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Effect of Educational Program on Use of Rotary Nickel-Titanium Endodontic Instruments: A Questionnaire Survey among Bulgarian Dental Practitioners

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Abstract: ***Aim: The aim of this questionnaire survey was to investigate the importance of university endodontic programs for improving knowledge of rotary instrumentation and acquiring more practical experience in using new brands of nickel-titanium rotary instruments in everyday dental practice. Methods: The sample consisted of 600 dental practitioners chosen on a random basis from all administrative districts in Bulgaria. The respondents received a specially designed online questionnaire comprising 15 closed-format questions divided in two separate parts. Only dentists practicing endodontics filled in the second part. Results: Two hundred and six (34.33%) dentists responded and filled in the questionnaire. NiTi instruments are used always or frequently by about 60% of the respondents practicing in the capital or in a district city. Commercial lectures (62.9%) and training courses (71.8%) were the basic source for theoretical knowledge and practical experience. Low importance of university programs was registered, but expectations for the inclusion of more rotary systems in university programs were clearly demonstrated. Conclusion: Constantly increasing interest towards implementation of NiTi rotary techniques into everyday dental practice was registered. Younger metropolitan dentists proved themselves more confident in the use of contemporary endodontic shaping systems, but the university students training courses need to be further developed.***

Keywords: Dental practitioner, Questionnaire, Nickel-titanium rotary files, Practical skills, University programs

1. Introduction

The endodontic treatment outcome and prognosis are highly dependent on the thorough cleaning, shaping and three-dimensional filling of the complex root canal space [3, 17, 20]. Nowadays, the success of these challenging procedures, especially in oval-shaped and severely curved canals, goes hand in hand with the application of new technological improvements [7, 17]. The invention and introduction of nickel-titanium instruments into practice is a revolutionary step resulting in less procedural errors, improved cutting efficiency and better fracture resistance than stainless steel files [22, 23, 24]. The resistance of instruments to cyclic fatigue and torsional overloading has been improved with the introduction of new manufacturing processes [9, 10] and different modes of rotation [6, 8, 21]. Owing to the specific characteristics of the nitinol alloy, the nickel-titanium files have become famous for their flexibility, super elasticity and ability to follow the original root canal, even in more complex cases [12, 27].

The nickel-titanium files are constantly increasing their popularity among general practitioners and endodontic specialists. Data from surveys among dentists in Australia [18, 19], Sweden [15], Denmark [4], Belgium [25], Saudi Arabia [2], and Sudan [1] reveal the preference to rotary instrumentation and implementation of new techniques and brands of files. The studies use specifically designed questionnaires for collection and analysis of the information. Their objectiveness, ease of delivering inexpensive and quick results and potentials to address and assess problems in clinical practice makes them a tool widely acknowledged by researchers.

The university programs with their contemporary educational approaches reflect the recent improvement of endodontic techniques and materials. Comprehensive theoretical and practical endodontic courses have been developed for undergraduates to introduce the new techniques and instruments and meet the higher expectations of the future practitioners [11, 13, 15, 16]. Basic endodontic topics and the concept of NiTi rotary instrumentation are presented not only by the endodontic departments/units, but also by lecturers of trade companies.

Recently, an increased interest of Bulgarian dental practitioners in adoption of rotary NiTi instrumentation was registered [14] but it is not yet clear how it is influenced by the university curriculum and what is the role of different sources of theoretical knowledge and practical skills.

The aim of this questionnaire survey was to investigate the importance of university endodontic programs for improving knowledge of rotary instrumentation and acquiring more practical experience in using new brands of nickel-titanium rotary instruments in everyday dental practice.

2. Method

Questionnaire design

The data in this cross-sectional study was collected on the basis of a specially designed online questionnaire (available from the authors) comprising 15closed-format questions

divided in two separate parts. A pilot questionnaire was tested on 10 general dental practitioners asked to evaluate the clarity of the questions and thus the final version was adopted based on their comments and understanding of the survey. The first part of the questionnaire included 5 questions: four of them were a multiple-choice type and participants chose the proper answers concerning the place and period of high-school graduation, the location and type of their dental practice. A positive or a negative statement was required in the fifth question concerning the performance of a root canal treatment in their practice.

