Use of nickel-titanium rotary instruments by endodontists in the state of Rio Grande do Sul, Brazil

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ABSTRACT

Objective: To assess the use of nickel-titanium rotary instruments among endodontists in the state of Rio Grande do Sul, southern Brazil. **Methods:** A survey was conducted with all endodontists registered at the Regional Council of Dentistry (CRO/RS). **Results:** A total of 430 questionnaires were sent to endodontists via regular mail, and 106 returned (25% return rate). The great majority of respondents (88.7%) reported to have already used nickel-titanium rotary instruments, and 44.3% of these reported to have received training as part of lato sensu specialization programs. The main advantages associated with rotary vs. manual instrumentation were less fatigue to the professional and improved comfort to the patient (29%), and faster instrumentation (24.9%). Cost was the most frequent reason for not using or for interrupting use of rotary instrumentation (55.8% and 59.3%, respectively). The most frequent problem observed was file fracture (54%). A longer time working as an endodontist negatively influenced the use of endodontic instruments ($p = 0.03$), but did not affect file fracture. **Conclusion:** Most of the endodontists in the state of Rio Grande do Sul use and recognize the benefits of rotary instrumentation. However, the high costs involved and frequent file fracture impede a more extensive use of this technology.

Keywords: Instrumentation. Endodontics. Diffusion of innovation.

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Introduction

Endodontic instruments are essential elements in the cleaning and shaping of root canals, and several authors have reported, over the last decades, on the great influence exerted by the root canal preparation phase on the results of obturation procedures.[1,2]

In the 60s, endodontic instruments were fabricated from carbon steel. However, the identification of some disadvantages associated with this material resulted in its subsequent replacement with stainless steel. Stainless steel instruments, in turn, were also found to present poor flexibility (especially the higher tapers), potentially leading to procedural errors, especially in curved canals.[3] Moreover, several studies have shown a high incidence of apical transportation associated with stainless steel instruments.[4,5]

More recently, in the 80s, the first endodontic instruments fabricated from nickel-titanium alloys were introduced into the market. These instruments presented two to three times more flexibility when compared with stainless steel instruments, in addition to increased resistance to fracture and shape memory effect.[6] Nickel-titanium rotary instruments have been shown to effectively produce a well-prepared root canal, with a low margin for procedural errors,[7,8] thus improving clinical outcomes.[9]

The advent of nickel-titanium alloys allowed the design and development of rotary instruments with 360-degree rotation, to be used specifically in curved canals. This contributed to a more rapid preparation process and to a lower degree of stress for both the endodontist and the patient.[10,11]

In spite of the many advantages described in the literature for nickel-titanium endodontic instruments, no study so far has provided information on the use of this new technology in clinical practice in Brazil. Therefore, we conducted a survey with endodontists in the state of Rio Grande do Sul, southern Brazil, to assess the use of nickel-titanium rotary instruments and to identify possible reasons for using, not using or interrupting the use of these instruments during the preparation of root canals.

Methods

The study protocol was approved by the Research Ethics Committee of Federal University of Santa Maria (UFSM), state of Rio Grande do Sul, Brazil (protocol No. 0127.0.243.362-08). All dental professionals included in the study signed an informed consent form.

The study sample comprised all endodontists registered with the state dental board, namely Conselho Regional de Odontologia do Estado do Rio Grande do Sul (CRO/RS), at a total of 430 professionals. The addresses of all endodontists were provided by CRO/RS.

Subjects were asked to fill a questionnaire (in Brazilian Portuguese) constructed to address data such as sex, age, time working as an endodontist and nine other questions concerning the use of rotary instrumentation, as follows:

» Question 1: Have you already used nickel-titanium rotary instruments?

» Question 2: If yes, have you attended any training to learn how to use these instruments?

» Question 3: In case you do not use nickel-titanium rotary instruments, can you explain the reasons for this decision?

» Question 4: If you have had previous experience with rotary instruments, but have stopped using them, please explain the reasons for your decision.

» Question 5: How long have you been using (or did use) the instruments, in months?

» Question 6: How often do you use nickel-titanium rotary instruments in a week?

» Question 7: Please list any problems you have experienced during the use of nickel-titanium rotary instruments.

» Question 8: Have you observed any advantages associated with rotary instrumentation when compared with manual instrumentation?

» Question 9: In case you have experienced instrument fracture, what do you think has caused the problem?

Questionnaires were sent to endodontists via regular mail together with informed consent forms and prepaid return envelopes.

A pilot study was initially conducted with nine graduate students of endodontics so as to assess the clarity of questions. The results of this pilot study were used to adjust the questions and to prepare the final version of the questionnaire.

The answers to each question were analyzed and tabulated to allow individual comparison of data.

Results were submitted to the analysis of frequency measures and plotted in graphs and tables so as to facilitate data interpretation. Significance was set at 0.05%.

Results

Of a total of 430 questionnaires sent to endodontists, 106 returned (response rate of approximately 25%). Table 1 describes the sample in terms of sex, age, and time working as an endodontist.

