Undergraduate teaching and clinical use of rotary nickel–titanium endodontic instruments: a survey of French dental schools

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Abstract

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Aim To evaluate the impact of rotary nickel–titanium (NiTi) instruments on undergaduate teaching and clinical use in French dental schools and to evaluate the impressions of dental students when learning and using these techniques.

Methodology A questionnaire was mailed to all 16 French undergraduate dental schools. Data were gathered on a range of issues concerning teaching and use of NiTi endodontic techniques.

Results The response rate was 100%. The need for teaching NiTi techniques to dental students was agreed by all schools. Lectures and laboratory courses for rotary NiTi techniques were organized in all of the schools. In 13 of the 16 teaching hospitals, students could use rotary NiTi techniques for canal preparation under the supervision of teaching staff. Similarities were observed in the majority of responses, e.g. type of rotary system taught and used clinically. Some differences were also observed, e.g. the association of hand files to rotary NiTi instruments and at what stage in the undergraduate curriculum rotary instruments were introduced.

Conclusion There was a national consensus over the need for undergraduate teaching of rotary NiTi systems in France. These techniques had made a substantial impact in endodontic teaching and were widely taught and used in French dental schools.

Keywords: dental school, nickel–titanium, rotary techniques, survey, undergraduate teaching.

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Introduction

Nickel–titanium (NiTi), also known as nitinol, is a biocompatible shape-memory alloy with many interesting properties (Serene *et al.* 1995). In endodontics, NiTi was initially reported for use in 1988 by Walia *et al.* (1988) and the advantages of NiTi for endodontic use have been known for more than a decade. There have been many reports on rotary NiTi instruments and their properties, but studies relating to teaching of these systems in dental schools throughout the world are few. An endodontic survey in 1997 compared various types of canal preparation and obturation techniques in American dental schools (Cailleteau & Mullaney 1997). An international study in 1999 compared preclinical endodontic teaching in Europe, Scandinavia and North America (Qualtrough *et al.* 1999). The authors observed that one-quarter of Western European and Scandinavian dental schools and 12% of those in North America used rotary NiTi instrumentation. Another study evaluated the pattern of undergraduate endodontic teaching in Philippine dental schools (Cruz *et al.* 2000). The authors found similarities and differences between schools at the various stages of endodontic teaching and concluded that there was a necessity to review endodontic teaching in the Philippines. A recent European study compared endodontic courses and assessed the treatment quality at two dental schools in Malmo and Paris (Petersson

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et al. 2002). The results have demonstrated differences between these two faculties in educational methods and also in the evaluation of student performance. The subject of all these studies was the comparison and evaluation of general aspects of endodontics; they did not evaluate rotary NiTi techniques specifically.

The impact of these new techniques on endodontic teaching has not been evaluated. The British Endodontic Society (BES) noted in 1983 that differences in the endodontic teaching programmes could influence the standards and nature of root canal treatment (British Endodontic Society 1983). The importance of calibration of undergraduate training within the context of the European Union is an important factor. The European Society for Endodontology (ESE) has formulated guidelines for undergraduate endodontic curricula (European Society of Endodontology 1992; 2001) and endodontic treatment quality (European Society of Endodontology 1994). This study and similar investigations on a European scale would allow guidelines on NiTi instruments to be formulated.

In France, there are 16 dental schools; the dental undergraduate course lasts 6 years. Endodontic teaching is generally composed of three parts: lectures (second, third and fourth years), practical courses (second and third years) and clinical teaching (fourth, fifth and sixth years). Dental students in the fourth, fifth and sixth years provide care under the supervision of teaching staff.

The purpose of this study was to evaluate the impact of rotary NiTi techniques on undergaduate teaching in French dental schools. A comparison of preclinical training and clinical use of these techniques in each school and teaching hospital was conducted. A further aim was to evaluate the impressions of dental students when learning and using these techniques.

