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THESE POUR LE DIPLÔME D'ETAT DE DOCTEUR
EN CHIRURGIE DENTAIRE

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I. INTRODUCTION

La compétence du chirurgien-dentiste en endodontie repose en grande partie sur la formation initiale qu'il suivra à la faculté. Nous nous sommes intéressés à l'enseignement initial de l'endodontie et en particulier aux différences qui peuvent exister entre les différentes facultés.

Par le passé certains auteurs se sont intéressés à la comparaison de l'enseignement initial de l'endodontie comme Dummer en 1991 qui a comparé le Royaume-Uni à quelques facultés d'Europe et des États-Unis (1). Dummer a mis en évidence que le temps dédié à l'enseignement préclinique au Royaume-Uni était inférieur par rapport aux autres facultés et qu'il n'y avait pas suffisamment d'examen qualitatif. En 1997, Qualtrough & Dummer ont conduit une étude comparative au Royaume-Uni sur le même sujet afin d'évaluer l'évolution de l'enseignement initial et concluaient en une augmentation du temps dévolu à l'enseignement préclinique. Toutefois beaucoup de thèmes recommandés par l'ESE n'étaient pas abordés (2). Récemment, une nouvelle étude a été conduite par Raisi & Al en 2019 avec pour objectif la réévaluation de l'enseignement initial en endodontie au Royaume-Uni. Cette étude a mis en évidence que le temps dédié à l'enseignement préclinique avait été augmenté comparativement à 1997 et que les recommandations de l'ESE étaient mieux suivies (3).

Depuis 1991, des nouveautés ont modifié le domaine de l'enseignement de l'art dentaire à travers l'Europe. En effet, au sein de l'Union Européenne une reconnaissance du diplôme de Docteur en chirurgie-dentaire permettant une meilleure mobilité des ressortissants a été mise en place. Ainsi en 2005 pour encadrer cette disposition, une directive vient en définir les modalités d'application (4). Elles concernent à la fois la durée des études (5000 heures de formation théorique et pratique) ou encore les matières obligatoires (matières de base, médico-biologiques, médicales générales, odonto-stomatologiques) ceci dans le but d'harmoniser la formation entre les différents pays membres. Toutefois cette directive laisse entrevoir la possibilité de nombreuses disparités puisqu'elle ne définit pas un programme éducatif précis. En parallèle de cette directive, en 1992, en 2001 et enfin en 2013, l'ESE (European Society of Endodontology) a publié des recommandations (*« The curriculum is presented as a list of competencies that the graduating student will be expected to have achieved. These provide a minimum level of competence and are defined by a baseline consensus of the committee. Whilst the time and resource given to endodontic education will vary from school to school, the committee has sought to develop a curriculum*

that can be delivered by most of the dental schools in Europe“) sur la formation initiale en endodontie destinées aux facultés ainsi qu’aux instances en charge d’établir la réglementation (5). L’objectif de l’ESE était de définir des recommandations qui puissent être suivies par la majorité des facultés européennes afin d’améliorer les standards de qualité du traitement endodontique. En effet malgré de nombreuses avancées technologiques qui ont enrichi le domaine de l’endodontie (Nickel Titane 1988, réciprocity 2008 (6,7)), l’ESE a fait le constat que les études conduites durant les années 2000 mettaient en évidence que les standards de qualité de traitement endodontique n’étaient pas satisfaisants (8–12).

Qu’est ce qui est enseigné en Europe en 2019 ? Les recommandations de l’ESE sont-elles appliquées ? Les dernières nouveautés sont-elles intégrées au programme ?

Peu d’études ont été publiées sur ce sujet récemment, c’est pourquoi nous avons décidé de nous intéresser à l’enseignement initial de l’endodontie en 2019 en réalisant une étude comparative sur les facultés d’Europe. Cette étude vise à déterminer le niveau de l’enseignement et à évaluer l’homogénéité entre différents pays.

L’étude menée dans le cadre de ce travail de thèse s’intitule « Comment est enseignée l’endodontie ? Étude de l’enseignement initial de l’endodontie en Europe ». Elle aborde les différents aspects de l’enseignement de l’endodontie : La théorie, l’enseignement préclinique et clinique. Pour cela nous avons créé un questionnaire de 30 items que nous avons adressé aux chefs de département d’odontologie conservatrice et d’endodontie. Le questionnaire porte sur les conditions d’enseignement, les techniques enseignées, les matériaux ou encore les instruments mis à disposition des étudiants.

