained in Group I (without lower third molars), mean values obtained in the Group II (with lower third molars) and p values.

TOOTH	MEAN GI	MEAN GII	P
47	58,72	61,63	0,15
46	65,36	68,06	0,14
45	75,73	73,89	0,22
44	82,14	81,67	0,89
43	87,96	85,76	0,14
33	84,60	84,84	0,89
34	82,28	82,14	0,92
35	73,58	73,49	0,95
36	67,24	68,97	0,35
37	60,93	62,79	0,40

*Statistically significant difference $p < 0.05$.

were smaller than those exhibited by the Control Group. It can be inferred that in Class I and Class II malocclusions that either do or do not present third molars, the pre-molars and molars present their crowns more angulated in the mesial direction then when compared to a normal occlusion.

Considering that orthodontic cases should

present the same mesiodistal angulation as in normal occlusion which is a goal at the end of treatment²⁸, it can be affirmed that the axial mesiodistal angulation of lower pre-molars and molars should receive special attention at the end of the treatment. This is because, as the results of this research indicate, the angular values observed in

malocclusions were smaller in relation to the normal occlusion.

It demonstrates that in a large part of the orthodontic treatments, the posterior teeth, pre-molar and molars, need a less angulated positioning. However, this alteration in the position of the posterior segment can provide an increase of the vertical dimension, in this manner, demanding a more complex evaluation of the effects that this change can cause in the individual facial pattern.

This situation is evident when Graphs 1 (Group I) and 2 (Group II) are observed.

However, when the means of the mesiodistal angulation of lower canines, pre-molars and molars in the presence (Group I) and in the absence (Group II) of lower third molars were compared (Graph 3), there were no differences between Groups.

Considering the results and the statistical analysis, it can be observed that individuals who presented malocclusion and did not receive orthodontic treatment presented lower pre-molars and molars with increased angulation in the mesial direction, independent of the presence of the lower third molars.

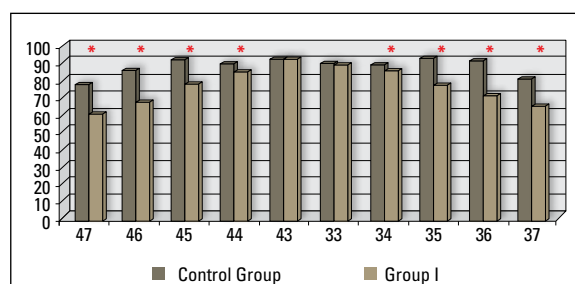
The correction of pre-molar and molar angulation during orthodontic treatment should be established as one of the requirements for the correction of malocclusions, apart from the presence of third molars.

The reduced angular values, corresponding to the accentuated mesial crown angulation found in the Groups I and II, can be related to other factors inherent to the malocclusion. These other factors include a deep curve of Spee, an influence of the anterior component of forces carried out by the functional vectors and dental wear. The evidences presented in this work demonstrate that the third molars exert little or no influence in the mesiodistal angular positioning of the lower canines, pre-molars and molars.

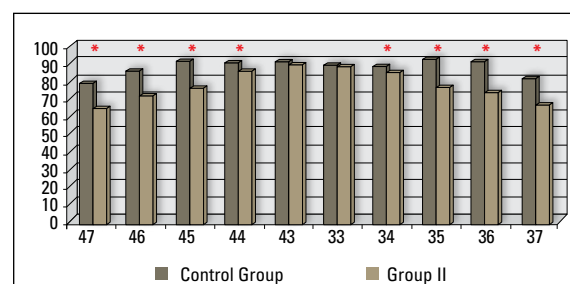
Considering the two lines of thought that involve the development of the third molars, the results of this research corroborate with the more recent theory^{1,14,18,19,20,23,24,30}, agreeing that third molars do not present the capability to provide all the harmful effects that the older theory suggests^{3,15,16,29}.

The etiology of these alterations is multifactorial and involves the dynamics of the stomatognathic system, as the anterior component of forces³⁰ and the presence of correct interdental contacts¹⁶.

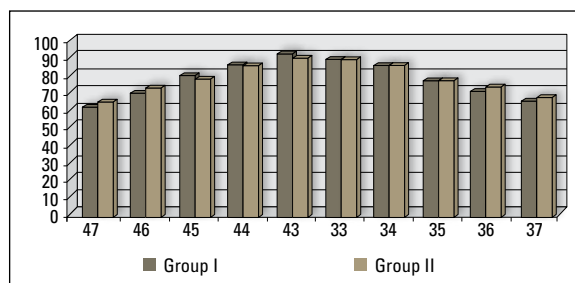
As an objective of this research, normal mean pattern of the mesiodistal angulations of lower canines, pre-molars and molars were compared to the values of these angulations in individuals that presented (Group I), as in those that did not exhibit (Group II) lower third molars. Additionally, this research compared the values of these two



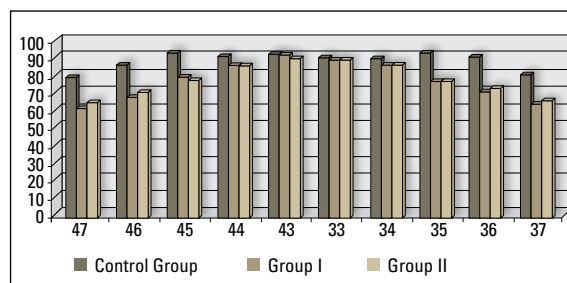
GRAPH 1 - Means of the mesiodistal angulations of Groups I and Control.
* Statistically significant difference $p < 0.05$



GRAPH 2 - Means of the mesiodistal angulations of Groups II and Control.
* Statistically significant difference $p < 0.05$.



GRAPH 3 - Means of the mesiodistal angulations of Groups I and II.



GRAPH 4 - Means of the mesiodistal angulations of Groups I, II and Control.

Groups between themselves. The similarity of the values between the Groups and the difference of these values in relation to the normality pattern, presented in Graph 4, endorses the previous statements.

Considering the similarity between the mesiodistal angulation of lower canines, pre-molars and molars, of subjects with and without lower third molars, the results of this study suggest that the professional does not have to worry with the presence of these teeth, because they do not constitute a factor capable to alter them.

Individuals with Class I and Class II malocclusions did not exhibit pre-molar and molar angulations similar to those with normal occlusion.²⁸ These teeth presented smaller values, or in other words, they exhibited crowns more angulated in the mesial direction when compared with the normality pattern.

The canines did not suffer an influence of the malocclusion from the third molars. Therefore, according to the present study, the canines present mean values similar to the normality pattern.

CONCLUSIONS

Groups I and II, with and without lower third molars, composed of individuals that had never received orthodontic treatment and presented malocclusion, when compared to a Control Group of normal occlusion, showed:

- Lower pre-molars and molars more angulated in the mesial direction.
- Lower canine teeth with similar mesiodistal angulations.

The two appraised Groups presented similar values of mesiodistal angulations for the lower canines, pre-molars and molars so that:

- The presence of the third molars did not exert an influence on these dental angulations.
- The largest mesiodistal angulation of lower pre-molars and molars of both Groups suggests that this is a characteristic related to the factors inherent to malocclusion with very little involvement of the third molars.

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Evaluation of dental changes in the maxilla of patients submitted to surgically-assisted rapid maxillary expansion without pterygomaxillary suture involvement*

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Abstract

Objective: to evaluate transverse changes in the maxillary dental arch and the amount of tipping of the anchoring teeth caused by the Hyrax expansion appliance in patients submitted to surgically-assisted rapid maxillary expansion (SARME), as well as the effectiveness of this surgical technique. The sample consisted of 34 pairs of plaster cast models of 17 patients, 6 male and 11 female. Methods: measurements of the changes in the vertical and transverse planes were taken in plaster cast models. The surgical procedure performed was an osteotomy on the lateral maxillary walls without pterygoid plate involvement, osteotomy from the nasal spine to the dental midline (upper central incisors), separation of the midpalatal suture using a chisel, and nasal septum separation. Activations were initiated on the third day post-surgery, once in the morning and once at night. Results: there was a statistically significant expansion – 6.03mm, 9.82mm, 8.66mm, 9.72mm and 5.67mm, in the canine, first and second pre-molar areas, respectively. When the amount of crown tipping was evaluated for the anchoring teeth, an asymmetrical buccal tipping was observed, since the values found for first molars were 6.89° (right) and 9.56° (left), while the values for first pre-molars were 4.74° (left) and 3.26° (right) – the latter being considered statistically non-significant. Conclusions: the surgical technique applied in this study proved to be effective in achieving maxillary transverse change, resulting in dentoalveolar tipping of the appliance anchoring teeth.

Keywords: Maxillary expansion. Orthognathic surgery. Dental cast models.

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INTRODUCTION

Maxillary transverse changes leading to unilateral or bilateral posterior crossbites are responsible for several different occlusal problems. Achieving adequate maxillary transverse dimension is essential for a functional and stable occlusion. In the maxilla, proximity to skeletal maturity increases osseous interdigitation as result of the fusion of craniofacial sutures^{11,14}. This, in turn, makes it more difficult to separate the maxilla at the midpalatal suture if the procedure is performed using only orthopedic forces through rapid maxillary expansion (RMA). In such cases, a maxillary suture release by osteotomy is the chosen method to reduce bone resistance and make the maxillary transverse expansion effective.

In SARME, an osteotomy is performed on the structures that are resisting expansive forces. This procedure brings advantages such as skeletal expansion, absence of pain, reduced periodontal health risks, increased nasal air flow, cosmetic improvement in the buccal corridor, as well as avoiding tooth extractions to correct dental crowding^{15,16,18,20}.

The results obtained from surgical expansion show a significant increase in maxillary transverse width, with correction of posterior crossbite and reduction of palatal depth, minimizing the buccal tipping of posterior teeth^{13,16} that may have occurred with RMA.

Clinically, we can observe maxillary arch atresia or posterior crossbite in patients that require maxillary expansion, which can be corrected with treatment.

The objective of the present study was to analyze the effects of SARME (without separation of the pterygomaxillary suture), by using plaster cast models to determine any possible transverse changes and buccal tipping of the canines, first and second pre-molars, first and second maxillary molars, as well as the overall effectiveness of this surgical technique.

MATERIAL AND METHODS

The sample used in this study consisted of 34 pairs of plaster cast models from 17 patients, 6 male and 11 female, subjected to SARME. As exclusion criteria, patients could not feature congenital malformations or facial syndromes.

Patients were selected from the Graduate Program in Orthodontics at the Methodist University of São Paulo (Unesp), and from the Craniomaxillofacial Surgery Service of the Division of Plastic and Burn Surgery at the Central Institute of the University of São Paulo Medical School General Hospital (HCFMUSP).

For each patient, two pairs of models were prepared, obtained at different stages: T1 – initial (prior to the surgical procedure), and T2 – three months after the activation of the expansion appliance was ended.

The expansion appliance used was a Hyrax-type expansion appliance, built with a 13mm expansion screw (Morelli, Sorocaba / SP).

Each patient was subjected to general anesthesia and nasotracheal intubation. A Le Fort I osteotomy was performed on the maxilla, with separation of the central and lateral maxillary pillars without pterygomaxillary suture involvement. The midpalatal suture was separated, starting at the anterior nasal spine and between the central incisors over the alveolar bone. After the osteotomy, the Hyrax appliance was activated with the purpose of confirming maxillary separation, maintaining a 1-mm separation between the central incisors. Appliance activation took place on the third day post-op, with two daily activations – one in the morning (1/4 turn) and another at night (1/4 turn) – until reaching total screw opening or achieving occlusal objectives⁷ (Fig. 1).

Transverse and vertical measurements were made in plaster cast models placed in a three-dimensional manual measuring device, in which values were measured by shifting all three axes, X, Y and Z (Fig. 2). The measuring device was

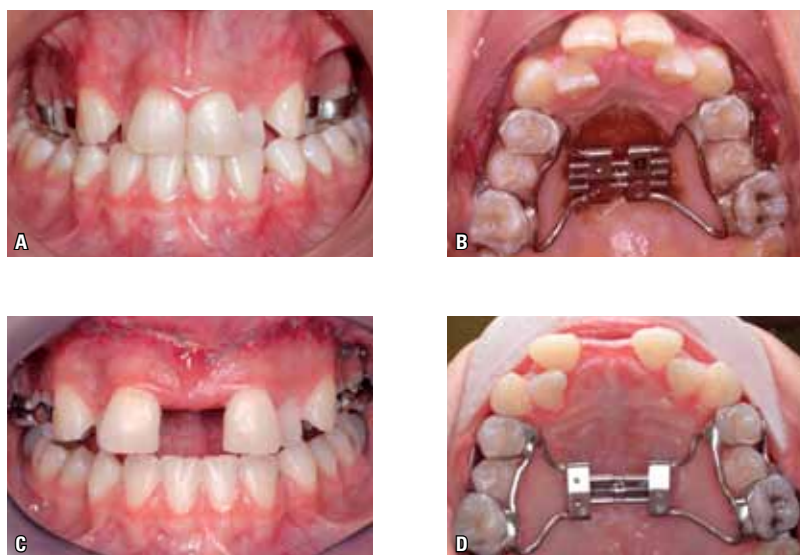


FIGURE 1 - **A, B)** Frontal and upper occlusal views of the Hyrax expansion appliance, placed with bands on the first maxillary molars and first pre-molars, with a buccal and palatal connecting arch between these teeth. **C, D)** Frontal and upper occlusal views of the expansion appliance after activation, demonstrating the expansion effect on the maxillary teeth.

developed on an aluminum platform, on top of which two 150-mm digital calipers were placed, forming a 90° angle (horizontal plane, X and Y axes), as well as a 50-mm Mitutoyo® analog sliding caliper (vertical plane, Z axis).

The reference points on the maxillary dental arches were determined on the maxillary plaster cast model of each patient, and reference points were set on the occlusal surface of teeth, as shown on figure 3.

Transverse measurements (X axis) had the objective of quantifying the changes occurred after the activation of the Hyrax expansion appliance. The measurements were taken after placing the plaster model on the three-dimensional measuring device, with the occlusal plane leveled by referencing the mesiopalatal cusps of the first molars and the incisal edges of the central incisors, thus measuring the linear distances between left and right teeth (Fig. 4).

For posterior teeth tipping, the horizontal (X axis) and vertical (Z axis) linear distances of the

buccal and palatal cusps of maxillary first molars and premolars were measured (Fig. 5, 6). The measurements were later computed in a mathematical formula to convert linear distances into degrees (Fig. 7). The horizontal measurements were placed over the X-axis, and vertical measurements were placed over the Z-axis, as shown on figure 6.

Once the desired measurement was obtained, the mathematical formula illustrated on figure 7 was applied, with the purpose of determining the amount of tipping of each tooth in periods T1 and T2. A positive value was attributed to buccal tipping, while palatal tipping received a negative value.

RESULTS

To verify the effects obtained from the treatment, Student's t-test was applied, at a 5% significance level ($p < 0.05$) for paired data, as shown on tables 1 and 2. Method error was evaluated by applying Dahlberg's formula.