Only dentists who were practicing endodontics filled in the second part and answered to questions with a possibility for a single choice. They gave information concerning the frequency, number and type of used nickel-titanium rotary systems and the results of their use. Awareness of the types and qualities of the newly introduced reciprocating systems and instruments for a glide path creation was examined. The importance of university lectures and practical training lessons for acquiring theoretical knowledge and practical experience in use of NiTi systems was compared to non-university sources. It was further evaluated by discussing the need of more lessons and knowledge on more nickel-titanium rotary endodontic systems.
A letter requesting for participation and explaining the objectives of the study accompanied the questionnaire. Absolute anonymity was guaranteed as no personal data were collected.

Distribution and collection of the questionnaire
The questionnaire was created by using a Google template allowing immediate answers. It was sent to the e-mails of the participants via their local dental organizations without a direct contact with the participants in the survey. When fully completed responses were automatically sent to the researchers by the web system.

The sample consisted of 600 dental practitioners chosen on a random basis from all administrative districts in Bulgaria. The data were collected from January 2022 to February 2022.

Statistical analysis
The collected data from the Google format questionnaire were automatically entered into a Microsoft Excel spreadsheet, with each response allocated in a separate column. Responses were analyzed using SPSS; Version 19. The statistical analysis included chi-square test, with level of significance set at $p<0.05$.

3. Results

Two hundred and six (34.33%) dentists responded and filled in the questionnaire. The questionnaire was completed by 98.5% by them as they performed endodontic treatment.
Preference to NiTi rotary systems according to workplace location. One of three possible answers concerning the current location of the dental practice was chosen by the participants: in the capital (53.2%), in a district city (34%) and in a town with a smaller number of population (12.8%). Respondents in the capital and district cities used rotary NiTi instruments significantly more often than their colleagues in smaller cities (Table 1). Dentists from the capital city preferred them "always" in 37.7% and "frequently" in 27.4% and these from the district cities – in 42.6% and 20.6%, respectively. Only 10.4% from the capital and 16.2% from the district cities "never" used them.

Preference to NiTi rotary systems according to the graduation place. The prevailing part of the respondents (79.3%) acquired their diplomas in Sofia, 14.3%-in Plovdiv, 2.5% in Varna and 3.9%-abroad. Users of NiTi files dominated significantly non-users (Table 1). Forty-one percent of Sofia University graduates preferred these systems "always", 35.7%-"frequently" and 20.8%-"sometimes". The results for the Plovdiv University graduates were 35.7%, 32.1% and 17.9%, respectively. Around 15% of the former students of Sofia and Plovdiv University never used rotary instrumentation.

Preference to NiTi rotary systems according to the graduation year (clinical experience). The majority of respondents graduated and were practicing in the last two decades – 52% graduated after the year 2006 and 19.6%-in the period 1996-2005. For 15.7% of the participants the graduation was in the period 1986-1995 and for 12.7%-before 1985. The cross-tabulation between year of graduation and adoption of NiTi systems revealed an increasing usage of rotary NiTi instruments in younger dentists but the difference remained insignificant (Table 1). Recent years graduates preferred "always" rotary instrumentation in 37.5%, "frequently" – in 21.2% and "sometimes" – in 25%.

Table 1: Preference to nickel-titanium rotary systems

Question	Variable	Usage of NiTi rotary systems		p-Value
		Yes n (%)	No n (%)	
Location of dental practice	Capital (Sofia)	95 (89, 6)	11 (10, 4)	0, 001
	District city	57 (83, 8)	11 (16, 2)	
	Smaller city	15 (60, 0)	10 (40, 0)	
Graduation place	Sofia	134 (84, 3)	25 (15, 7)	
	Plovdiv	24 (85, 7)	4 (14, 3)	0, 036
	Varna	2 (40, 0)	3 (60, 0)	
	Abroad	7 (100, 0)	-	
Year of graduation	Before 1985	19 (73, 1)	7 (26, 9)	
	1986-1995	29 (90, 6)	3 (9, 4)	0, 309
	1996-2005	33 (86, 8)	5 (13, 2)	
	2006-2017	87 (83, 7)	17 (16, 3)	
Type of dental practice	General dentistry	144 (83, 7)	28 (16, 3)	
	Specialized in the field of endodontics	16 (94, 1)	1 (5, 9)	0, 310
	Specialized in other field	8 (72, 7)	3 (27, 3)	

Preference to NiTi rotary systems according to the:

- Type of practice

The prevailing part of the respondents (85.3%) defined themselves as practitioners in a general dental practice, followed by 8.3%-in an endodontic practice and 6.4%-in a practice with other field of specialization. Endodontic treatment was performed in almost all dental practices – 98.5%.