II. ARTICLE

How is endodontics taught? A survey to evaluate undergraduate endodontics teaching in dental schools within Europa.

Abbreviations	
Ca(OH) ₂	Calcium Hydroxide
CBCT	Cone beam computed tomography
CNEOC	Collège National des Enseignants en Odontologie Conservatrice (National College of Teachers in Conservatrice Dentistry)
EDTA	Ethylenediaminetetraacetic
ESE	European Society of Endodontology
EU	European Union
FOV	Field Of View
GIC	Glass Ionomer Cements
HAS	Haute Autorité de Santé
NiTi	nickel-titanium alloy
PC	Preclinical
RMGIC	Resin-Modified Glass Ionomer Cements
UK	United Kingdom
ZOE	Zinc Oxyde Eugenol

Introduction

Education dispensed by dental schools, and in particular endodontics, differs from one country to another. There is no uniformity in education throughout the world. Some students may benefit from recent technologies and materials when others cannot. Good practices' recommendations varied from country to country. All of this can potentially lead to a difference of level from one faculty to another.

To take the example of European Union, diploma is recognized by the different member countries. Indeed, European directives define the framework of odontology studies such as

length of studies (5 years), obligatory matters or specific knowledge to acquire but the learning conditions differ from country to country (4). Each country transposes European directives through its governmental bodies to establish university programs and thus ascertaining the weight put on theoretical education, preclinical and clinical practice. In order to harmonized education between the different European dental schools, an independent organization named ESE published undergraduate guidelines (5). This is a list of competencies and knowledge that student should acquire during studies. The way of ESE is to promoting standards in Undergraduate education.

To take the case of France, each dental school teaches in accordance with the national and European good practices' recommendations but there is no national education program (13,14). In fact, each school defines on its own the exact content of the syllabus, which means that it decides the level of importance granted to theoretical education, preclinical education and clinical practice. Similarly, each dental school decides for itself which materials, instruments, learning supports, techniques to make available to students.

As can be seen, differences in teaching can be found from one country to another as well as within the same country. This has been made object of survey in the past. In 1991 DUMMER compared the program of initial endodontic education in the United Kingdom to other dental schools of Europe and United States (1). He concluded that English students were not supervised by endodontic staff members unlike other dental schools. In general, time devoted to practice of root canal therapy in the UK should be increased.

However, in the past 30 years, endodontic field has evolved considerably with the aim of improving the therapeutic results, simplifying the protocols either by improving existing techniques or by creating new processes. This is why new innovative techniques have emerged and continue to be developed. Dummer had already made this observation in 1991 and it's even more true today (1). Each step that composes endodontic treatment sees new techniques and new instrumental sequences appearing. This progress is seen both in instrumental design and materials use. Notable advances include the arrival of Nickel-Titanium instruments associated with a continuous rotation in the early 1990s (6). More recently the reciprocity introduced in 2008 by YARED who was inspired by the balanced force from Roane described in 1985 (7,15). Whenever possible, all these advances who enrich every year the endodontic field must be integrated to dental program.

What is taught in French and other European dental schools in 2019? Are the latest techniques and technologies taught? The aim of this study was to give an answer by comparing endodontic undergraduate education provided in French dental school to Europeans'.

Materials and methods

In April 2019, with the approval of CNEOC (Collège National des Enseignants en Odontologie Conservatrice/National College of Teachers in Conservative Odontology), an online questionnaire and a letter were mailed to the Heads of Departments of conservative Dentistry of 16 dental schools of France. This questionnaire was composed of 30 questions, whose type was mainly multiple-choice questions (Fig.1). Some question offered the possibility to complete the answer by a personalized write-in response. This survey was about various aspects of endodontic undergraduate teaching which are theoretical training, preclinical practice and clinical practice. A panel of speakers tested the questionnaire and the average time to respond was estimated at 5-7 minutes.

The questionnaire was mailed to 16 French dental schools for the first time in April 2019. Three weeks after the first mailing, the questionnaire was mailed again to the persons who did not responded. It was mailed a third time to the no-respondent schools.