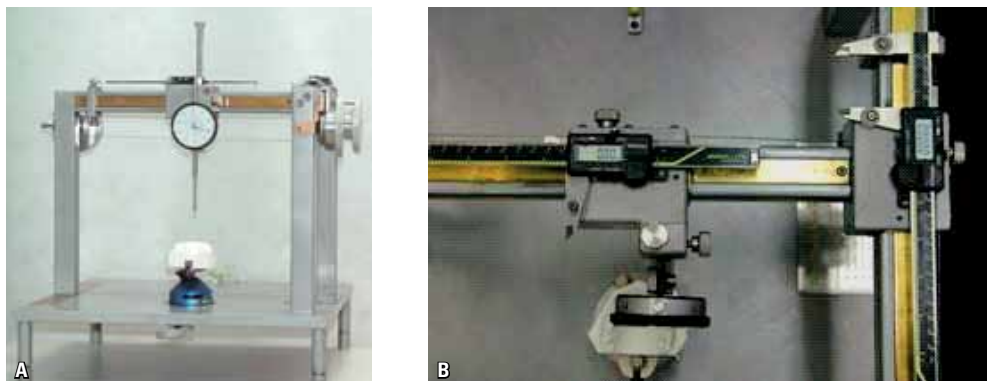


FIGURE 2 - Three-dimensional measuring device developed at Umesp. **A)** frontal view, showing the vertical measurement clock (Z-axis), and **B)** upper view, showing the two digital calipers for transverse (X-axis), and anteroposterior (Y-axis) measurements.

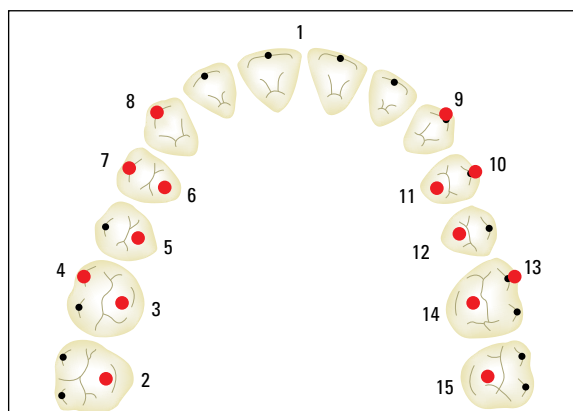


FIGURE 3 - Linear distances: distance between canines – linear distance, in mm, obtained between points 8 and 9; distance between first pre-molars – distance obtained between points 6 and 11; distance between second pre-molars – distance obtained between points 5 and 12; distance between first molars – distance obtained between points 3 and 14; distance between second molars – distance obtained between points 2 and 15.

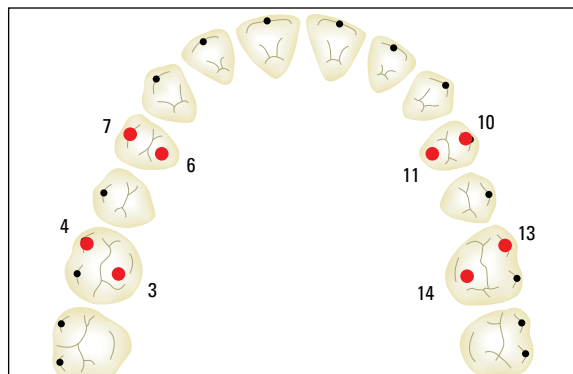


FIGURE 5 - Landmarks used to calculate the degree of dental tipping: Maxillary right first pre-molar – points 7 to 6; maxillary left first pre-molar – points 10 to 11; maxillary right first molar – points 4 to 3; maxillary left first molar – points 14 to 13.



FIGURE 4 - Transverse measurements performed on plaster cast models.

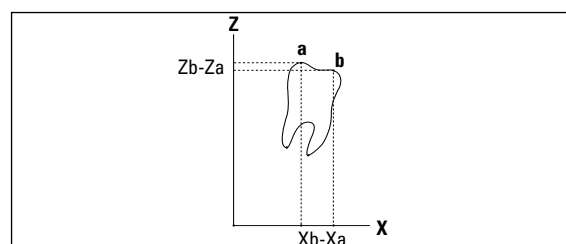


FIGURE 6 - Graph along Z and X coordinates, with Xa (buccal cusp) and Xb (palatal cusp) in the horizontal plane and Za (buccal cusp) and Zb (palatal cusp) in the vertical plane.

$$\theta = \arctg\left(\frac{Z_b - Z_a}{X_b - X_a}\right) \cdot \frac{180}{\pi}$$

FIGURE 7 - Mathematical formula used to determine angular measurement.

Transverse measurements

Distance between maxillary canines

There was a statistically significant increase in the distances between left and right canines, as shown on table 1. The mean difference (T2 – T1) between the intervals was 6.03mm.

Distance between maxillary pre-molars

There was a statistically significant increase in the distances between first and second pre-molars, as shown on table 1. The mean difference (T2 – T1) between the intervals was 9.82mm for the first pre-molar and 8.66mm for the second pre-molar.

Distance between maxillary molars

There was a statistically significant increase in the distances between first and second molars, as shown on table 1. The mean difference (T2 – T1)

between the intervals was 9.72mm for the first molar and 5.67mm for the second molar.

Dental tipping

Tipping of the maxillary first molars

After measurement of the X and Z axes, as demonstrated on figures 5 and 6, and application of the mathematical formula in figure 7, it was possible to observe buccal tipping of the right and left first molars, resulting in statistically significant values, as shown on table 2. Mean observed variation was 6.89°, demonstrating buccal tipping of the right first molar. For the left first molar, mean buccal tipping observed was 9.56°.

Tipping of maxillary first pre-molars

The behavior of first pre-molars was not statistically similar, with a tendency for asymmetrical tipping. For right first pre-molars, the observed

TABLE 1 - Distance between teeth.

VARIABLES	T1		T2		T2 - T1		T	P
	Mean	s.d.	mean	s.d.	mean	s.d.		
distance between canines	29.85	2.53	35.87	2.41	6.03	1.27	-18.92	0.0000
distance between first pre-molars	25.51	2.59	35.33	2.82	9.82	1.48	-27.33	0.0000
distance between second pre-molars	30.96	3.32	39.62	4.62	8.66	5.30	-6.33	0.0000
distance between first molars	36.03	4.27	45.75	3.99	9.72	1.57	-24.74	0.0000
distance between second molars	43.39	4.14	49.07	4.68	5.67	2.40	-9.45	0.0000

* statistically significant difference (p < 0.05).

n.s. = statistically non-significant difference.

TABLE 2 - Buccal-lingual tipping.

VARIABLES	T1		T2		T2 - T1		T	P
	mean	s.d.	mean	s.d.	mean	s.d.		
right molar tipping	7.28	8.02	14.17	7.18	6.89	5.55	-5.12	0.0001
left molar tipping	4.01	9.48	13.57	9.45	9.56	9.08	-4.34	0.0005
right pre-molar tipping	-5.58	10.11	-2.32	7.97	3.26	6.96	-1.93	0.0715
left pre-molar tipping	-7.33	7.37	-2.58	7.68	4.74	3.98	-4.92	0.0002

* statistically significant difference (p < 0.05).

n.s. = statistically non-significant difference.

tipping was not considered statistically significant, as shown on table 2. However, buccal tipping measured on left first pre-molars proved to be statistically significant, as shown on table 2, with a variation of 4.74°.

DISCUSSION

Timms & Vero²¹ suggest that, in patients under 25, rapid maxillary expansion⁸ (RMA) should be attempted. However, the risk exists of failure in this type of treatment, and the high relapse rates in adults^{2,4,10,14,22} should also be considered.

The fusion of maxillary sutures is the main reason for this difficulty. Therefore, the surgical release of all maxillary sutures is reported in the literature as the most adequate choice of treatment; as affirmed by Betts et al.⁷, the release of the pterygoid process must be performed so that no limitation occurs in posterior maxillary expansion. Kennedy et al.¹² conducted studies in monkeys and concluded that the zygomatic pillar is the area that offers greater resistance to maxillary expansion; however, in order to basal maxillary movement occur, all maxillary pillars and sutures must be sectioned. Thus, the area for the osteotomy is still a subject of much debate and controversy. Based on literature findings that show the efficacy of expansion in patients submitted to maxillary osteotomies^{1,3,14,17}, the surgical technique selected for the present work did not involve separation of the pterygoid process during the osteotomy. The level of expansion obtained must be correlated to the level of buccal tipping in order to determine the efficacy of the surgical technique. Few studies correlate dentoalveolar expansion with tipping.

The amount of transverse change produced by SARME is effective in both the anterior and posterior regions of the maxilla^{1,3,6,9,14,17,19}. On table 3, the efficacy of this procedure can be evaluated, from other studies found in the literature.

A comparison of the results obtained in the present sample with those from other studies indicates that the level of expansion obtained was in

accordance with the findings in the literature, even though the surgical technique did not involve the osteotomy of the pterygomaxillary suture.

In evaluating the transverse change between the canines, the result obtained in the sample indicates a statistically significant increase in the distances between right and left canines. The mean found for the differences (T2 – T1) between intervals was 6.03mm. When compared with other findings, it can be observed that an important variation was obtained on the canines; since the variation between the analyzed studies was 4.1mm and 6.03mm, it demonstrates that regardless of the surgical technique employed, significant transverse variations were obtained for these teeth, even though they did not receive direct support through bands or wires.

The transverse distance between maxillary pre-molars showed a statistically significant increase. For first pre-molars, the mean between intervals was 9.82mm; for second pre-molars, 8.66mm. It can be observed that the variation was similar for first and second pre-molars, which shows that the second pre-molar followed the transverse movement that was produced. The 1.16mm difference between the first and second pre-molars is likely due to the absence of support from bands on the second pre-molars, which had palatal support (stainless steel wire). The values obtained in the literature were similar; however, Antilla et al.¹, and Byllof & Mossaz⁹ found the increase in transverse distance to be greater in the second pre-molar, as shown on table 3, which is different from the findings of this study and other studies in the literature.

When evaluating molar transverse distance, the mean variation between intervals found for first molars was 9.72mm and 5.67mm for second molars. The value found between first pre-molars and first molars was comparable; however, it must be mentioned these teeth were used as anchorage for the application of expanding forces and were also connected to the expansion screw by bands.

TABLE 3 - Comparison of articles that measured dental changes in patients subjected to SARME.

AUTHOR	OSTEOTOMY	CANINES	FIRST PRE-MOLARS	SECOND PRE-MOLARS	FIRST MOLARS	SECOND MOLARS
Anttila et al. ¹	osteotomy on lateral maxillary wall	4.1mm	6.8mm	7.2mm	7.2mm	5.1mm
Bays, Grecco ³	osteotomy on lateral maxillary wall	4.5mm	0	0	5.8mm	0
Berger et al. ⁶	Le Fort osteotomy with pterygomaxillary suture involvement	4.84mm	0	0	5.78mm	0
Byloff, Mossaz ⁹	Le Fort osteotomy with pterygomaxillary suture involvement	5.19mm	8.08mm	8.26mm	8.73mm	5.48mm
Northway, Meade ¹⁴	osteotomy on lateral walls	4.26mm	0	0	5.9mm	0
Schimming et al. ¹⁷	osteotomy on lateral walls	5.9mm	0	0	6.0mm	0
Stromberg, Holm ¹⁹	Le Fort osteotomy with pterygomaxillary suture involvement	5.0mm	0	0	8.3mm	0

Similar performance has been observed in other works. However, the amount of transverse change was noteworthy for the second molars, which responded with a lower variation also observed in other studies.

It can be suggested that such a variation is due either to the lack of an extension of the osteotomy over the pterygomaxillary suture or the lack of direct support on the second molars. In the work by Byloff & Mossaz⁹, who used a more invasive osteotomy, the result found for the second molar is similar to that obtained in the present sample. Thus, the osteotomy is likely not to be responsible for the lack of expansion in that area, due to the absence of band support in the second molars, which resulted in smaller transverse change. Comparing the measurements found for the canines (6.03mm) and second molars (5.67mm), a correlation is found between the obtained values, as both groups did not receive direct support from the expansion appliance during activation. This alteration may be the result of the change that took place over the maxillary bone only.

Regarding the tipping observed in the posterior teeth, the results exhibited an asymmetric behavior, in which the left teeth showed greater buccal tipping, which could be a trait of the analyzed sample. The method employed for this sample allows for the individual measuring of tipping endured for each tooth.

The changes in the left and right maxillary first molars were calculated in the T1 and T2 time intervals, with the purpose of quantifying the obtained movement. The values found were statistically significant, as shown on table 2. Mean observed variation was 6.89°, showing significant buccal tipping of the right molar. For the left molar, mean buccal tipping of 9.56° was observed. The results demonstrated an asymmetrical behavior for this group of teeth, teeth on the left side showed statistically greater buccal tipping, which could be a trait of the analyzed sample.

The changes found in the left and right maxillary first pre-molars at T1 and T2 time intervals were different, as shown on table 2. For the right side, the mean observed variation was 3.26°,

which was statistically non-significant. Buccal tipping in the left first pre-molars, however, was statistically significant, with a 4.74° change. Tipping in these teeth was also asymmetrical in regard to buccal movement of posterior teeth.

The sample demonstrated that there is effective transverse gain; however, there was buccal pendular movement of the crowns of teeth supporting the Hyrax appliance. First pre-molars and first maxillary molars showed the greatest transverse changes. The changes in these teeth are the added result of two effects: the expansive transverse movement that occurs due to bone separation and buccal tipping of dental crowns. Buccal tipping may be considered an undesirable effect, according to the clinic needs for each patient, as lateral teeth movement should be more parallel.

CONCLUSIONS

From the results obtained with the surgical

technique applied in SARME, it can be concluded that:

- Regarding transverse changes, there was a statistically significant increase in the transverse distances of the canines, first and second pre-molars, first and second molars.

- There was a statistically significant increase in the tipping of left and right first molars, as well as of the first pre-molars on one side, suggesting asymmetrical behavior of the teeth evaluated based on SARME.

- The surgical technique applied proved to be effective, as it allowed transverse changes in the maxilla, although with buccal tipping of the crowns of teeth supporting the expansion appliance.

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Prevalence of malocclusion in children aged 9 to 12 years old in the city of Nova Friburgo, Rio de Janeiro State, Brazil

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Abstract

Introduction: Knowledge of a population's epidemiological situation is important in the planning and provision of dental services. **Objectives:** Assess the prevalence of malocclusion in children aged 9 to 12 years old from public schools in the city of Nova Friburgo, Rio de Janeiro State, Brazil. **Methods:** A randomly selected sample consisting of 407 children (53.1% female) who were evaluated by a trained professional, after parental consent. **Results:** The most prevalent malocclusions were crowding (45.5%), excessive overjet (29.7%), posterior crossbite (19.2%), anterior diastema (16.2%), partially erupted teeth (12.0%) and excessive overbite (10.8%). Class I molar relationship prevailed (76.7%). The presence of diastemas was higher in females and excessive overbite was more prevalent in males, both in mixed dentition. Negative overjet and the presence of partially erupted teeth had a higher prevalence in permanent dentition. **Conclusion:** It was observed that the mere evaluation of malocclusion prevalence does not reveal case severity or treatment need, both of which are important factors in public health planning.

Keywords: Prevalence. Malocclusion. Children. Public health.

Maximum interincisal distance in mouth breathing children

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Abstract

Introduction: The maximum interincisal distance is a very important aspect during myofunctional orofacial evaluation, because myofunctional orofacial disorders can limit mouth opening. **Purpose:** To describe the maximum interincisal distance of mouth breathing children, according to age, and to compare maximum interincisal distance means of mouth breathing children to those of children with no history of speech-language pathology disorders. **Methods:** Ninety-nine mouth breathing children, of both genders, with ages ranging from 7 to 11 years and 11 months, leukoderms, in the mixed dentition took part in this study. The control group was composed of 253 children, with ages ranging from 7 to 11 years and 11 months, leukoderms, in the mixed dentition period, with no history of speech-language pathology disorders. **Results:** The results show that the maximum interincisal distance mean of mouth breathing children was, considering the total sample, 43,55 millimeters, and did not show statistically significant difference according to age. There is no statistically significant difference between maximum interincisal distance means of mouth breathing children and of the control group children. **Conclusions:** The maximum interincisal distance is a measure that did not modify in mouth breathing children, during the mixed dentition period, according to age, and seems not to be altered in this population. The importance of the use of the caliper in objective evaluation of the maximum interincisal distance was also observed.