Materials and methods

A questionnaire was prepared and sent to all Endodontic and Restorative Dentistry departments at the 16 dental schools in France. The questionnaire was a modified version of those described previously (Dummer 1991, Qualtrough & Dummer 1997). The changes made to the survey reflected more recent use of rotary NiTi instruments. The questionnaire contained a range of issues and two principal parts: the first was designed to determine details about lectures and practical courses in dental faculties, and the second part to evaluate the clinical use of rotary NiTi instruments by students in teaching hospitals. The range of issues included: the department delivering undergraduate endodontic courses, the number and qualifications of teaching staff, staff:student ratios, time allocated to preclinical teaching, year of endodontic teaching, recommended procedures and materials, rotary NiTi systems taught and issues about clinical use (first year of use, procedures, materials, systems, type of irrigating solution, etc.). The questionnaires were completed by the teaching staff in charge of endodontic education. For a number of questions, dental students were interviewed by the staff to give their general impressions over the use of rotary NiTi engine-driven techniques. Data gathered from the survey were analysed using EXCEL® (Microsoft, Redmond, WA, USA).

Results

Response

The 16 schools surveyed returned completed questionnaire, representing a response rate of 100%.

Academic responsibility for endodontic teaching

In France where Endodontology is not an individual clinical academic speciality, the subject is grouped with Conservative Dentistry. Thus, the teaching of root canal preparation using rotary NiTi instruments in French schools is the exclusive responsibility of Endodontic and Conservative Dentistry Departments. The staff of each department is made up of several part-time or full-time professors, associate professors, assistant professors and instructors. The number of staff is not the same in all 16 dental schools (mean 13.5, range 4–30). The number of students is also variable (mean 243; range 70–440). The mean staff:student ratio in France is 1 : 18 (range 1 : 11 to 1 : 32). Staff in charge of endodontic training have a special knowledge and interest in endodontics.

Preclinical courses in NiTi endodontic teaching

Lectures in rotary NiTi endodontic techniques
Lectures for rotary NiTi instrumentation were organized in all of the dental schools, principally during fourth and fifth years (Table 1).

Laboratory courses in rotary NiTi endodontic techniques
Practical courses relating to rotary NiTi instruments take place in all of the 16 schools, principally during fifth and sixth years of dental studies (Table 1). Dental

Table 1 Rotary NiTi instruments teaching in French dental schools

Teaching's year	Lectures, no. of schools (%)	Laboratory courses, no. of schools (%)
Second year	0	0
Third year	3 (18.7)	4 (25)
Fourth year	10 (62.5)[a]	4 (25)[a]
Fifth year	10 (62.5)[a]	8 (50)[a]
Sixth year	1 (6.3)	5 (31.2)

[a]At some schools, courses take place at 2 years.

Table 2 Rotary NiTi systems taught in French dental schools

System	No. of schools (%)
Hero642®	13 (81.3)
ProFile®	12 (75)
ProTaper®	7 (43.7)
Quantec®	2 (12.5)
Endomagic®	1 (6.2)
GT Rotary®	0
K3®	0
Other systems	1 (6.2)

students use extracted teeth and resin-simulated root canals as teaching tools.

Most dental faculties did not indicate the time devoted specifically to teach NiTi techniques. However, students spend an average of 78 h on endodontic laboratory exercises (manual and rotary root canal preparation and filling).

In the majority of schools, these laboratory courses have been organized since 2001 (18.8%), 1998 (12.5%) or 1997 (12.5%). The three most taught rotary NiTi systems in the French faculties are: Hero642® (Micro-Mega, Besançon, France) in 13 schools, ProFile® (Maillefer Dentsply, Ballaigues, Switzerland) in 12 schools and ProTaper® (Maillefer Dentsply) in 7 schools (Table 2). In seven schools (43.8%), use of hand files in association with rotary instruments is recommended. In nine schools (56.3%), there is a postgraduate teaching of endodontics, with a mean time of 2 years. During postgraduate teaching, various aspects of rotary NiTi techniques are covered. In all of dental schools, there is a summative assessment in the form of written, oral and practical examinations. In the majority of them, there is also a formative assessment.

Clinical use

In 13 out of the 16 university hospital centres (81.2%), students could use rotary NiTi techniques for canal preparation under staff supervision. Generally, dental students used NiTi instruments for the first time in their fifth year (46%) or fourth year (30.8%). In all the schools, endodontic staff advocate taking into account the manufacturer's recommendations, e.g. adequate number of clinical use or rotation speed of the instruments. Three rotary NiTi systems were used in French dental teaching hospitals: Hero642® in 10 (77%), ProFile® in 6 (46.2%) and ProTaper® in 3 (23.1%). Dental students could use these systems for endodontic retreatment in 8 of the 13 hospitals (61.6%). Sodium hypochlorite (NaOCl) was used as the main irrigating fluid in all the centres. A number of schools (25%) also recommended using a combination of NaOCl with one of the following products: EDTA (ethylenediaminetetraacetic acid), citric acid or other irrigating fluids.