Time working as an endodontist was inversely related with use of nickel-titanium rotary instruments: Professionals working as endodontists for a longer time reported a lower frequency of use of rotary instrumentation, with a statistically significant difference ($p = 0.03$).

With regard to the use of nickel-titanium rotary instruments (question 1), 94 (88.7%) respondents reported to have already used this type of instrument, in contrast with 12 (11.3%) who reported not to use or have used them.

Among the endodontists who reported to use rotary instrumentation, 44.3% had received training (question 2) as part of lato sensu specialization programs, 25.5% had attended specific/commercial rotary instrumentation training courses, 12% did not attend any course, and 6.6% reported that they had received training both as part of specialization programs and at specific/commercial courses; 11.3% did not answer this question.

The reasons for not using nickel-titanium rotary instruments (question 3) and for interrupting their use are shown in Tables 2 and 3, respectively.

In response to question 5 (time using the instruments), 18% of the respondents informed that they had been using or had used the instruments for 0 to 12 months, 13% for 13 to 24 months, 16% for 24 to 36 months, and 33% for more than 36 months; 20% of the participants did not answer this question.

The weekly frequency of use of nickel-titanium rotary instruments was as follows: 19.8% of the respondents used them less than once a week and 20.8% used them more than five times a week; 27.3% reported to use the instruments between one and five times a week, and 32.1% did not answer this question.

Table 1. Rate of use of nickel-titanium rotary instruments according to sex, age, and time working as an endodontist.

Variable	n (%)
Sex	
Female	64 (60.4)
Male	42 (39.6)
Age (years)	
20 to 29	12 (11.3)
30 to 39	52 (49.1)
40 to 49	28 (26.4)
50 or over	14 (13.2)
Time working as an endodontist	
1 to 5 years	23 (21.7)
5 years and 1 month to 10 years	41 (38.7)
10 years and 1 month to 15 years	14 (13.2)
15 years or over	28 (26.4)

Table 2. Reasons for not using nickel-titanium rotary instruments (n = 43 answers)*.

Reason	No. of answers	%
Cost	24	55.8
Long time required to learn the technique	3	7.0
Difficult use	2	4.6
No specific reason	14	32.6
Total	43	100.0

* Respondents could provide more than one answer to the question.

Table 3. Reasons for interrupting the use of nickel-titanium rotary instruments (n = 59 answers)*.

Reason	No. of answers	%
Cost	35	59.3
Instrument fracture	12	20.3
Difficult use	5	8.5
Did not like the results	2	3.4
Long time required to learn the technique	0	0.0
No specific reason	5	8.5
Total	59	100.0

* Respondents could provide more than one answer to the question.

Table 4. Problems observed during the use of nickel-titanium rotary instruments (n = 100 answers)*.

Problem	No. of answers	%
File fracture	54	54.0
Apical deviation	13	13.0
Excessive dentin removal	8	8.0
Zips in curved canals	7	7.0
Root canal leakage	2	2.0
Perforation of curved canals	1	1.0
Other reason	9	9.0
Do not know	6	6.0
Total	100	100

* Respondents could provide more than one answer to the question.

Table 5. Advantages associated with rotary instrumentation (n = 277 answers)*.

Advantage	No. of answers	%
Less fatigue for the professional and improved comfort for the patient	80	29.0
Faster instrumentation	69	24.9
Easier obturation	54	19.5
Maintenance of canal curvature	50	18.0
Maintenance of working length	19	6.8
Other	5	1.8
Total	277	100

* Respondents could provide more than one answer to the question.

Table 6. Reasons for instrument fracture (n = 140 answers)*.

Problem	No. of answers	%
Excessive pressure on the file	43	30.8
Overusage	34	24.4
Complex canal anatomy	26	18.6
Wrong angle of file insertion	9	6.4
Wrong sequence of file use	7	5.0
Insufficient irrigation of the canal	4	2.8
Excessively high rotation	3	2.1
Non-constant rotation speed	3	2.1
Patient bit the handpiece	2	1.4
Other	4	2.8
Do not know	5	3.6
Total	140	100

* Respondents could provide more than one answer to the question.

The longer the professional had been working as an endodontist, the lesser times the instruments were used weekly (p = 0.017).

The problems observed during preparation with nickel-titanium rotary instruments are listed in Table 4.

Table 5 shows the advantages associated with rotary vs. manual instrumentation, and Table 6 shows the reasons attributed to instrument fracture.

The frequency of instrument fracture was not statistically influenced by time working as an endodontist (p = 0.416).

Discussion

The present study assessed the use of nickel-titanium rotary instruments by endodontists in the Brazilian southern state of Rio Grande do Sul. Of all professionals who answered the questionnaire, 88.7% reported to have used or use nickel-titanium rotary instruments. This result is in line with surveys conducted in Australia and in the United States, which have revealed rates of 64 and 98% for the use of this technology among endodontists.