Keywords: Face. Measurements. Mouth. Child. Mouth breathing.

INTRODUCTION

Mouth breathing is one of the most frequent orofacial myofunctional disorders in the speech-language pathology clinic, and has a high prevalence in the population, in all ages¹⁰. Evaluation and early detection of mouth breathing individuals is extremely important. This disorder compro-

mises the nasomaxillary process development, due to the disruption of the physiologic balance of the dentomaxillofacial architecture. The effects of mouth breathing have been discussed in the literature. It describes disorders in the normal development of the face, bones and occlusion, due to the unbalance caused to the relationship between

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muscle, bone and dental tissues. In this way, the alterations of the skeletal and muscular patterns of mouth breathing individuals have been demonstrated^{4,9,10,17,18,19,22,26,29}.

During speech-language pathology evaluation, Bianchini³ proposes the use of the caliper to measure the maximum interincisal distance, that is, the distance between the upper and lower incisors, in the maximum possible mouth opening. This instrument is also used to measure the maximum mouth opening which is considered as the distance between the upper and lower incisors, adding the amount of overbite or subtracting the anterior open bite distance.

Others authors^{20,21,23,24,27} also proposes the use of the caliper to measure, among other orofacial measurements, maximum mouth opening.

The use of the caliper, an anthropometric instrument, offers many advantages in the objective evaluation of the craniofacial complex, once it is a simple non-invasive technique that poses no risk to subjects and has low costs³⁰.

In reference to the norms of maximum mouth opening, Bianchini⁴ describes that an opening under 35 millimeters (mm) in a child is an alert to muscular and/or joint problems. Hamazaki et al.¹⁶ found, in their study with children from 6 to 12 years old, that the mean for maximum mouth opening was 48.33mm, and this measure increased according to age. Rísoli and Bacha²³ indicated that maximum mouth opening is about 40 to 45mm, and they did not differentiate between genders or ages. Rodrigues²⁵ considers, in adults, that 40mm is a reference value for maximum mouth opening.

In a study, with the purpose of describing the maximum interincisal distance in leukoderm children with no speech-language pathology complaints, in the mixed dentition, the verified mean for this distance in the sample was 44.75mm, and a significant statistical difference was only observed in males from 7 to 11 years and from 8 to 11 years old. Females showed lower means than

males, except in 8-year-old children⁶.

The interest of the present study has grown as a lack of norms for maximum interincisal distance in mouth breathing children was observed, as well as, no description for this characteristic according to age.

The purposes of this study were: (1) to describe the maximum interincisal distance of mouth breathing children and to verify if there is a statistically significant difference between the means of this measurement, according to age; and (2) to compare the maximum interincisal distance means of mouth breathing children to those of children with no history of speech-language or swallowing disorders and to verify if there is statistically significant difference between the means of these two populations, according to age.

MATERIAL AND METHODS

Subjects

Participants were 99 mouth breathing children with ages ranging from 7 to 11 years and 11 months, being 50 (50.5%) males and 49 (49.5%) females. The mean age was 8 years and 5 months and the median was 8 years. The children were divided according to age: 31 children (31%) from 7 years to 7 years and 11 months; 21 children (22%) from 8 years to 8 years and 11 months; 21 children (21%) from 9 years to 9 years and 11 months; 12 children (12%) from 10 years to 10 years and 11 months; 14 children (14%) from 11 years to 11 years and 11 months.

The inclusion criteria were: (a) diagnosis of mouth breathing by an otorhinolaryngologist; (b) functional alteration of breathing; (c) leukoderm; and (d) being in the mixed dentition period with the four permanent first molars completely erupted.

The exclusion criteria were: (a) history of speech-language pathology, with present and/or previous treatment, in any area (voice, language, orofacial myology and/or audiology); (b) history of facial and/or pharyngeal surgery; (c) history of

syndrome and/or neurological disease and/or bifid uvula; (d) history of craniofacial malformations; and (e) history present and/or previous orthodontics and/or facial orthopedics and/or craniomandibular treatments and/or temporomandibular joint dysfunction (TMD).

The control group was composed by 253 (same sample from Cattoni's⁵ study, 2003), with ages between 7 years and 11 years and 11 months, being 137 boys (54%) and 117 girls (46%), leukoderms, in the mixed dentition period with the four permanent first molars completely erupted, with no history of speech-language pathology with no present and/or previous treatment, in any area (voice, language, orofacial myology and/or audiology), with no speech-language pathology complaints and attending private schools in the city of São Paulo. The mean age was 8 years and 5 months and the median was 8 years.

The children were divided according to age: 48 (19%) children between 7 years and 7 years and 11 months; 51 (20.1%) children between 8 years and 8 years and 11 months; 50 (19.7%) children between 9 years and 9 years and 11 months; 54 (21.5%) children between 10 years and 10 years and 11 months and 50 (19.7%) children between 11 years and 11 years and 11 months.

Material

The instrument used to obtain the maximum interincisal distance was the electronic digital sliding caliper Starrett Series 727, made in Brazil, made of stainless steel, containing LCD display with an active unit system in millimeters with 0.01 mm of resolution and repeatability. Data protocols, cotton and ethyl alcohol were also used.

Procedure

On the first phase, the otorhinolaryngologist carried out the diagnostic evaluation, composed by physical and radiologic exams. The physical exam was composed by oroscopy to evaluate the size of palatine tonsils and anterior rhinoscopy

to evaluate the turbinal bones, septum and nasal mucosa. Complementary exams were asked, such as cavum radiography, to determine the extension of nasopharyngeal obstruction by the pharyngeal tonsil. The children that, after the otorhinolaryngologic evaluation and results of the exams, received mouth breathing diagnosis were referred to evaluation of the maximum interincisal distance. When all criteria for participation in this study were respected, parents or legal guardians of the children were asked to fill in the informed consent form (ICF). The research and the ICF were approved by the Ethics Committee of Hospital das Clínicas (CAPPesq) and of the Medical School of the University of São Paulo (protocol number 096/04).

On the second phase, the maximum interincisal distance was measured, and it corresponded to the distance between the incisal edge of the central upper incisor and the incisal edge of the central lower incisor, after maximum mouth opening. If the right central upper and/or lower incisors were in eruption process or absent, the distance between the correspondent teeth on the left side was measured. If the central upper and/or lower incisors, on the right and left sides, were in eruption process or absent, the distance between the incisal edge of the lateral upper incisor, on the right side and the incisal edge of the lateral lower incisor on the right side was measured. When it was impossible to obtain this last measurement, as result of the incomplete eruption process or absence of the central and lateral incisors on the right side, the distance between the incisal edge of the lateral upper incisor on the left side and the edge of the lateral lower incisor on the left side was measured. In the absence of the central and lateral lower and upper incisors or if they were in eruption process, this measurement was not obtained.

The child was asked to remain seated, with both feet on the ground, with the head in resting position. The maximum interincisal distance

was measured, in frontal vision, with the jaws for internal measurement of the sliding caliper, and it was written in millimeters in the data protocol. The measurement was taken twice and, afterwards, the average was calculated. At the end of the evaluation of each child, the caliper jaws were washed and disinfected with ethyl alcohol, rubbed with cotton.

Finally, the analysis that compared the results for the maximum interincisal distance between the mouth breathing children and the control group was carried out, verifying if there was statistically significant difference among the means of these two populations, according to age. The procedures were similar with the control group.

Statistical analysis

The studied population was characterized by descriptive statistics (mean, standard deviation, median, minimum and maximum values). The adherence to Normal curve was evaluated by Komolgorov-Smirnov test.

In the data analysis regarding maximal interincisal distance, means were compared according to age, by the analysis of variance (ANOVA). The confidence interval was calculated at 95%.

The comparison of the maximum interincisal distance means between the mouth breathing children and the control group was performed by the Student's *t* test, according to age.

All analysis were processed with SPSS for Windows version 12.0 and the level of significance was considered at 5%.

RESULTS

Descriptive statistics for the maximal interincisal distance, considering the total number of mouth breathing children, demonstrates that the mean was 43.55mm and the median was 43.75mm. The minimum value obtained was 31.12mm and the maximum value was 55.83mm. The maximum interincisal distance mean in the sample showed a close value to the median and it

presented adherence to the Normal distribution ($p > 0,663$ by Komolgorov-Smirnov test).

The descriptive statistics for the maximal interincisal distance, considering the total number of children from the control group, demonstrated that the mean was 44.75mm and the median was 44.65mm. The minimum value obtained was 32.34mm and the maximum value was 58.01mm.

Regarding the characterization of the study population according to the main otorhinolaryngologic diagnosis, in accordance to age, the most frequent was hypertrophy of the pharyngeal and palatine tonsils (48%), which was followed by the hypertrophy of pharyngeal tonsils (32%). Enlarged palatine tonsils, as well as rhinitis, were observed in 15% of the study population. No significant statistical difference among the percentages of the otorhinolaryngologic diagnosis according to age was found ($p > 0.005$).

In Table 1, it can be observed that there was no significant statistical difference among the maximal interincisal distance means, according to age ($p = 0.950$). The minimum value found in the sample was 31.12mm, in a 7-year-old child, and the maximum value was 55.83mm, in a 10-year-old child.

Table 2 shows the comparison of the maximum interincisal distance means. Significant statistical difference among the means of this measurement in the two studied populations was not verified. The mean values in the control group children were close to the ones obtained in the mouth breathing children, for all ages ($p > 0.005$).

DISCUSSION

Although the literature does not describe disorders in the maximal interincisal distance in mouth breathing children, this measurement was collected in order to describe this population. It is important to emphasize that, during the data gathering process, the procedures proposed by Bianchini³, Cattoni and Fernandes⁶ were respected.

Regarding selection criteria of the children,

TABLE 1 - Descriptive statistics of the maximum interincisal distance, according to age.

AGE (years)	MEAN (mm)	ERRO PADRÃO	CI 95% (mean)	MÍN. - MÁX. (mm)
7	43,29	0,92	41,39 – 45,19	31,12 – 51,05
8	43,85	1,07	41,61 – 46,09	31,55 – 51,67
9	42,99	0,98	40,94 – 45,04	35,24 – 52,20
10	43,86	1,77	39,94 – 47,77	36,07 – 55,83
11	44,20	1,18	41,63 – 46,77	35,40 – 53,04

CI=confidence interval (ANOVA) $p = 0,950$.

only mouth breathing children confirmed by otorhinolaryngologic diagnosis participated in this study, reducing the subjectivity in determining this condition. Moreover, the children should not present history of present and/or previous speech-language pathology and/or treatment, because alterations in the orofacial muscles can be verified after myofunctional therapy¹⁷.

Also, the participants in this study could not have present and/or previous history of facial and/or pharyngeal surgery; syndrome, neurological disease and/or bifid uvula; craniofacial malformations; orthodontics and/or facial orthopedics and/or craniomandibular treatments; or TMD, because these clinic and surgical treatments, such as the cited alterations, can damage the craniofacial complex^{2,3,8,11-15,20,28}. If these exclusion criteria were not respected the obtained data would not present the desired validity.

The mixed dentition was the chosen period, because some other investigations^{5,6,7} have also focused on this dentition phase as inclusion criteria. It is determined by the presence of four completely erupted first permanent molars since important transformations occur in the oral cavity, between 5 and 6 years old, as a result of the eruption of these teeth. Hence, it was possible to obtain an homogeneous sample in regard to the dentition development.

TABLE 2 - Comparisons among means of the maximal interincisal distance in the different groups according to age.

AGE	n	CONTROL GROUP mean (mm)	n	MOUTH BREATHING CHILDREN mean (mm)	p
7	48	43,90	31	43,29	$p > 0,05$
8	51	43,70	21	43,85	$p > 0,05$
9	50	45,67	21	42,99	$p > 0,05$
10	54	44,96	12	43,86	$p > 0,05$
11	50	45,46	14	44,20	$p > 0,05$

n=number of patients; p= t-Student test.

Among the mouth breathing children, significant statistical differences were not verified between the maximum interincisal distance means, according to age, and the mean value for this sample was 43.55mm. It was noted that the obtained results are according to data described by Bianchini⁴, which describes that mouth opening under 35mm in a child is one of the aspects that indicate possible muscular and/or joint disorders. However, it is emphasized that there is a difference between the maximal interincisal distance and maximal mouth opening, once there are different procedures to obtain them.

The results regarding maximal interincisal distance in mouth breathing children are close to previously published data about children with no speech-language pathology complaints (43.55mm and 44.75mm, respectively)⁶. These researches respected the same assessment procedures, which allows data comparison.

When the two studied populations are compared, no significant statistical difference between the means according to age was observed, this indicates that in mouth breathing children this measurement seems not to be altered.

It is emphasized, finally, that the mouth breathing children who participated in this study are attending a highly specialized hospital –due to other conditions - and the generalization of the

obtained data in this research can, therefore, have some limitations. In this way, it would be interesting to repeat this kind of study in other health care services, with different populations, in other dentition periods.

As a final consideration, the use of the caliper was shown to be useful during speech-language pathology evaluation, adding to the visual assessment with quantitative measures. It is relevant to indicate that its use needs procedure standardization, in order to obtain an accurate analysis of the maximum interincisal distance.

CONCLUSIONS

There was no significant statistical difference between the maximum interincisal distance means in mouth breathing children, according to age.

There was no significant statistical difference between the maximum interincisal distance means in mouth breathing children and in the control group, according to age.

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Angle Class I malocclusion with congenitally missing and retention of mandibular second premolars*

Eduardo Silveira Ferreira**

Abstract

This article reports the orthodontic treatment of a 14 year and 6 months old patient that had a Class I malocclusion with an ectopic position and retention of the tooth 45. This case was treated the extraction of the tooth 45 and space closure in the lower arch. Initial, final and post-treatment orthodontic records will be presented and discussed. This case was presented to the Brazilian Board of Orthodontics and Facial Orthopedics (BBO), category 7, free choice, as part of the requirements of achieve the title of BBO diplomate.

Keywords: Angle Class I Malocclusion. Tooth Retention. Congenitally Missing Tooth. Corrective Orthodontics.

HISTORY AND ETIOLOGY

The 14 years old patient presented himself for an initial consultation in good general health, reporting allergy sinus and nasal-oral breathing. He did not report any history of serious illnesses nor trauma. He was in the decelerating phase of the pubertal growth spurt curve and his dental history reported deficient oral hygiene and the presence of marginal gingivitis. His main complaint was the edentulous inferior spaces and the orthodontic treatment was prescribed by his dentist. The patient had not had any orthodontic treatment until this moment.

DIAGNOSES

The patient presented a Class I skeletal pattern with ANB of 1° (SNA=81° and SNB=80°) and

increased FMA and Y axis values in relation to Steiner and Down analysis (FMA=31° and Y axis = 64°). This information can be seen on Table 1.

The dental features can be observed in Figures 1 and 2. The patient had a dental Class I relationship with problems (spaces) located in the inferior second premolars region⁵, lower medium line deviation of 1mm to the left, 1mm anteroinferior crowding, 2mm overjet, 3mm overbite and the following teeth (15, 25, 22, 23 and 31) were rotated.