Despite the ratio of dentists using rotary systems was very high in all defined groups, the type of the practice did not influence significantly preference to these shaping systems (Table 1). Endodontic specialists chose them "always" in 82.4%, while general practitioners' preference for them was "always" in 36.1%, "frequently" – in 23.3% and "sometimes" – in 24.4%.

- Number of NiTi rotary systems

Almost one fifth of the respondents (17, 6%) do not use rotary NiTi instruments. For 29, 1% of them the preference is for only one system, while the majority (53, 3%) have experience in use of several systems.

- Types of NiTi rotary systems

Half of the questioned dentists (54, 6%) are experienced in use of different NiTi systems, depending on the complexity of the case. The continuous rotation is preferred by19, 1%, reciprocating systems – by13, 9% and systems with mixed rotation – by12, 4% of the respondents.

Theoretical knowledge of rotary systems and techniques according to the source of information. Respondents were given 3 possible answers concerning the source of information: from the university, commercial courses and both of them. Information was basically received from non-university lecturers (62.9%), from the university in 8.4% of the cases and from both sources – in 28.7%. Self-assessment of knowledge for using NiTi rotary instruments was not significantly influenced by the source of theoretical knowledge (Table 2).

Table 2: Self-assessment of knowledge and experience for using rotary NiTi systems according to the information source

Question	Variable	Self-assessment of knowledge and experience forusing NiTi rotary systems			
		Satisfactory n (%)	Very good n (%)	Excellent n (%)	p-Value
Source of theoretical knowledge	University	8 (72, 7)	2 (18, 2)	1 (9, 1)	0, 120
	Commercial courses	38 (35, 8)	47 (44, 3)	21 (19, 8)	
	Both sources	20 (36, 4)	28 (50, 9)	7 (12, 7)	
Source of practical skills	University	7 (63, 6)	3 (27, 3)	1 (9, 1)	0, 289
	Commercial courses	48 (39, 0)	53 (43, 1)	22 (17, 9)	
	Both sources	11 (28, 9)	21 (55, 3)	6 (15, 8)	

Practical training level according to the source of acquiring practical skills. Three groups of sources were defined-from the university, non-university courses and both of them. In 71.8% the practical experience was gained from commercial courses, in 8.3%-only from the university training lessons and in 19.9%-from both sources. The source for acquiring practical skills does not influence significantly the level of self-assessment of respondents (Table 2).

The *need of contemporary university programs* reflecting the progress in manufacturing rotary NiTi systems is further documented by the answers summarized in Table 3.

Table 3: Need of more theoretical knowledge and practical skills in using rotary NiTi systems

Question	Yes (%)	No (%)
Experience in more rotary NiTi systems	97, 5	2, 5
Knowledge of more rotary NiTi systems	97, 0	3, 0
Awareness of the types and treatment protocols of reciprocating systems	75, 0	25, 0

The understanding of philosophy and treatment protocols of instruments for a glide path creation is revealed in the three possible answers: knowledge only on theory (21.5%), theoretical knowledge and practical skills (68%) and lack of any information and skills (10.5%)

4. Discussion

This online questionnaire survey was conducted with the aim to collect and analyze information concerning the influence of university programs on preferences and use of NiTi rotary systems by Bulgarian dental practitioners. The importance of their experience, level of qualification and location of the practice was additionally studied. AlShwaimi [2] collected the data in a similar way in his study on the application of NiTi instrumentation in Saudi Arabia. Other researchers examined the interest of specialists and general practitioners to rotary files [1, 4, 18, 19] by mailing their questionnaires.

The questionnaire form was e-mailed to the target group via their local professional organizations. The lack of direct communication with the dentists and the impossibility to send them reminding e-mails resulted in a response rate of 34.33%. Although not as large, the total number of respondents was large enough. Bird et al. [5] and AlShwaimi [2] registered similar response rates but in the study of Slaus and Bottenberg [25]only 25% of the targeted participants answered.