In September 2019, the same questionnaire was mailed to the Heads of Departments of conservative Dentistry of 53 different schools in European Union. Identity of all respondent schools was not requested.

Theoretical education

- 1-How many hours of endodontic courses do students have before graduation?
- 2-Which of the following teaching materials are available for students?

Preclinical education

- 3-How many hours of endodontic hands-on workshop do students have before graduation?
- 4-How many students per groups during hands-on workshop?
- 5-How many instructors per groups during hands-on workshop?
- 6-Do students have quantitative objectives for endodontic graduation?
- 7-If so, how many?
- 8-Which of the following teeth do you use for hands-on workshop?
- 9-Do students have to perform endodontic retreatment for graduation in hands-on workshop?
- 10-Which of the following methods are taught for shaping during hands-on workshop?
- 11-Which NiTi sequence are taught for shaping during hands-on workshop?
- 12-Which of the following root canal obturation's technique are taught?
- 13-Is dental dam mandatory in hands-on workshop?

Clinical education

- 14-Which of the following methods are taught for shaping in clinical practice?
- 15-Which NiTi sequence are taught for shaping during clinical practice?
- 16-Is mechanical glide path taught in clinical practice?
- 17-Which of the following irrigation solution are taught in clinical practice?
- 18-Which inter appointment medication do you use in clinical practice?
- 19-Which tooth filling materials do you use for inter-appointment in clinical practice?
- 20-Which irrigation technic is/are taught in clinical practice?
- 21-Which of the following root canal obturation's technique are taught in clinical practice?
- 22-Which of the following endodontic sealer are taught in clinical practice?
- 23-Do students have to perform endodontic retreatment for graduation in clinical education?
- 24-Which of the following optical magnification are available for endodontic procedures in clinical practice?
- 25-Which of the following X-ray exams do you use in clinical practice?
- 26-Is there any CBCT available for students in clinical practice?
- 27-If yes, are students trained in its use alone or is it conducted under the supervision?
- 28-When do you recommend 2 visits for endodontic treatments in clinical practice?
- 29-Do you teach vital pulp therapy?
- 30-Is dental dam mandatory in clinical practice?

Figure 1 Questionnaire of the survey

Results

Six weeks after the first mailing, 10 of 16 French dental schools responded to the questionnaire.

At the end twelve French dental schools responded to the questionnaire.

Fourteen European dental schools responded on the 53. The rate of response was 75% for French schools and 26% for European schools (Table1).

Table 1 Number of mails send, number of responses received and response rate ratio

	Number of schools mailed	Number of responses	Response rate
France	16	12	75%
European Union	53	14	26%

Theoretical training:

10 French (83,3 %) and 12 European dental schools (85,8%) responded that they had more than 30 hours of endodontic courses. 2 French (16,7%) and 1 European dental schools (7,1%) responded that they had 20 to 30 hours of endodontic courses. 1 European dental school (7,1%) responded 10 hours to 20 hours (Fig.2).