In the facial evaluation, the subject had a slight labial protrusion with lower lip ahead of the upper lip (UL=1mm and LL=3.5mm). He had passive lip sealment, a slightly enhanced lower facial third and no evident asymmetries nor mandibular functional deviation (Fig. 1).

* Case report, category 7, free choice, approved by the Brazilian Board of Orthodontics and Facial Orthopedics (BBO).

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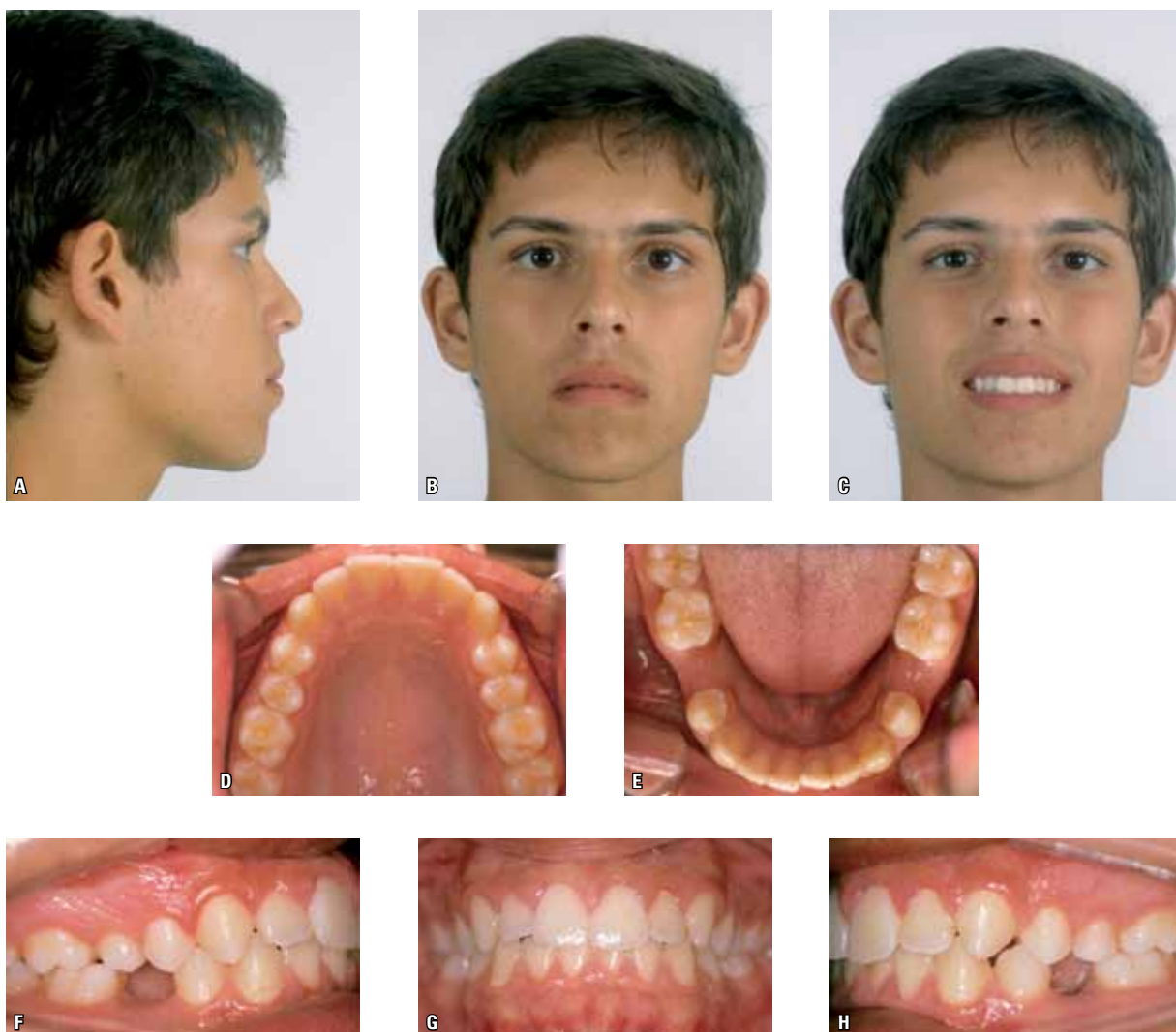


FIGURE 1 - Initial facial and intraoral photographs.

The radiographic evaluation revealed the absence of teeth 35 and 45 and the root resorption of tooth 46 (Fig. 4, 5). Previous panoramic radiographs indicated prolonged retention of teeth 75 and 85, ectopia and cystic lesion in tooth 45 that was later diagnosed as fibroameloblastoma (Fig. 3), upper teeth roots with incorrect axial inclinations and the presence of third molars. The hand and wrist radiograph showed advanced stages of calcification of the phalanges and wrist bones, and the presence of the sesamoid bone (Fig. 6). The lateral radiograph and cephalometric tracing (Fig.

7) revealed a balanced facial growth⁶, clean upper airways, buccal inclined incisors and a straight facial profile. The cephalometric values are presented in Table 1.

TREATMENT GOALS

The goal was to maintain the vertical, transverse and anteroposterior pattern of both jaws. In the upper jaw, the main objective was to level, align and stabilize the teeth for latter use as anchorage unit for Class II elastic mechanics¹⁰. The specific goal for the lower dentition was mesial

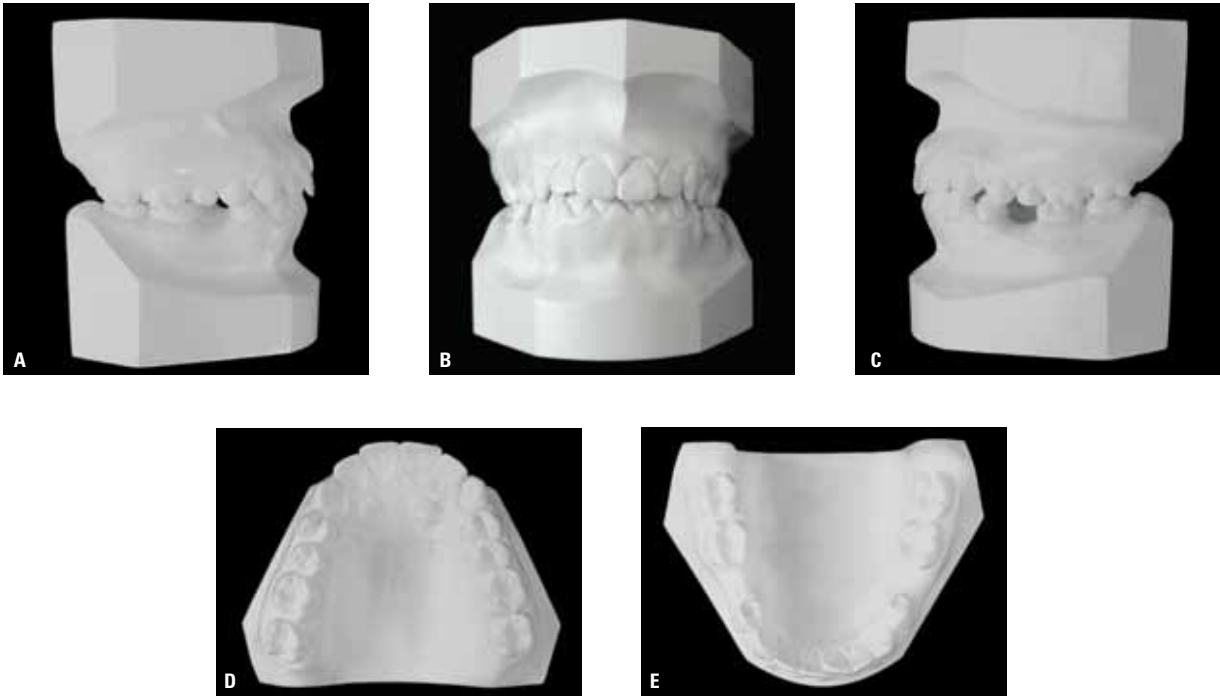


FIGURA 2 - Initial dental cast.



FIGURE 3 - Panoramic radiograph previously to the orthodontic appointment.



FIGURE 4 - Initial panoramic radiograph.

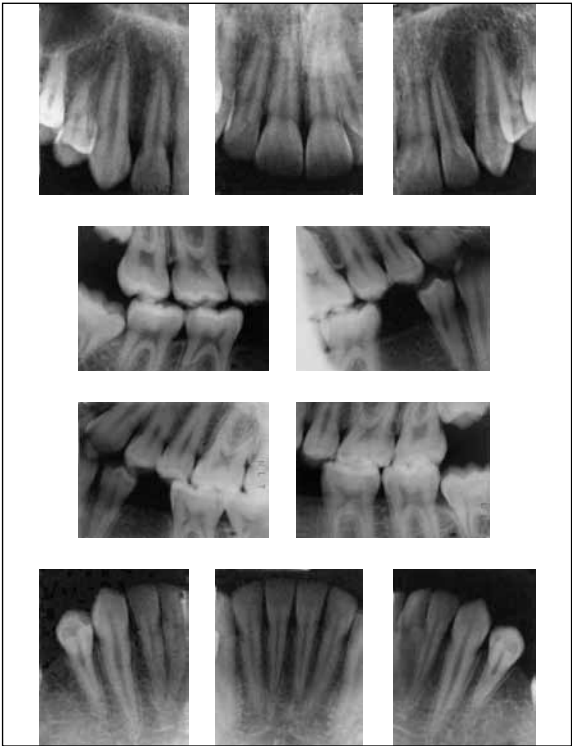


FIGURE 5 - Periapical radiographs of anterior superior and inferior teeth and left and right bitewings radiographs.



FIGURE 6 - Hand and wrist radiograph.



FIGURE 7 - Initial lateral radiograph (A) and cephalometric tracing (B).



movement of molars, leveling of Spee curve, the maintenance of lower canine distance and improvement of the overjet and overbite. Therefore, by the end of the treatment, a molar Class III and cuspid Class I relationship was to be obtained³. The patient rejected the orthodontic treatment proposal of maintaining the spaces for further implants and prosthetics of teeth 45 and 35. Hence, the treatment plan of totally closing the spaces in the region was chosen.

TREATMENT PLANNING

In order to achieve the treatment goals, the patient was informed about the treatment plan which consisted of upper and lower Edgewise appliance, 0.022" x 0.028" slot and 0.014", 0.016", 0.018" and 0.020" stainless steel arches for leveling and aligning. From the 0.020" arch, chain elastic were to be used in order to move mesially the lower molars, keeping the anterior teeth tied-together. Later, this movement would be continued with 0.018" x 0.025" arch and, if necessary, Class II elastics (force magnitude of 180g) would be installed in both sides. For finalization, it was planned the use of 0.019" x 0.026" in both jaws with individ-

ualized bends according to the patient's need^{7,8}. After the active treatment end, a removable appliance (wraparound) made of 0.032" stainless steel wire and a lingual arch bonded to the lower cuspid teeth made of twisted 0.032" wire would be used. The extraction of the upper third molars as well as the bonding of a wire segment in the buccal faces of teeth 46 to 44 and 36 to 34 was not discarded. The patient was formally informed of the needed care of his orthodontic appliances as well as his oral hygiene⁴.

TREATMENT PROGRESS

Orthodontic bands with welded accessories were made for the upper and lower molars. The other teeth were bonded with 0.022" x 0.028" edgewise brackets.

Sequential arches from 0.014" to 0.020" were used for leveling and aligning of both upper and lower teeth. In the lower arch, with 0.020" wire, all anterior teeth as well as both bicuspid were tied-together and the molars were mesialized with the aid of chain elastic. This mechanic was sustained in the 0.018" x 0.025" stainless steel wire. Class II elastics (180g) were used to aid the an-

chorage loss in both sides.

After the lower spaces were closed the case was finalized with 0.019"x 0.026"arches in both jaws.

After all treatment goals were obtained, the fixed orthodontic appliances were removed and the retention phase was initiated. A removable appliance (wraparound) made of 0.032"stainless steel wire and a lingual arch bonded to the lower cuspid teeth made of twisted 0.032"wire were used. The upper appliance was to be used 24h a

day during the first year and to sleep for following year. The lower arch was to be used indeterminately.

TREATMENT RESULTS

The patient's final records evaluation (Fig. 8-12) show that the primary goals were achieved^{1,9}. The maxilla was kept in its position and the upper incisors were slightly retracted. The lower molars were moved mesially and their distance decreased from 46.5mm to 43mm, while the intercanine

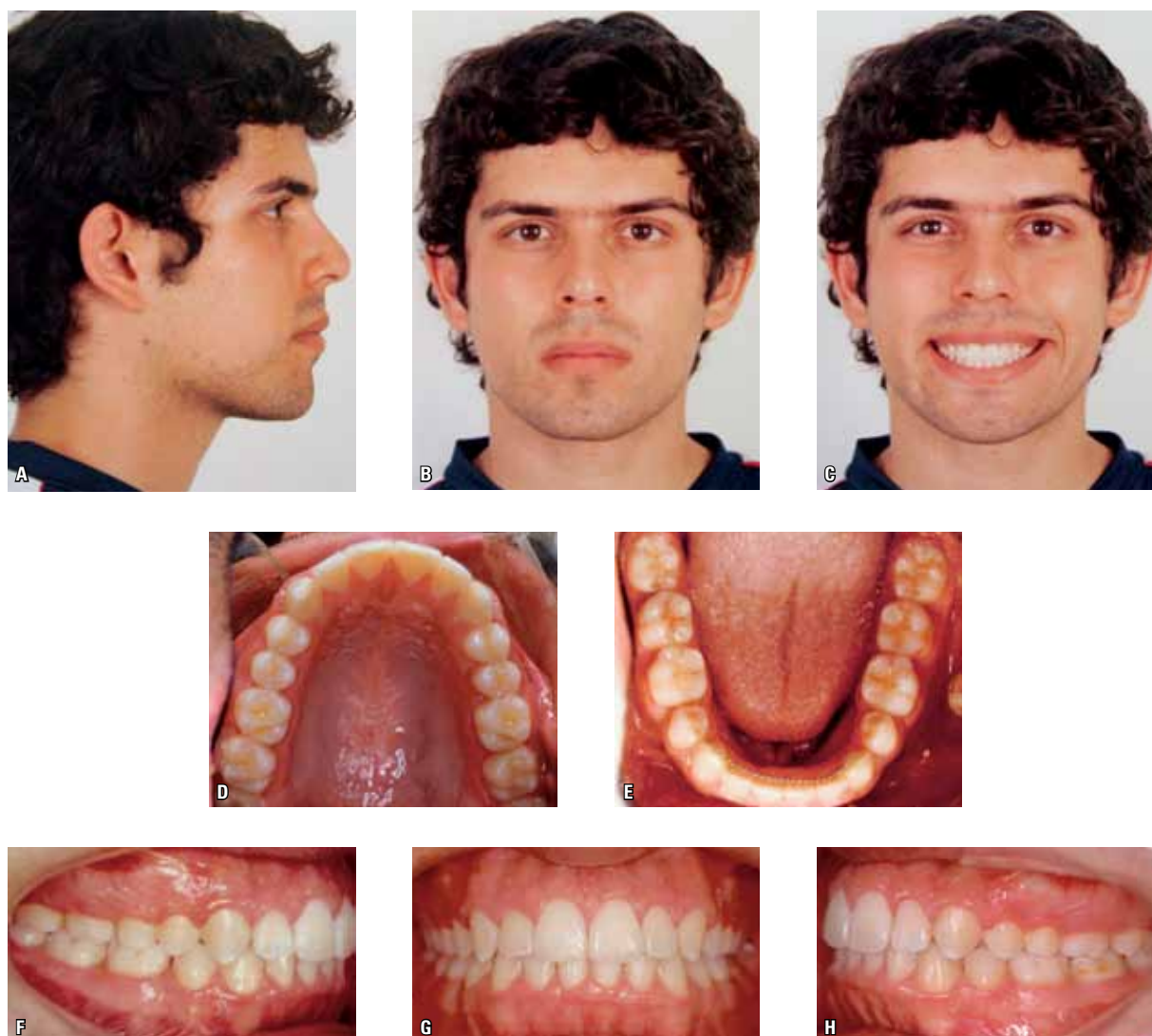


FIGURE 8 - Final facial and intraoral photographs.