The two parts of the questionnaire were filled in only by practitioners who provided endodontic treatment in their practice. Very high rate of practitioners (98.5%) performing endodontic treatment was registered. Similar findings have been observed in studies conducted in Saudi Arabia (82.8%) 20, USA (90%) [28], and Sudan (85%) [1].

The prevailing part of participants (85.3%) defined themselves as practitioners in a general dental practice. Being a general dentist does not necessarily mean lack of knowledge and skills on rotary instruments. Thanks to university training or their own initiative for visiting commercial courses, they had acquired experience in these new technologies and readily applied them into practice. This statement is supported by the analyzes of questionnaire answers – NiTi files were "always" used by 36.1% and "frequently" – by 23.3%.

It has been found that the younger generations are more familiar with the contemporary shaping techniques and feel more confident in using them than dentists who graduated before 2005. Half of the respondents in the study (52%) graduated after 2006 and 83.7% of them use NiTi rotary files. Similar pattern was stated in the works of Parachos and

Messer [25] and AlShwaimi [2] who found a reduced use of rotary NiTi systems among dentists studying in the decades before 2000.

The adoption of new technologies reflects the theoretical knowledge and practical experience gained through years – atthe university and/or continuing education. Although the endodontic programs at Bulgarian universities have changed over the last decade, it has become obvious that the courses provided by commercial companies are still an important source of information and practical skills in the field of NiTi rotary instrumentation. It was not surprising that only 2.9% of all participants assessed their knowledge and skills in using NiTi systems acquired at the university as excellent. For quarter of them it was satisfactory. As the predominant part of the respondents graduated before 2005, when the use of rotary NiTi instruments was not taught, they restricted the use of rotary systems or do not use them.

As part of a grant program, the NiTi treatment protocols have become part of our educational program since 2012. Recently, more rotary systems with different characteristics, function and mode of rotation have been included in the training courses for students. These changes in the program meet the expectations of students and practitioners for knowledge of greater variety of NiTi systems and better practical experience in using them. The students' interest towards these new topics was proved in our previous study among students in the Faculty of Dental Medicine in Sofia [18]. The introduction of innovations at undergraduate level seems to be the best time for learning new techniques as students experience fewer problems than practitioners with greater experience [19, 26].

The attempts of manufacturers to provide endodontic instruments that are more resistant to fatigue and fracture and adapt better to the unique shape of the root canals resulted in the appearance of a great variety of NiTi rotary files on the market. Nowadays, it is difficult to have sufficient knowledge of all the systems used for preliminary or final shaping of the endodontic space, driven by continuous or reciprocating rotation, consisting of a single or multiple files. At the same time, it is obvious that no one system is universal and choice must be made depending on the characteristics of each clinical case. Our results reveal that half of the questioned dentists have experience in the application of several rotary systems and use them according to the clinical situation. The introduction of instruments with different types of rotation in university programs and commercial courses has led to almost equal preference for all of them, with a slight dominance of that with continuous rotation. The importance of the instruments for preliminary enlargement of the root canal is well defined, as 68% of the respondents have theoretical knowledge and practical skills to use them. The role of the educational programs for integration of rotary techniques into everyday clinical practice is also demonstrated in the study of Koch et al. [15]. The adoption of new technologies is highly influenced by the personal interest and experience of dental practitioners in the field, the technical equipment of the practice and last but not least, the financial status of the population. The questionnaire results clearly demonstrate that the location of the dental practice influences significantly the preference to rotary systems. They are used always or frequently by about 60% of the respondents practicing in the capital or in a district city. Only 12.8% of the dentists in cities with smaller population preferred them in the endodontic treatment. It can be speculated that rural clinicians have more restricted access to trade representatives and participation in hand-on workshops and lectures when compared with metropolitan and urban dentists. Similar tendency was noticed in the study of AlShwaimi [2] and Parashos and Messer [19]. At the same time, many of the graduates of the three Bulgarian dental schools, who have already be entrained with NiTi rotary systems, start practicing in the capital or in district cities, where patients also have a better financial situation.

5. Conclusion

Constantly increasing interest towards implementation of NiTi rotary techniques into everyday dental practice was registered. Younger metropolitan dentists proved themselves more confident in the use of contemporary endodontic shaping systems, as these innovations have been introduced recently in the undergraduate university program. Students training courses need to be further developed to expand the scope of knowledge and practical skills and to meet the expectations of students and practitioners for better experience in using rotary NiTi instruments.

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