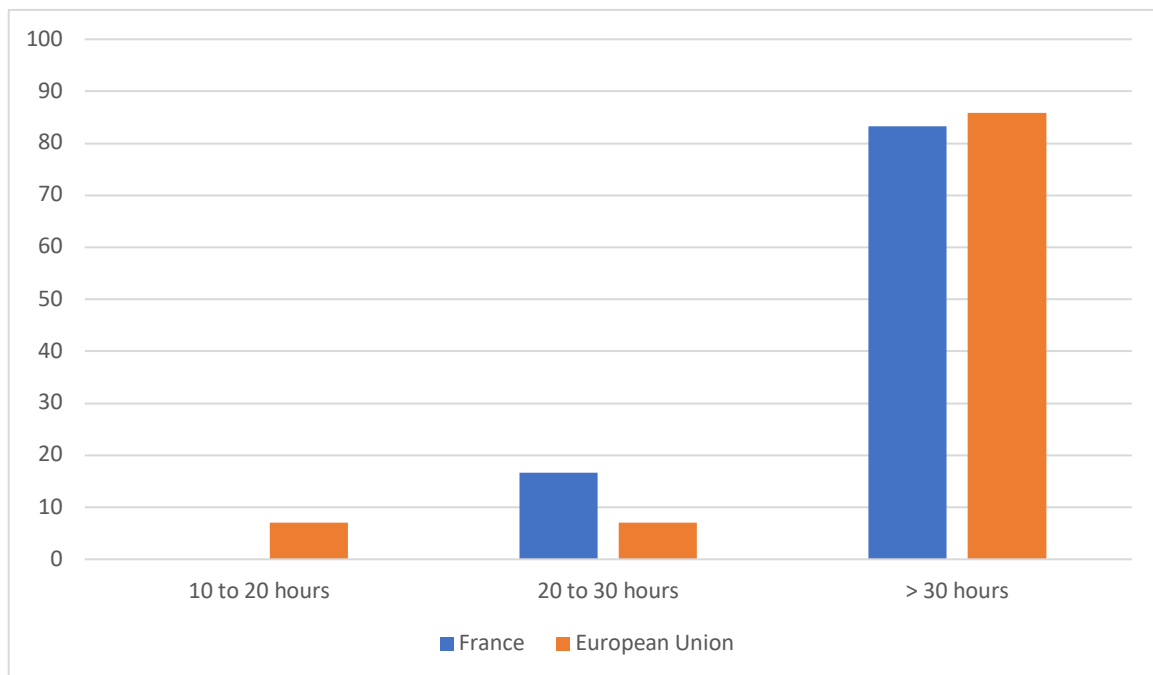


Figure 2 Number of hours of theoretical education

Every French and European dental schools made available teaching methods to their students. In fact, endodontic scripts were available in 12 French (100%) and in 13 European dental schools (92,9%). Videos and files from internet or intranet were available in 8 French (66,7%) and in 11 European dental schools (78,6%). Lecture prints-out were available in 6 French (50%) and in 11 European dental schools (78,6%). 5 French (33,3%) and 1 European dental schools (7,1%) answered they had other teaching methods available, but they did not give more precisions about it (Fig.4).