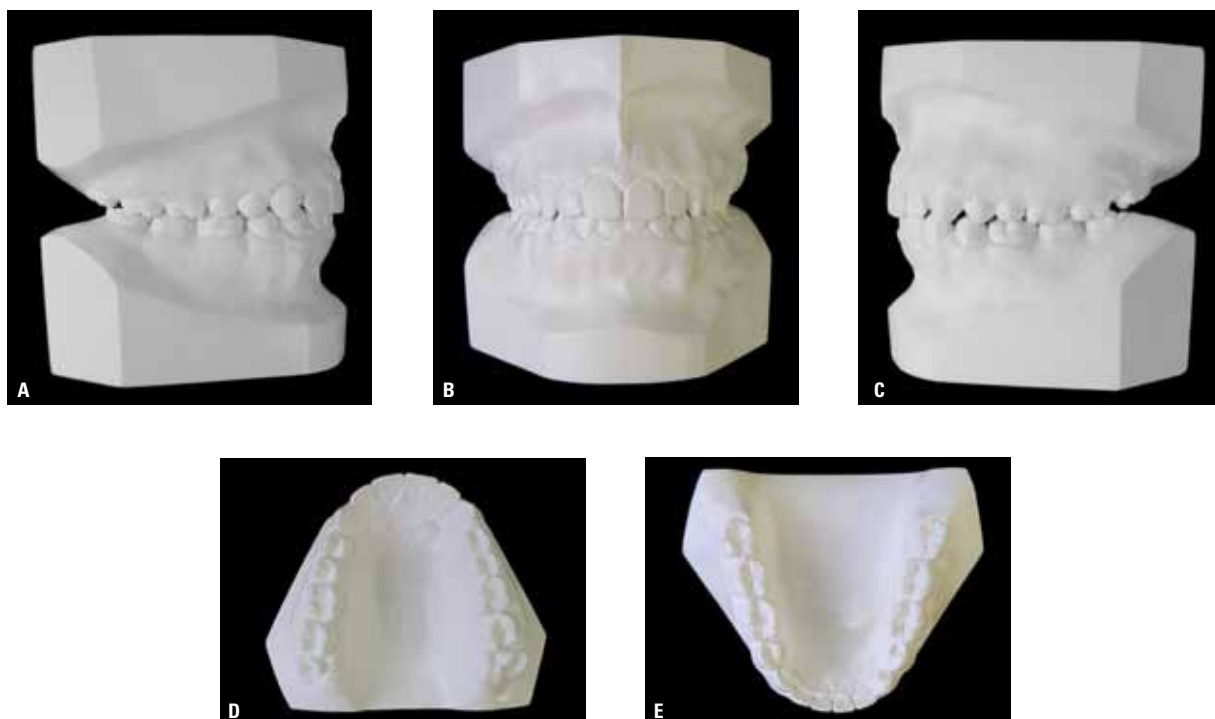


FIGURE 9 - Final dental cast.



FIGURE 10 - Final panoramic radiograph.

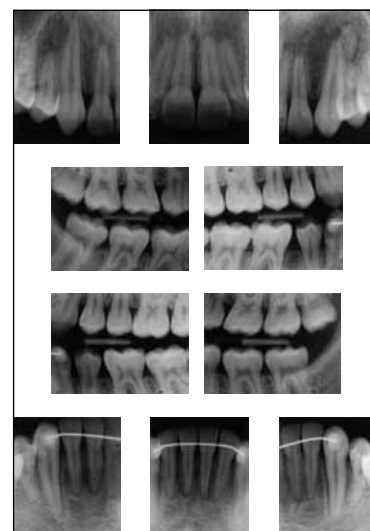


FIGURE 11 - Final periapical radiographs of anterior superior and inferior teeth and left and right bitewings radiographs.

distance was practically kept stable (Table 2). The cephalometric analysis indicated the maintenance of the skeletal pattern, with minor reduction of Y axis and SN-GoGn angle values. There was also a reduction of the linear values and an increase of the incisal angle. In the facial profile, a 1mm and 2.5mm retraction of the upper and lower lip respectively in relation to Steiner S line (Table 1).

In the panoramic radiograph analysis (Fig. 10), a good root parallelism was observed, except in the upper lateral incisors and canine area, and the lesion absence of fibroameloblastoma (tooth 45).

A general rounding of the upper incisors roots was noted as well as significant radicular loss in teeth 36 and 46. The remaining structures were normal, including the third molars, which were already erupted.

The dental occlusion was improved in the molars regions', even with the relationship between upper first bicuspid with lower first molars and upper second molars with lower third molars. The facial aesthetics had no significant alterations and the smile line showed significant improvement with the alignment of anterior

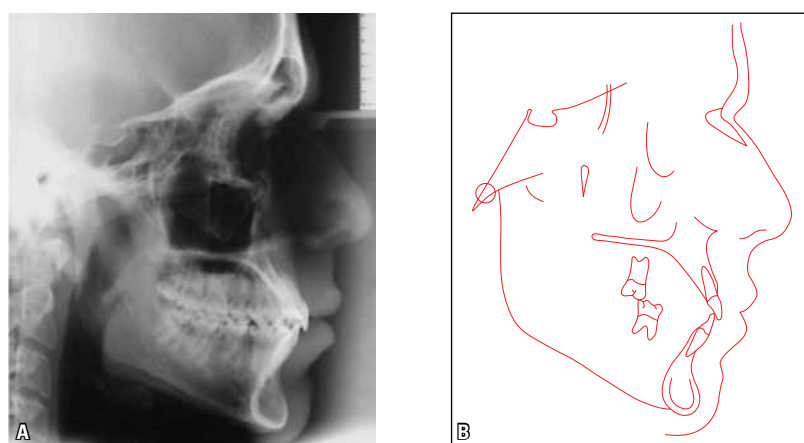


FIGURE 12 - Final lateral radiograph (A) and cephalometric tracing (B).

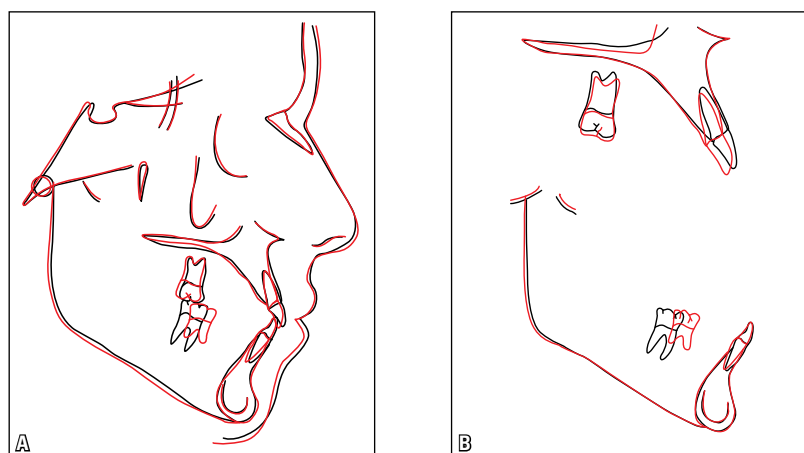


FIGURE 13 - Superimpositions, total (A) and partials (B), of initial (black) and final (red) cephalometric tracings.

TABLE 1 - Cephalometric measurements.

	MEASUREMENTS	STANDARD	A	B	DIFFERENCE A - B	C
SKELETAL PATTERN	SNA (Steiner)	82°	81°	81°	0	80°
	SNB (Steiner)	80°	80°	80°	0	80°
	ANB (Steiner)	2°	1°	1°	0	0°
	Convexity Angle (Downs)	0°	-2°	0°	2	-1°
	Y Axis (Downs)	59°	64°	61°	3	62°
	Facial Angle (Downs)	87°	85°	83°	2	86°
	SN – GoGn (Steiner)	32°	32°	30°	2	31°
	FMA (Tweed)	25°	31°	31°	0	30°
DENTAL PATTERN	IMPA (Tweed)	90°	85°	89°	4	89°
	┐ – NA (degrees) (Steiner)	22°	20°	22°	2	21°
	┐ – NA (mm) (Steiner)	4mm	11mm	8mm	3	9mm
	┐ – NB (degrees) (Steiner)	25°	21°	23°	2	22°
	┐ – NB (mm) (Steiner)	4mm	8mm	7mm	1	6mm
	Interincisal Angle (Downs)	130°	133°	134°	1	135°
	┐ – APo (mm) (Ricketts)	1mm	6mm	4,5mm	1,5	5mm
PROFILE	Upper Lip – S Line (Steiner)	0mm	1mm	0mm	1	0mm
	Lower Lip – S Line (Steiner)	0mm	3,5mm	1mm	2,5	0mm

TABLE 2 - transverse distances measurements of both arches (mm).

MEDIDAS	A	B	A - B	C
Lower intercanine distance	29,5mm	29mm	0,5	30mm
Lower intermolar distance	46,5mm	43mm	3,5	42mm
Upper intercanine distance	37mm	38mm	1	38mm
Upper intermolar distance	54mm	54mm	0	55mm

teeth. The total treatment time was 39 months; the upper retention was to be used 24h per day during one year and additional 12 months of nocturnal use.

The records 5 years after the end of orthodontic treatment (Fig 14-18) showed that the relationships obtained, the space closure and the minor increase of the overbite remained stable. The

radiographic evaluation showed that the resorption in the teeth 46 and 36 did not evolve after the ceasing of orthodontic treatment². The upper third molars were extracted and the cystic lesion area presented itself with normal skeletal aspect. The cephalometric values and the distances between molars and canines presented small variation as shown in Table 1.



FIGURE 14 - 5 years post-treatment facial and intraoral photographs.

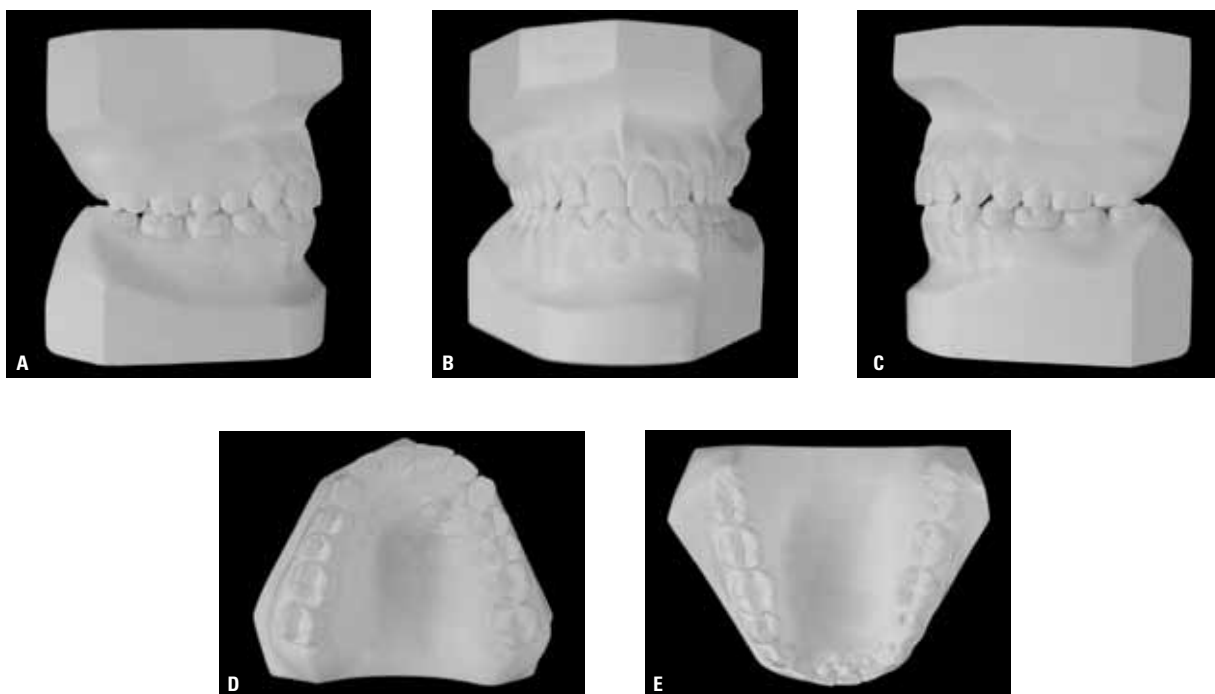


FIGURE 15 - 5 years post-treatment dental casts.



FIGURE 16 - 5 years post-treatment panoramic radiograph.

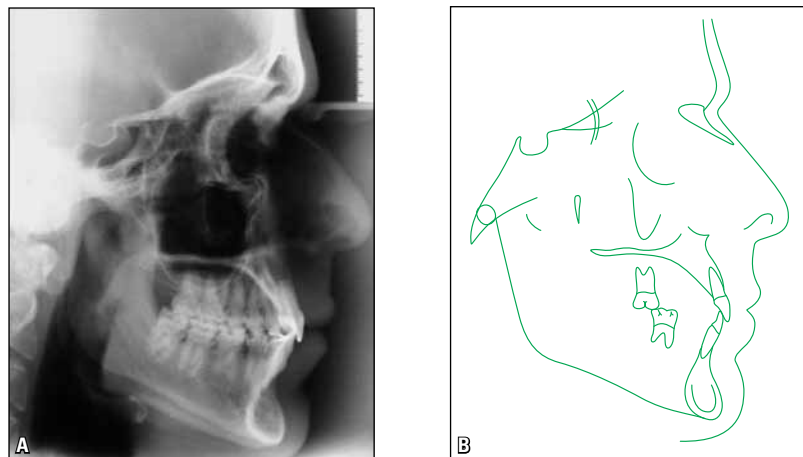


FIGURE 17 - 5 years post-treatment lateral radiograph (A) and cephalometric tracing (B).

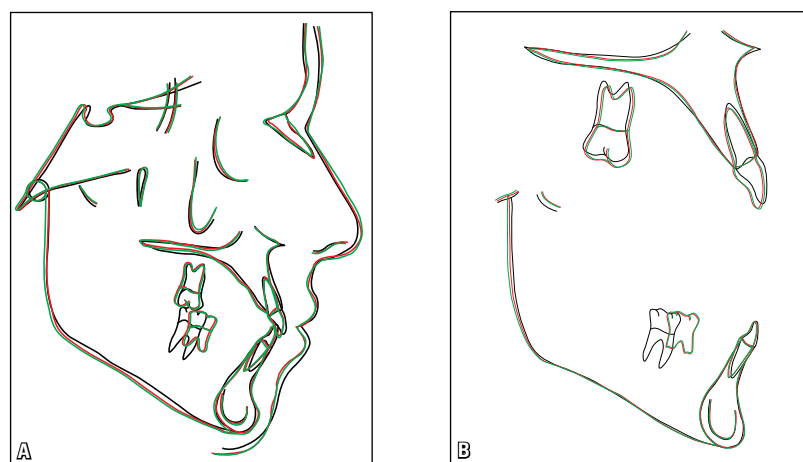


FIGURE 18 - Superimpositions, total (A) and partials (B), of initial (black), final (red) and 5 years post-treatment (green) cephalometric tracings.