The data collection method employed in the present study, namely questionnaires sent via regular mail to all endodontists registered with the state dental board, aimed to recruit a large sample at a relatively low cost when compared with one-to-one interviews (the CRO refused to provide the emails addresses of the endodontists). Our response rate was of approximately 25%, similar to the response rates obtained in other studies, e.g. 25%,[12] 32%,[13] and 38%.[14] Parashos and Messer[15] obtained a response rate as high as 87%; however, in that study, each questionnaire was sent to the participants three times, and telephone contact was made with those who did not return the material via regular mail.

Among the endodontists who reported to use nickel-titanium rotary instruments, 44.3% had received training as part of lato sensu specialization programs, and 25.5% at specific/commercial rotary instrumentation courses. Reit et al[10] found that a combination of theoretical and hands-on training sessions resulted in a better short-term acceptance rate (94%) when compared with teaching given only in lecture format (53%). Those authors concluded that the short-term acceptance of a new technology

may be influenced by the design of the introductory educational program that professionals attend. Parashos and Messer,[15] in turn, found that 73% of the respondents sought continuing education programs. Koch et al[11] have also assessed the rate of use of nickel-titanium rotary instruments and concluded that the technique was fully adopted by 77% of dental professionals who had attended an educational program on rotary instrumentation; this result was significantly higher than that found in the group who had not attended the program (6%). All these studies emphasize the importance of education/training for the adoption of a new technology. The fact that more endodontists are using rotary instrumentation in the current days is probably a reflection of the significant recent increase in the number of lato sensu programs in Brazil.

For a new technology to be adopted, it is necessary that professionals perceive advantages associated with its use when compared with an already consolidated, successful technique. Rogers[16] suggests that the diffusion of innovations takes place through a five-step process: Knowledge, persuasion (the individual is interested in the innovation and actively seeks information/detail about the innovation), decision (the individual weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject it), implementation, and confirmation.

In the present study, the main advantages associated with the use of nickel-titanium rotary instruments vs. manual instrumentation were less fatigue for the professional and improved comfort for the patient (29%), faster instrumentation (24.9%), easier obturation (19.5%), and maintenance of canal curvature (18%). Similar results were obtained by Parashos and Messer,[15] who found the following advantages associated with the use of rotary instruments vs. manual stainless steel instruments: Faster canal preparation (80%), maintenance of canal curvature (73%), easier obturation (72%), and maintenance of working length (66%). Bjorndal and Reit[17] observed an apparent influence of nickel-titanium rotary instrumentation on treatment time and also on the number of sessions necessary to complete treatment.

One of the main findings of the present study was that cost was the most influent factor in the decision not to adopt nickel-titanium rotary instruments, cited by 55.8% of respondents. In addition, the main factors determining interruption of rotary instrumentation (for those who used the technology for some time) were, again, cost (59.3% of respondents), followed by instrument fracture (20.3%). Similar results were obtained by Bird et al[14] in a survey on usage parameters of nickel-titanium rotary instruments. Those authors found that the most significant factors affecting use of rotary instrumentation were instrument fracture (52%) and cost (55%), independently of time working as an endodontist or geographic region. Parashos and Messer,[15] in turn, found the following three main (most frequently cited) reasons for not using rotary instruments: No perceived advantages, instrument fragility, and high cost.

Operator experience has been suggested to be an important factor affecting fracture and plastic deformation of files during the shaping process.[18,19] Other authors have shown that, in addition to operator experience, adequate training also contributes to minimizing fracture of rotary instruments.[20,21]

In the present study, the two main causes of file fracture cited by respondents were excessive pressure on the file (30.8%) and overusage (24.4%). These results are in line with those reported by Parashos and Messer[15] who also found excessive pressure (62%) and overusage (43%) as the main reasons for instrument fracture.

Another factor that seems to significantly influence instrument fracture is the number of times that files are used. There is no consensus in the literature with regard to the number of times an instrument can be used without any risk of fracture. In fact, in more complex cases, e.g. curved or calcified canals, studies have recommended that instruments be discarded after only one use.[22,23,24] However, discarding rotary instruments after one use would result in even higher costs, further reinforcing the already strongest reason for not using rotary instruments among the endodontists surveyed in our study. In the study conducted by Bird et al,[14] 21% of the respondents informed that they discarded nickel-titanium rotary instruments after only one use. Parashos and Messer[15] found that 70% of the respondents used the instruments 2 to 5 times, whereas 19% reported to use the files 6 to 10 times; only 12% reported to discard the instrument after one use.

It is possible to observe that the high cost of new technologies significantly influences the decisions made by professionals. However, the inclusion of at least one technique of rotary instrumentation in the core curriculum of undergraduate dental schools is of paramount importance and would allow students to discuss the indications, advantages and disadvantages of this treatment modality. This measure would also ensure a more comprehensive understanding of instrumentation,[25] as well as guarantee that endodontic teaching and training is coherent with the technological development of endodontics.

Conclusions

Our findings allow us to draw the following conclusions:

- Most of the endodontists in the state of Rio Grande do Sul (Brazil), use and recognize the benefits of rotary instrumentation. However, the high costs involved and frequent file fracture impede a more extensive use of this technology.

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