Impression of dental students

The perceptions of dental students relating to NiTi instruments were evaluated in 12 of the 16 schools. Generally, students considered these techniques easier to learn (75%) and use (75%), more effective (91.7%), shorter (91.7%), and safer (58.3%) in comparison with other techniques.

Discussion

All of the 16 French dental schools answered the questionnaire. Thus, the results of this study represent the current trends in undergraduate teaching of rotary NiTi endodontic instrumentation in France. This high response rate was obtained in similar national endodontic surveys (Qualtrough & Dummer 1997, Cruz *et al.* 2000). However, this rate tends to fall when surveys are international and concern several countries (Qualtrough *et al.* 1999).

The results of this study show that endodontic rotary NiTi techniques are widely taught and used in French dental schools. However, some divergence existed over the details of teaching and clinical use. An international endodontic survey demonstrated in 1999 the predominance of stainless steel K and H hand files compared to rotary instruments in dental faculties. Only 27% of the dental schools in Western Europe and 12% of those in North America, which responded to the questionnaire, had incorporated NiTi rotary instruments (Qualtrough *et al.* 1999). In 2002, all of the French schools had incorporated NiTi rotary techniques in their endodontic curriculum.

The mean staff:student ratio in France was 1 : 18. This remains weak compared to 1 : 8 in other European

countries or to the 1 : 9 ratio in North America (Qualtrough *et al.* 1999) and should be improved. Qualtrough *et al.* (1999) also noted that amongst the rotary techniques, two systems were predominating in all geographical areas: ProFile® and Lightspeed® (Lightspeed Technologies Inc., San Antonio, TX, USA). Three years later, the French survey did not confirm this predominance, the most taught and clinically used techniques being Hero642®, ProFile® and ProTaper®.

French lectures and laboratory courses on rotary NiTi techniques are organized later in the curriculum than courses for other endodontic techniques. The NiTi techniques are taught in the fourth, fifth or last year of studies whereas other methods are taught at the preclinical stage (third).

In French schools, manual techniques continue to be taught. In seven schools (43.8%), endodontic staff advocate the association of hand files with rotary NiTi instruments for the first stage of canal preparation.

Thirteen dental centres were equipped with NiTi Instruments, and students in fourth, fifth and sixth years could use these techniques. However, their utilization was less frequent than manual techniques. It may be that the cost of these instruments remains a challenge to support their use.

The European Society of Endodontology (2001) noted that evaluation of preclinical endodontic courses should involve two types of assessment: formative and summative (European Society of Endodontology 2001). French endodontic staff assessed students through a summative process in the form of examinations. Another aspect of evaluation, formative assessment, was generally applied as well.

The perception of students using rotary NiTi instruments was positive in the majority of dental faculties. They noted it was easier to learn, more rapid and more effective clinical use. These statements are subjective and expressed by inexperienced subjects, but they reflect the attitude of French dental students. Students considered that these endodontic techniques were 'generally better' than manual root canal preparation. However, although rotary NiTi instruments were considered better than hand files, they were less frequently used; 41.7% of the students found NiTi systems unsafe in clinical use with the possibility of instrument fractures, apical blockages and root canal perforations. Rotary NiTi teaching in fourth, fifth and sixth years of the curriculum could explain their lower use. In order to encourage more frequent clinical use of these instruments, endodontic staff would have to modify undergraduate teaching.

Studies have shown the poor quality of endodontic treatments, undertaken by general dentists in Europe (De Cleen *et al.* 1993, Weiger *et al.* 1997, Boucher *et al.* 2002). The ESE considers that undergraduate endodontic education and clinical experience may be, in part, responsible of this low quality (European Society of Endodontology 2001). In order to ensure adequate and common undergraduate training and clinical use of rotary NiTi instrumentation in European dental schools, endodontic societies could formulate guidelines for teaching these new techniques.

Conclusions

Based on the results gathered from this survey, rotary NiTi instruments are being taught in French dental schools. Endodontic teachers are advocating the use of rotary NiTi techniques and have incorporated lectures and laboratory courses related to these systems in the undergraduate dental curriculum.

There is a French national consensus relating to the need of integration of these new techniques on the endodontic teaching. However, some divergence exists concerning a number of training parameters.

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