FINAL CONSIDERATIONS

The treatment results were obtained by space closure of teeth 35 and 45. The patient used all orthodontic devices and was responsible in fulfilling his duties. His parents were informed about the delicate situation of the root resorption of tooth 46 due to its cystic lesion and orthodontic movement, which might result in its extraction and future implant replacement. The records after 5 years after the removal of the orthodontic appliances show the stabilization of the tooth 46 situ-

ation. Radiographic control was made during the entire treatment period (Fig 12B). The lower left first molar also presented root resorption due to the great mesial movement until reaching tooth 34. The superimposition of the cephalometric tracings shows the facial pattern evolution associated with the orthodontic mechanics described in the treatment planning (Fig. 13, 18). The patient is still being controlled by the surgeon responsible for the lesion removal before the beginning of the orthodontic treatment in order to diagnose any relapse.

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Orthodontic wires: knowledge ensures clinical optimization

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Abstract

The wide range of orthodontic wires available in the market can raise doubts about the best choice for different clinical situations. Thus, knowledge of their mechanical properties can facilitate the choice of wire required to achieve a given orthodontic movement based on the treatment phase. The evolution of wire manufacturing technology and the development of new orthodontic techniques have led to the search for better quality alloys, more biologically effective for the teeth and supporting tissues. This article summarizes the main characteristics of the wires used in orthodontics, their history, mechanical properties and clinical application, according to specific treatment phases.

Keywords: Orthodontic wires. Mechanical properties. Shape memory effect. Orthodontics.

INTRODUCTION

To be competent, orthodontists should have the manual skills of a craftsman and an in-depth knowledge of orthodontic science. Professionals, however, might wonder, "Would learning about orthodontic wires improve my skills or expand my customer base?" If manual skills alone were sufficient then great craftsmen would make excellent orthodontists. Therefore, knowledge of orthodontic wires allows the professional to perform more efficient movements and avoid damage to teeth and supporting tissues.

Orthodontic mechanics is based on the principle of elastic energy storage and its conversion into mechanical work through tooth movement. Each time the orthodontic appliance is adjusted it stores and controls the transfer mechanism

and distribution of forces. An optimal control of tooth movement requires the application of a system of special forces which is properly supported by accessories, such as orthodontic wires.

Despite the considerable number of brands available in the market and their powerful commercial appeal the most widely used consist of four groups of alloys, namely:

Stainless steel; a variety of nickel-titanium (NiTi) alloys (superelastic, thermodynamic and with the addition of copper); beta-titanium alloys and aesthetic composites, recently launched in the market. It is therefore essential that orthodontists acquire some knowledge of the mechanical properties and composition of wires so they can make the best informed choice for clinical use.

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HOW ORTHODONTIC ARCH WIRES EVOLVED

When gold was king

Since the old days, when the first professionals glimpsed the possibility of moving teeth they employed wires. Edward Angle was undoubtedly the patron of Orthodontics worldwide. The specialty was the first to be recognized by the science of Dentistry and celebrated its 100 years anniversary during the American Association of Orthodontists (AAO) conference of Chicago, USA, in 2000.

Initially, in 1887, Edward Angle used nickel-silver alloys in his orthodontic accessories. Subsequently he replaced them with copper, nickel and silver-free zinc alloys. Eventually, gold alloys became his favorite choice¹⁸.

Until the early 1930s, type IV gold alloys were the most widely employed in the manufacture of orthodontic accessories. In those days, 14 to 18-carat gold was routinely used for wires, bands, hooks and ligatures as well as iridium-platinum bands and wires. The advantage of using gold alloys lay in the fact that since they can be heat treated their stiffness can be altered by about 30%, in addition to their excellent resistance to corrosion¹⁸.

In Brazil, gold alloys were used by the pioneers of Brazilian Orthodontics, then professors at Universidade Federal do Rio de Janeiro, until the early 1950s (Fig. 1).

The advent of stainless steel

Stainless steel was introduced into orthodontic practice in 1929, when Renfert, a North American company, began selling wires made from these alloys, which were produced by a German company named Krupp².

In the 1931 AAO Conference, Norris Taylor and George Paffenbarger introduced steel as a substitute for gold claiming it featured greater resilience and was less likely to break under stress. In 1933, the founder of Rocky Mountain Orthodontics, Archie Brusse, suggested for the first time the clinical application of stainless steel in orthodontics during the meeting of the American Orthodontic Society in Oklahoma City. Since then, the rivalry between gold and steel formally began. Economic factors undoubtedly helped to determine the worldwide acceptance of steel over gold¹⁸.

In Brazil, stainless steel began to be utilized in the manufacture of orthodontic accessories in the late 1940s. Until then, fixed orthodontic appliances were still made of gold. The first course of orthodontics as a specialty in Brazil was spearheaded by the Federal University of Rio de Janeiro (UFRJ) as an outgrowth of the discipline of orthodontics taught in the regular graduate dentistry course. In 2008, the course celebrated its 50-year anniversary. Its founder was Professor Dr. José Édimo Soares Martin - patron of Brazilian Orthodontics³⁰.



FIGURE 1 - **A)** Package of gold brackets. **B)** Glass containing eyelets, used to correct tooth rotations; dental tungsten needle to aid in welding eyelets; gold band with welded eyelets **C)** Bracket welded to a band, both in gold (Source: material obtained from the files of UFRJ professors, Drs Antonio Carlos Peixoto da Silva and Hélio de Oliveira Fernandes - both members of the group of Brazilian Orthodontics pioneers).

Cobalt-chromium alloys

In the 1940s the Elgin Watch Company developed cobalt-chromium alloy, composed of cobalt (40%), chromium (20%), silver (16%) and nickel (15%), primarily used in the manufacture of springs for watches. In the 1960s, cobalt-chromium alloys were found their way into Orthodontic practice and were patented as Elgiloy® by Rocky Mountain Orthodontics¹⁸.

These alloys have mechanical properties that are similar to stainless steel and compared with wires of the same dimensions they produce forces of similar magnitude¹⁸. However, in order to use their full response potential some heat treatment should be applied after preparing the bend and prior to tying the brackets with the wire. Most orthodontists never reaped the full benefit offered by these alloys and often cannot even distinguish them from stainless steel given their physical similarities.

A few years later, new alloys emerged

Beta-titanium alloy

Beta-titanium alloys are made from titanium. When subjected to heat treatment these alloys undergo changes in the structural rearrangement of their atoms, aka beta phase¹¹ titanium alloys.

Beta-titanium alloys have been used as structural material since 1952. Until 1979, however, wire drawing technology did not allow the manufacture of wires of orthodontically compatible cross-sections. In 1977, the beta phase of titanium was stabilized at room temperature¹⁸.

The first clinical applications of this alloy in orthodontics occurred in the 1980's when a different form of titanium called "high temperature" was introduced. Since then, this titanium gained wide clinical acceptance and popularity. It is commercially available as "TMA" (titanium molybdenum alloy) and, for many years, one company owned its sole manufacturing rights. Currently, the market offers a wider variety of commercial brands¹¹.

Nickel-Titanium (NiTi) alloys

Nickel-titanium alloys were developed by the U.S. Naval Laboratory in Silver Spring, Maryland, by researcher William Buehler. He was the first to observe the so-called "shape memory effect" typical of this material. This alloy had hitherto not yet been applied in Orthodontics^{11,23}.

In 1972, Unitek Corporation produced the NiTi alloy for clinical use under the trade name Nitinol®, composed of 55% nickel and 45% of titanium, in an equiatomic structure³. However, at that time, the alloy had no shape memory effect or superelasticity. Still, it was seen as a step forward towards achieving light forces in large activations. In 1976, several brands of nickel-titanium wires were launched in the orthodontic market and were characterized as materials of high elastic recovery and low stiffness, garnering widespread clinical acceptance due to these properties. These wires, however, featured no thermal activation or superelasticity.

The evolution of nickel-titanium alloys

Nickel-titanium superelastic alloys

In 1985 the clinical and laboratory use of a new superelastic nickel-titanium alloy was reported. It was called "Chinese NiTi" and was developed especially for application in orthodontics. The term "superelasticity" had not been used until that time. The Chinese nickel-titanium wire was the first to show superelastic potential. It was originally developed in China and after having its properties improved it was reported that this wire had greater elastic recovery and less stiffness than conventional nickel-titanium wires of the same cross section as well as less permanent deformation after deflection. Since then, a number of studies have been conducted in an attempt to produce orthodontic wires with similar properties, a goal achieved only in 1986 with the introduction of the "Japanese NiTi". These alloys were produced by the GAC Company (GAC Int., NY, USA) under the trade name

Sentalloy^{6,8,24}.

Thermodynamic nickel-titanium alloys

The commercial use of thermodynamic nickel-titanium alloys began in the 1990s. In addition to the properties of elastic recovery and resilience provided by superelastic wires, thermodynamic nickel titanium wires boast the additional feature of being activated by oral temperature.

Gradually thermodynamic nickel-titanium wires

The 1990s saw the emergence of gradually thermodynamic nickel-titanium wires since there is a consensus that the tooth's response to the application of force and the amount of tooth movement achieved are dependent on the periodontal surface area. This means that an ideal arch wire should not only generate constant and light forces but should also be able to vary the force magnitude according to the periodontal area involved. Thus, a range of different forces should be generated by the same arch wire in its different segments. The magnitude of force applied is graded across the entire arch wire length according to the size of the patient's teeth¹⁸.

Copper, nickel and titanium alloy (CuNiTi)

In the mid-1990s, nickel-titanium wires with the addition of copper (CuNiTi) first became available on the market. They consist basically of nickel, titanium, copper and chromium. Due to the incorporation of copper these wires feature better defined thermal properties than NiTi superelastic wires while yielding an outstanding system of forces with increased control over tooth movement. These wires were first marketed by Ormco Corporation with three transition temperatures (27° C, 35° C and 40° C), enabling clinicians to quantify and apply loads that are appropriate to the orthodontic treatment goals²⁷.

AESTHETIC ORTHODONTIC WIRES

Since orthodontic treatments extend over a number of months the aesthetic appearance of the appliance is rated by patients as a significant factor worthy of consideration. The demand for aesthetics led several companies to begin production, in the late 1970's, of non-metallic brackets made from polycarbonate or ceramics. Currently, aesthetic brackets have become an inescapable reality of the orthodontic clinic, offering an alternative to metal brackets. However, the same is not true of aesthetic wires, which were seldom reported in the orthodontic literature until the mid-2000s¹³.

Different types of aesthetic orthodontic wires have been launched on the market, such as: Teflon coated stainless steel wires, stainless steel wires coated with epoxy resin, orthodontic wires comprising a nylon-based matrix reinforced with silicone fibers, and orthodontic wires made from polymer composite material reinforced with glass fiber (Fig. 2).

Table 1 shows the development of orthodontic arch wires components throughout the history of orthodontics.



FIGURE 2 - Orthodontic appliance with aesthetic brackets. Composite wire reinforced with glass fiber on the upper arch and NiTi on the lower.

THE IMPORTANCE OF LEARNING ABOUT THE MECHANICAL PROPERTIES OF ORTHODONTIC ARCH WIRES

Many orthodontists choose their orthodontic wires based on clinical impressions. Ideally, however, the choice of arch wires should go hand in hand with knowledge of their mechanical properties. In the days when most orthodontists used only stainless steel arch wires with nearly identical moduli of elasticity for one and the same diameter, the tool most commonly used to gauge the amount of applied force was arch wire cross section variation. With the introduction of new alloys featuring different mechanical properties as well as nickel-titanium and beta-titanium alloys, orthodontists now have additional variables to control the magnitude of applied force⁴.

The traditional arch wire sequence, given the same material, provided progressively larger load/deflection rates as arch wire cross section increased. However, the variation in wire diameter also produced variation in the slack between the wire and bracket slot. When using small sized cross section arch wires the resulting excessive slack could lead to lack of control over the movement of the tooth crowns and roots. When using materials that have different moduli of elasticity, orthodontists can determine the amount of slack between the arch wire and the bracket slot thereby reducing the number of arch wires required for alignment⁴.

The ability to use rectangular cross-section arch wires with moduli of elasticity that are suited for the dental alignment and leveling phase enables orthodontists to maintain control over root position even during the early stages of treatment.

Nevertheless, there are situations in which round cross-section arch wires are the best choice, such as when the orthodontist desires first and second order movements or friction reduction⁴.

The elastic properties of arch wires serve as

PHASE	ALLOYS	CHRONOLOGY
PHASE I	gold	from the turn of the century to the early 1940s
	Stainless Steel	From the 1940s onward
PHASE II	stable NiTi	From the 1970s onward
	beta-titanium	Decade of the 1980s
PHASE III	Superelastic NiTi (active austenitic)	Mid-1980s
PHASE IV	Thermodynamic NiTi (active martensitic)	Decade of the 1990s
PHASE V	Gradually dynamic NiTi	Decade of the 1990s
PHASE VI	Metal wires with aesthetic coating	Decade of the 1990s
PHASE VII	Polymer composite wires lined with glass fiber	Researched in labs since 1994, launched on the market in 2008

TABLE 1 - Development stages of orthodontic wires.

a parameter to indicate the most recommended treatment phase for each arch wire. No single arch wire is best for all phases. There is no such thing as an ideal arch wire¹⁷.

Tooth alignment and leveling comprise the most important preliminary clinical phase in the fixed orthodontics procedure. Authors agree unanimously that continuous light forces are desirable to produce efficient, controlled and physiological tooth movement with minimal impact to the teeth and supporting tissues^{15,23}.

DEFINITION OF RESILIENCE

In the initial phase of treatment, resilience is an important mechanical property worthy of consideration by the orthodontist. Resilience is a property of arch wires whereby they store energy when deformed elastically, and release energy when unloaded²⁵. It represents the stored energy available in the wire to move teeth during deactivation.

DEFINITION OF MODULUS OF ELASTICITY

Modulus of elasticity (rigidity) is another variable that influences the success of any given treatment phase. It can be defined as a measure of the rigidity of the material. It is determined by the binding forces that operate between atoms. Since these forces are constant for each metal structure, the modulus is one of the most constant properties of metals²⁹. Clinically, it represents the magnitude of the force required to deflect or bend a wire. In an attempt to improve the biological environment for tooth movement and minimize the patient's discomfort the initiation of treatment requires low stiffness wires capable of producing lighter, constant forces during arch wire deactivation. However, during the finishing phase, stiffer arch wires - with a higher modulus of elasticity - should be used to contain the movements achieved in the earlier treatment phases²⁷.

DEFINITION OF ELASTIC LIMIT

Elastic limit refers to the maximum workload allowed. It is the maximum amount of stress that can be applied to a wire before it undergoes permanent deformation. It is the stress beyond which plastic deformation occurs and the material can no longer return to its original shape. A high elastic limit is desirable to prevent chewing forces from inducing plastic deformation or fracture²⁸.

DEFINITION OF FORMABILITY, WELDABILITY AND FRICTION

Formability refers to the ability of wires to be bent into desirable shapes without fracturing or deforming permanently while weldability relates to a wire's ability to have other materials, including accessories, welded to it. Stainless steel alloys are easily weldable¹⁰.

To achieve lower resistance to tooth movements and an improved response to the commands given through bends on the wires or pre-adjusted brackets, there should be no friction between wires and brackets⁷.

THE IMPORTANCE OF BIOCOMPATIBILITY

Due to the fact that orthodontic wires are positioned close to the oral mucosa for long time periods they should be resistant to corrosion, should not allow the release of ions in the oral cavity or cause allergic responses. In other words, orthodontic wires must be biocompatible with oral tissues²².

DEFINITION OF SHAPE MEMORY EFFECT

In conventional materials, when the elastic limit is exceeded and the load is removed, the material will show a permanent deformation of its crystalline structure represented by the macrostructural aspects of the shape (Fig. 3). However, alloys with "shape memory effect" undergo a reversal to the initial dimensions after deformation and reheating. It is as if the material "remembered" its original shape. This effect is called "Shape Memory Effect" and any alloy featuring this property is called "shape memory effect alloy." This phenomenon is characterized by a steady accumulation of force in the wire to the point of deformation. Similarly, when the wire is deactivated and returns to its original configuration the forces remain constant over a long period of time, which is clinically required to ensure physiological tooth movement²⁸.

Nickel-titanium alloys feature such property, which is applicable in Orthodontics.

There is a well known relation between shape memory effect and so-called "martensitic transformation", which can be defined as a change in the crystalline structure of nickel-titanium wires when tied to brackets. However, these wires show a tendency to return to the same original crystalline structure, which causes the return to the original wire shape as if they had never been deflected²⁸. If the martensitic transformation is caused by the load applied to the wire, it can be called superelastic. If such return to the original crystalline structure is induced by oral temperature the wire displays a thermal activation property.

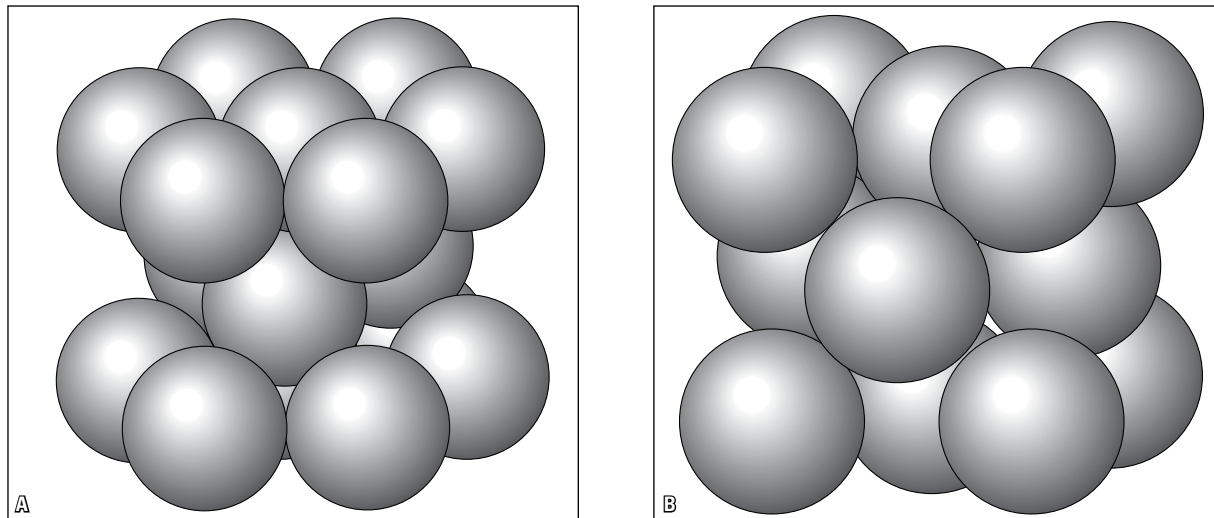


FIGURE 3 - **A)** Schematic representation of the compact hexagonal crystal structure of nickel-titanium alloys (martensitic phase). **B)** Schematic representation of the cubic crystal structure of face-centered nickel-titanium alloys (austenite phase).

KNOWLEDGE OF ORTHODONTIC WIRES APPLIED TO CLINICAL PRACTICE

When to use stainless steel alloys

Types 302 and 304 of 18-8 stainless austenitic wires are used in Orthodontics⁹.

For the tooth alignment and leveling phase even steel wires with a smaller cross-section result in high loads, which are not consistent with physiological forces. At this stage of the orthodontic treatment the use of steel wires is possible through the incorporation of loops that increase the wire's activation range and disguise, as it were, the low resilience and high stiffness of the wire. The disadvantage of using loops lies in the fact that as these loops lose their original shape they change the direction of force vectors. Loops can also hinder hygiene by entrapping food particles. If not positioned properly, loops can damage adjacent soft tissues (Fig. 4, 5).

Thus, to offset their relatively low resilience (compared with other alloys), stainless steel wires need to be bent during the alignment phase in order to increase the amount of wire

in the interbracket space and distribute the forces. Therefore, straight stainless steel arch wires would not be recommended in the initial stages of treatment without the use of loops⁶.

Stainless steel wires boast excellent resistance to corrosion¹⁶ and exhibit higher elastic limits and modulus of elasticity, which makes them more convenient than other alloys, especially in cases where more rigid wires are required, such as during the space closure and finishing phases (Fig. 6). These recommendations apply to both the Standard Edgewise and Straight Wire techniques.

Stainless steel wires feature excellent weldability and formability and - compared with all other alloys used in orthodontics - exhibit a lower friction coefficient.

The advantage of using stainless steel arch wires at the start of treatment, even with loops, lies in the fact that they allow greater control over the arch wire shape while preventing undesirable tooth expansions and projections. Besides, stainless steel arch wires are extremely affordable.

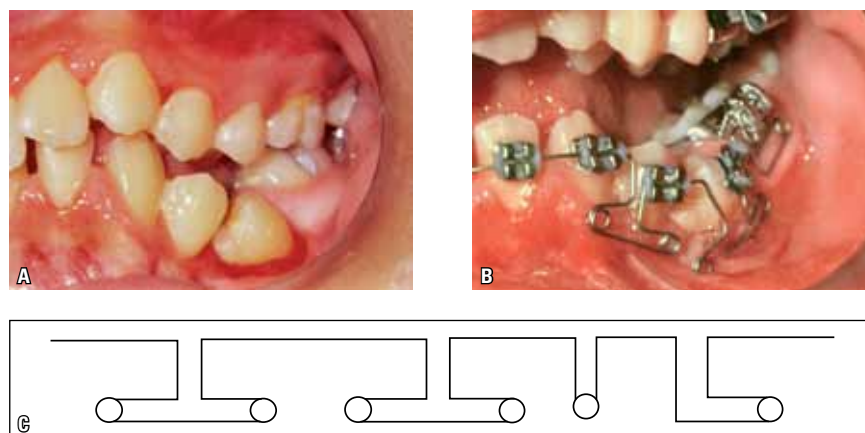


FIGURE 4 - **A)** Impaction of tooth 35 after removal of a dentigerous cyst in the region and misalignment of tooth 34. **B)** 0.014 Multiloop stainless steel arch wire for the alignment of an impacted second premolar and misalignment of the first premolar. **C)** Drawing of the loops made on the arch that is installed in the malocclusion shown in Figure A.

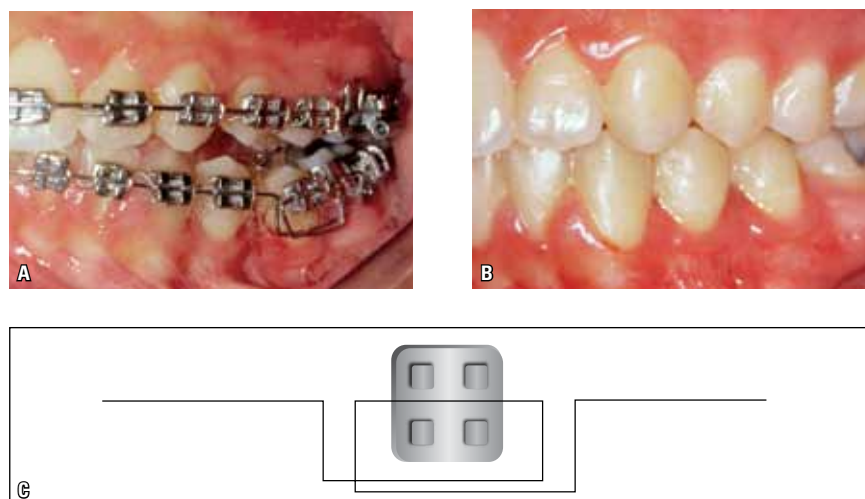


FIGURE 5 - **A)** Second premolar alignment and leveling continued (Fig. 4A) with 0.016" stainless steel wire and a box loop. **B)** Finished case (note gingival contour after removal of orthodontic appliance). **C)** Drawing of box loop in Figure A.

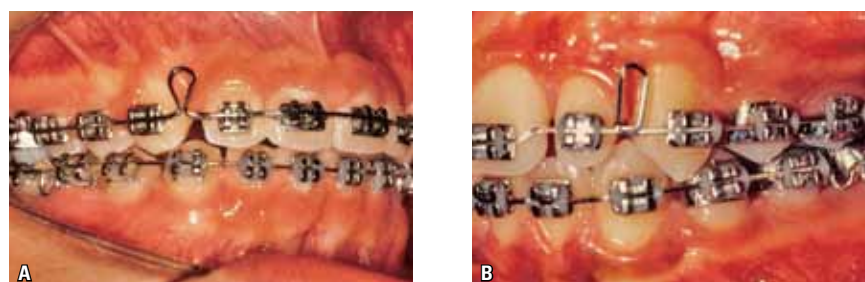


FIGURE 6 - 0.019 "x 0.025" stainless steel arch wire for upper incisor retraction: **A)** Drop-shaped loop and **B)** Reverse drop-shaped loop (reverse loop).

When to use multi-stranded stainless steel arch wires

By using multi-stranded stainless steel arch wires one can employ stainless steel arch wires in the initial stage of tooth alignment and leveling without the need for loops. These wires feature mechanical properties that differ considerably from conventional single-strand stainless steel wires even when similar diameters are compared¹⁹.

Multi-stranded wires can be braided, twisted or coaxial. All have similar properties and great potential for use in the early stages of orthodontic treatment²⁷.

The elastic recovery of multi-stranded wires is 25% higher than that of a conventional stainless steel wire of identical diameter¹⁹. The rigidity of interbracket segments is much lower than that of conventional stainless steel wires of identical diameter¹⁶.

When comparing conventional stainless steel wires with multi-stranded wires of similar diameter it is safe to state that the latter have one fifth the modulus of elasticity of the former, and an activation range 150 to 200 times greater than the former.

Stainless steel multi-stranded wires share some mechanical properties with nickel-titanium alloys²⁷.

The resilience of multi-stranded wires is considered high. However, their low elastic limit makes them susceptible to plastic deformation by external forces, such as chewing^{16,20}.

When subjected to identical stress these wires exhibit a much higher degree of permanent deformation than nickel-titanium²⁴.

With the purpose of saving chair time professionals often neglect to contour multi-stranded arch wires according to intercanine and intermolar widths as well as the shape and width of the patient's arch. Although less formable than conventional steel wires multi-stranded wires are responsive to contours and bends, such as omega loops for posterior tying, thus preventing tooth

projection. By resorting to this option the wire properties are optimized.

WHEN TO USE BETA-TITANIUM ALLOYS

Beta-titanium alloys have greater resilience than stainless steel wires of identical cross-section and approximately twice the stiffness of nickel-titanium wires. These wires, however, have less than half the modulus of elasticity and weldability of stainless steel wires. Therefore, similarly to stainless steel wires beta-titanium alloys can have hooks and other accessories welded to them, albeit with a certain amount of difficulty. Besides, the boast excellent formability¹¹. Thus, loops can be fashioned to close spaces or move specific teeth while producing much smaller loads than similar loop designs made with stainless steel (Fig. 7). These wires generate more friction than stainless steel wires but less friction than NiTi wires. Their clinical application would be best suited in situations where **load distribution** is lighter than what stainless steel alloys typically generate. Also in situations that require stiffness and formability, e.g., intermediate stages of treatment, such as space closure. Moreover, these wires have proven an ideal solution for patients with hypersensitivity to chromium and nickel, which are components of all other orthodontic alloys^{5,11}.

WHEN TO USE NICKEL-TITANIUM ALLOYS

For the tooth alignment and leveling phase nickel-titanium (NiTi) alloys feature extremely interesting properties. The unique properties inherent in these alloys are a high elasticity limit, low modulus of elasticity (low rigidity) and high resilience. These alloys can sustain a very wide deflection and return to their original shape while generating moderate and uniform forces. Both superelastic NiTi wires and thermally active wires as well as those to which copper has been added are more resilient and less rigid than other alloys. This means that these wires are the best choice¹⁵ when

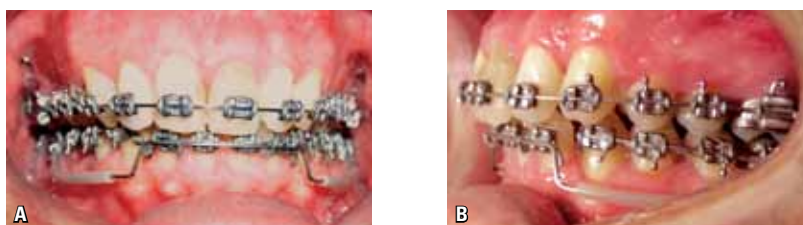


FIGURE 7 - Burststone-type incisor intrusion arch made of beta-titanium alloy and positioned on a utility arch: **A)** front view and **B)** side view

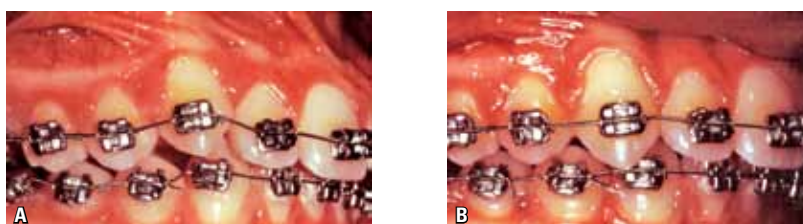


FIGURE 8 - Superelastic NiTi wire used in dental arch alignment given its adequate resilience and lower rigidity than other alloys while producing light and continuous forces.

it comes to producing light and continuous forces, even in the face of extensive deflections (Fig. 8).

NiTi wires can save professionals chair time since they do not require leveling and alignment loops or bends and can remain active in the oral cavity for a long period of time. These alloys feature low formability and bends can cause them to fracture. Thus, additional resources should be used for stops in the posterior region to prevent tooth projection. Since these alloys cannot be reshaped they are sold in pre-contoured forms. Professionals should therefore pay close attention to the original width of the patient's arches and always stock different arch forms to meet the needs of each particular case. Given the fact that these alloys will not respond to first, second and third order bends they should be used primarily in the Straight-Wire technique.

NiTi alloys are not weldable and have a higher friction coefficient with brackets when compared with stainless steel. In vitro studies have shown that nickel-titanium superelastic alloys

boast excellent elastic properties and generate continuous forces when subjected to loading, even in the presence of increased deflection. This feature has made these wires extremely popular for use in the leveling and alignment of teeth²³.

In addition to the properties of elastic recovery and resilience of superelastic wires, thermodynamic nickel-titanium wires exhibit an additional characteristic, i.e., heat activation. Thermally activated NiTi wires feature thermally induced shape memory effect in addition to being pliable at lower temperatures and returning to their initial configuration - with increased rigidity - when heated to approximately oral temperature²⁶.

On the other hand, since CuNiTi are manufactured for use under three transition temperatures (27° C, 35° C and 40° C) they can be used for different treatment²⁶ purposes, as described in Table 2.

With the launch of CuNiTi alloys on the market, orthodontic treatment protocols that

combine these wires with the use of self-ligating brackets have emerged. These protocols aim to achieve more biologically compatible treatments thanks to the deployment of physiological forces as well as shorter treatment time.

Currently, the Damon System® is the most popular brand of self-ligating brackets on the market. Unlike conventional mechanics, the designers of this system advocate that it is possible to move teeth without bone loss. In such cases, biological dynamics would purportedly enable a physiological adaptation of the alveolar bone in response to the orthodontic treatment. This issue, however, is still fraught with controversy in the literature.

FEATURES OF AESTHETIC ARCH WIRES

Teflon coated stainless steel arch wires

Teflon coating imparts to the wire a hue which is similar to that of natural teeth. The coating is applied by an atomic process that forms a layer of about 20-25µm thickness on the wire. This layer then undergoes a heating process and acquires a surface with excellent sliding properties and substrate adhesion¹⁴. Materials used for wire coating should fulfill the requirements of being easily applied in thin layers, resistant and having a low friction coefficient. They should also be biocompatible, pleasantly aesthetic and consistent with the translucency of aesthetic brackets and the different hues of the teeth¹⁷.

Manufacturers of orthodontic materials are currently investing in the search for the ideal wire coating, one that would combine aesthetics and mechanical efficiency. The different types of coatings can change some wire properties, such as friction. It should also be noted that Teflon coating protects the underlying wire from the corrosion process. However, since this coating is subject to flaws that may occur during clinical use, corrosion of the underlying wire is likely to take place after its prolonged use in the oral cavity.

CuNiTi	INDICATIONS
at 27°C	When a higher force magnitude is required to be constantly and rapidly conveyed to the teeth during deactivation, due to the fact that these wires are activated at lower than body temperatures their shape memory effect shows up immediately after tying, promoting fast alignment and leveling of malpositioned teeth. It is recommended that these wires be cooled (in a freezer or by applying "Endo-ice") at least one hour prior to insertion in the bracket slot to prevent premature activation when tying.
at 35°C	When moderate and constant forces are desired to align, level and rotate malpositioned teeth these wires are subject to deformation at temperatures lower than 20°C and would return to their original shape when exposed to oral temperature. Due to the fact that these wires are activated at body temperature they do not initiate reverse phase transformation as fast as wires manufactured at 27°C. Since only moderate forces are generated, rectangular arch wires can be used during the initial treatment phases. These wires should be cooled prior to insertion. Their efficacy can be noted within approximately one month after insertion.
at 40°C	When light, intermittent forces are required, 40°C CuNiTi arch wires are the best choice. Their use is recommended as the first arch wires for pain hypersensitive patients presenting with severely malpositioned teeth for whom rigid arch wires would be contraindicated either because of ligature issues or due to the generation of biologically incompatible forces. Since these wires are activated at 40°C patients should be instructed to use warm mouth rinse several times a day to further enhance the activation.

TABLE 2 - Aplicações clínicas dos fios de CuNiTi fabricados com diferentes temperaturas de ativação.

Stainless steel wires coated with epoxy resin

The coating process is performed through deposition by incrustation at the base of the wire using epoxy resin of about 0.002" thickness. With this procedure, a strong adhesion

between the coating and the internal wireless develops, thus preventing the wire from sliding underneath the coating layer.

The authors assessed the mechanical properties of aesthetic wires by comparing metal NiTi wires with aesthetically coated wires of the same diameter. The results of the comparison were as follows: Aesthetic wires fractured under lighter loads than non-coated; the three groups of wires tested in this study showed the widest thresholds, indicating that they were superior to non-coated wires;

The working limit of non-coated wires (GAC, Masel and TP brands), and the GAC and Masel aesthetic wires accumulated higher amounts of similar energy during activation. The non-coated TP wires accumulated a higher amount of energy during activation than could be endured by their resilience properties with variations between groups due to different activation loads. Aesthetic wires exhibited significantly higher activation thresholds than non-coated wires, demonstrating superior properties insofar as this feature is concerned. The deactivation thresholds of aesthetic wires were lower than those of non-coated wires, which demonstrates their superior performance regarding these properties²¹.

Orthodontic wires consisting of a nylon-based matrix and reinforced with silicone

This wire was launched in 2000. Known commercially as Optiflex® (Ormco Corp.), it was not recommended for clinical use and its mechanical properties were inferior to metal wires.

Orthodontic wires made of polymeric composite reinforced with glass fiber

Polymer composites are routinely used as dental restorative materials mainly due to their biocompatibility and aesthetic qualities. This combination of favorable aesthetic and mechan-

ical properties motivated the manufacture of orthodontic arch wires from a fiber-reinforced unidirectional polymer. This arch wire has the advantage of blending in with tooth color and being as rigid as metal arch wires. The elastic recovery of the composite wire should be sufficient to promote proper tooth movement, i.e., the wire should recover its original shape after being tied to the teeth.

Research with composite wire prototypes suggest that these arch wires could work well during the early and intermediate stages of orthodontic treatment. Research results show that composite arch wires have a stable modulus of elasticity. Since 1997 scholars have predicted that with the introduction of aesthetic composite materials metal wires will likely be replaced in most orthodontic applications, just as metal alloys were replaced by aerospace industry composites¹⁷.

In 2003, Huang et al.¹³ compared composite wire with metal Ni-Ti wire (Reflex®, TP Orthodontics Inc.). The results showed that the mechanical performance of the prototype was comparable to that of metal wire.

However, some contraindications regarding the of aesthetic wires should be highlighted, such as: Transverse fractures, stress fractures with fiber detachment, fractures flush with the surface of the polymer/fiber interface, compression fractures originating in bends located in the fibers and fractures flush with the intralaminar surface²¹.

The use of arch wires whose size can remain constant while their mechanical properties are undergoing changes that facilitate in achieving the goals of each treatment phase, could theoretically lead to fewer arch wire replacements. In order to play this role satisfactorily the arch wire in question needs to have the necessary endurance to remain in the oral cavity for a time period equal to or greater than is usually the case with other arch wires.

CONCLUSIONS

Acquiring scientific knowledge of orthodontic wires can be a daunting task. Ultimately, however, it becomes fascinating insofar as it enables professionals to choose the best possible treatment protocol for the patient thereby rendering treatment more effective, faster, less costly and less likely to cause damage to teeth and supporting tissues. Most importantly, however, a comprehensive knowledge of wires allows the orthodontist to make an informed - and therefore safer - choice of arch wires free from media manipulation.

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- Manuscripts must be submitted via www.dentalpress.com.br/pubartigos. Articles must be organized as described below.

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- Must comprise the title in English, an abstract and keywords.
- Information about the authors must be provided on a separate page, including authors' full names, academic degrees, institutional affiliations and administrative positions. Furthermore, the corresponding author's name, address, phone numbers and e-mail must be provided. This information is not made available to the reviewers.

2. Abstract

- Preference is given to structured abstracts in English with 250 words or less.
- The structured abstracts must contain the following sections: INTRODUCTION: outlining the objectives of the study; METHODS, describing how the study was conducted; RESULTS, describing the primary results, and CONCLUSIONS, reporting the authors' conclusions based on the results, as well as the clinical implications.
- Abstracts in English must be accompanied by 3 to 5 keywords, or descriptors, which must comply with MeSH.

3. Text

- The text must be organized in the following sections: Introduction, Materials and Methods, Results, Discussion, Conclusions, References and Illustration legends.
- Texts must contain no more than 4,000 words, including captions, abstract and references.
- Illustrations and tables must be submitted in separate files (see below).
- Insert the legends of illustrations also in the text document to help with the article layout.

4. Illustrations

- Digital images must be in JPG or TIF, CMYK or grayscale, at least 7 cm wide and 300 dpi resolution.
- Images must be submitted in separate files.
- In the event that a given illustration has been published previously, the legend must give full credit to the original source.
- The author(s) must ascertain that all illustrations are cited in the text.

5. Graphs and cephalometric tracings

- Files containing the original versions of graphs and tracings must be submitted.

- It is not recommended that such graphs and tracings be submitted only in bitmap image format (not editable).
- Drawings may be improved or redesigned by the journal's production department at the discretion of the Editorial Board.

6. Tables

- Tables must be self-explanatory and should supplement, not duplicate the text.
- Must be numbered with Arabic numerals in the order they are mentioned in the text.
- A brief title must be provided for each table.
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- All manuscripts must be accompanied by the following written statement signed by all authors: "Once the article is published, the undersigned author(s) hereby assign(s) all copyright of the manuscript [insert article title here] to Dental Press International. The undersigned author(s) warrant(s) that this is an original article and that it does not infringe any copyright or other third-party proprietary rights, it is not under consideration for publication by another journal and has not been published previously, be it in print or electronically. I (we) hereby sign this statement and accept full responsibility for the publication of the aforesaid article."
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- Articles must, where appropriate, refer to opinions of the Ethics Committees.

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- All articles cited in the text must appear in the reference list.
- All listed references must be cited in the text.
- For the convenience of readers, references must be cited in the text by their numbers only.
- References must be identified in the text by superscript Arabic numerals and numbered in the order they are mentioned in the text.
- Journal title abbreviations must comply with the standards of the "Index Medicus" and "Index to Dental Literature" publications.
- Authors are responsible for reference accuracy,

which must include all information necessary for their identification.

- References must be listed at the end of the text and conform to the Vancouver Standards (http://www.nlm.nih.gov/bsd/uniform_requirements.html).
- The limit of 30 references must not be exceeded.
- The following examples should be used:

Articles with one to six authors

Sterrett JD, Oliver T, Robinson F, Fortson W, Knaak B, Russell CM. Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man. *J Clin Periodontol*. 1999 Mar;26(3):153-7.

Articles with more than six authors

De Munck J, Van Landuyt K, Peumans M, Poitevin A, Lambrechts P, Braem M, et al. A critical review of the durability of adhesion to tooth tissue: methods and results. *J Dent Res*. 2005 Feb;84(2):118-32.

Book chapter

Kina S. Preparos dentários com finalidade protética. In: Kina S, Brugnera A. *Invisível: restaurações estéticas cerâmicas*. Maringá: Dental Press; 2007. cap. 6, p. 223-301.

Book chapter with editor

Breedlove GK, Schorfheide AM. Adolescent pregnancy. 2ª ed. Wiecezorek RR, editor. White Plains (NY): March of Dimes Education Services; 2001.

Dissertation, thesis and final term paper

Beltrami LER. Braquetes com sulcos retentivos na base, colados clinicamente e removidos em laboratórios por testes de tração, cisalhamento e torção. [dissertação]. Bauru: Universidade de São Paulo; 1990.

Digital format

Câmara CALP da. Estética em Ortodontia: Diagramas de Referências Estéticas Dentárias (DRED) e Faciais (DREF). *Rev Dental Press Ortod Ortop Facial*. 2006 nov-dez;11(6):130-56. [Acesso 12 jun 2008]. Disponível em: www.scielo.br/pdf/dpress/v11n6/a15v11n6.pdf.

* www.dentalpress.com.br/pubartigos

1. Registration of clinical trials

Clinical trials are among the best evidence for clinical decision making. To be considered a clinical trial a research project must involve patients and be prospective. Such patients must be subjected to clinical or drug intervention with the purpose of comparing cause and effect between the groups under study and, potentially, the intervention should somehow exert an impact on the health of those involved.

According to the World Health Organization (WHO), clinical trials and randomized controlled clinical trials should be reported and registered in advance.

Registration of these trials has been proposed in order to (a) identify all clinical trials underway and their results since not all are published in scientific journals; (b) preserve the health of individuals who join the study as patients and (c) boost communication and cooperation between research institutions and with other stakeholders from society at large interested in a particular subject. Additionally, registration helps to expose the gaps in existing knowledge in different areas as well as disclose the trends and experts in a given field of study.

In acknowledging the importance of these initiatives and so that Latin American and Caribbean journals may comply with international recommendations and standards, BIREME recommends that the editors of scientific health journals indexed in the Scientific Electronic Library Online (SciELO) and LILACS (Latin American and Caribbean Center on Health Sciences) make public these requirements and their context. Similarly to MEDLINE, specific fields have been included in LILACS and SciELO for clinical trial registration numbers of articles published in health journals.

At the same time, the International Committee of Medical Journal Editors (ICMJE) has suggested that editors of scientific journals require authors to produce a registration number at the time of paper submission. Registration of clinical trials can be performed in one of the Clinical Trial Registers validated by WHO and ICMJE, whose addresses are available at the ICMJE website. To be validated, the Clinical Trial Registers must follow a set of criteria established by WHO.

2. Portal for promoting and registering clinical trials

With the purpose of providing greater visibility to validated Clinical Trial Registers, WHO launched its Clinical Trial Search Portal (<http://www.who.int/ictrp/network/en/index.html>), an interface that allows simultaneous searches in a number of databases. Searches on this portal can be carried out by entering words, clinical trial titles or identification number. The results show all the existing clinical trials at different stages of implementation with links to their full description in the respective Primary Clinical Trials Register.

The quality of the information available on this portal is guaranteed by the producers of the Clinical Trial Registers that form part of the network recently established by WHO, i.e., WHO Network of Collaborating Clinical Trial Registers. This network will enable interaction between the producers of the Clinical Trial Registers to define best practices and quality control. Primary registration of clinical

trials can be performed at the following websites: www.actr.org.au (Australian Clinical Trials Registry), www.clinicaltrials.gov and <http://isrctn.org> (International Standard Randomized Controlled Trial Number Register (ISRCTN)). The creation of national registers is underway and, as far as possible, the registered clinical trials will be forwarded to those recommended by WHO.

WHO proposes that as a minimum requirement the following information be registered for each trial. A unique identification number, date of trial registration, secondary identities, sources of funding and material support, the main sponsor, other sponsors, contact for public queries, contact for scientific queries, public title of the study, scientific title, countries of recruitment, health problems studied, interventions, inclusion and exclusion criteria, study type, date of the first volunteer recruitment, sample size goal, recruitment status and primary and secondary result measurements.

Currently, the Network of Collaborating Registers is organized in three categories:

- Primary Registers: Comply with the minimum requirements and contribute to the portal;
- Partner Registers: Comply with the minimum requirements but forward their data to the Portal only through a partnership with one of the Primary Registers;
- Potential Registers: Currently under validation by the Portal's Secretariat; do not as yet contribute to the Portal.

3. Dental Press Journal of Orthodontics - Statement and Notice

DENTAL PRESS JOURNAL OF ORTHODONTICS endorses the policies for clinical trial registration enforced by the World Health Organization - WHO (<http://www.who.int/ictrp/en/>) and the International Committee of Medical Journal Editors - ICMJE (# <http://www.wame.org/wamestmt.htm#trialreg> and http://www.icmje.org/clin_trialup.htm), recognizing the importance of these initiatives for the registration and international dissemination of information on international clinical trials on an open access basis. Thus, following the guidelines laid down by BIREME / PAHO / WHO for indexing journals in LILACS and SciELO, DENTAL PRESS JOURNAL OF ORTHODONTICS will only accept for publication articles on clinical research that have received an identification number from one of the Clinical Trial Registers, validated according to the criteria established by WHO and ICMJE, whose addresses are available at the ICMJE website <http://www.icmje.org/faq.pdf>. The identification number must be informed at the end of the abstract.

Consequently, authors are hereby recommended to register their clinical trials prior to trial implementation.

Yours sincerely,

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