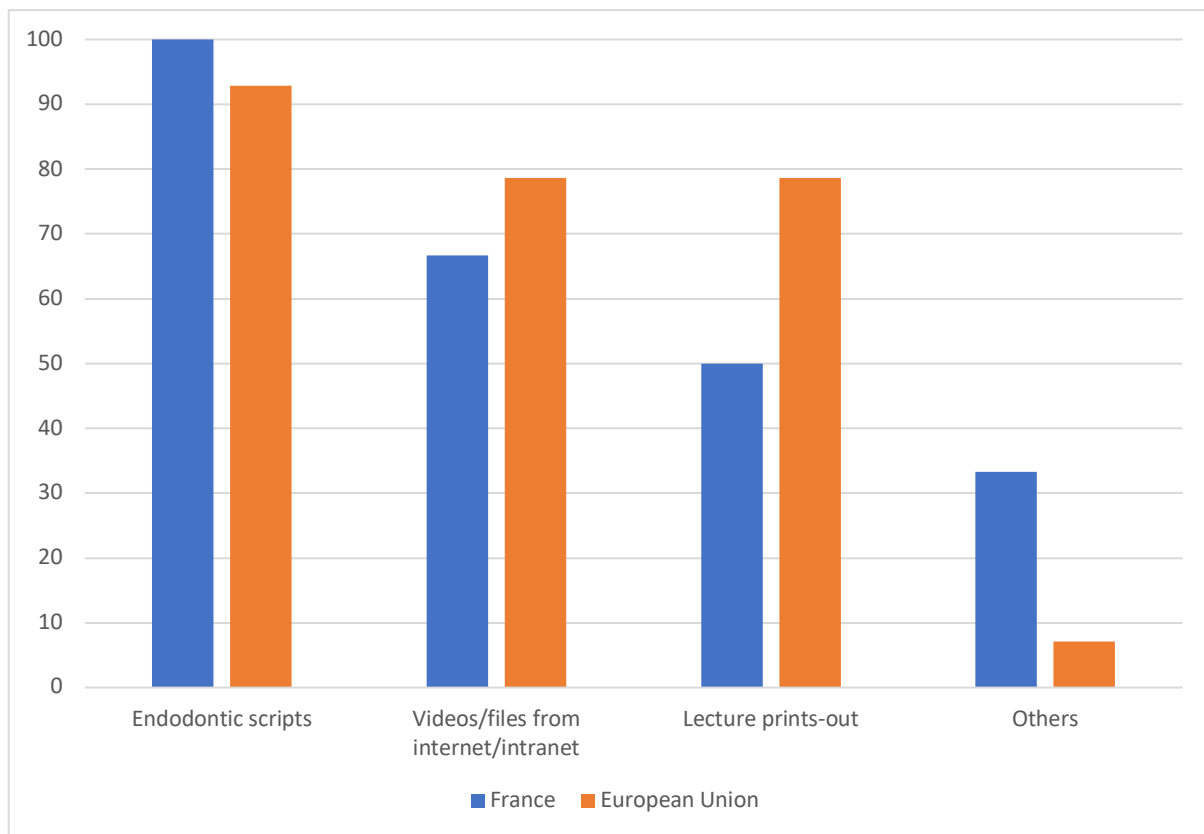


Figure 3 Teaching material available

Preclinical Education:

11 French (92,7 %) and 11 European dental schools (78,6%) responded that they had more than 30 hours of endodontic hands-on workshops. Only 1 French (8,3%%) and 3 European dental schools (21,4%) responded that they had 20 to 30 hours of endodontic courses (Fig.3).

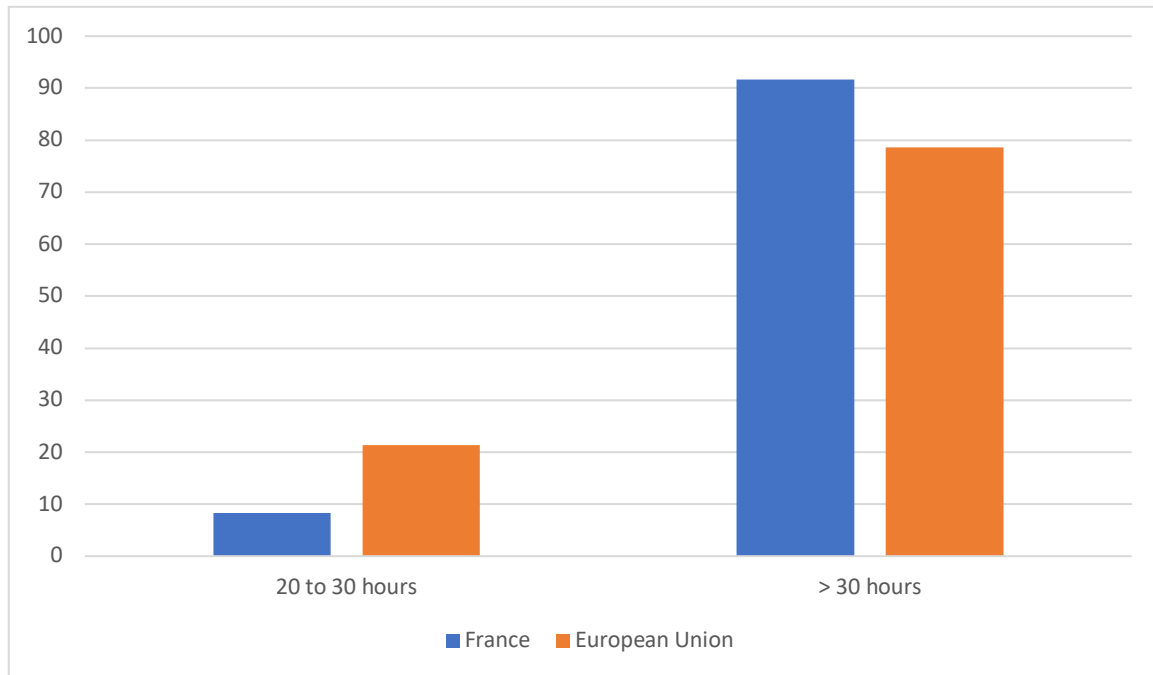


Figure 4 Number of hours of preclinical practice

10 French (83,3%) and 7 European dental schools answered there was more than 20 students per group during hands-on workshops. There was a difference as 1 French dental school precised that there was 24 students per group when another precised that there was 50 to 60 students per group. Unfortunately, we did not receive other precisions of other French and European dental schools about the exact number of students per group. 2 French (16,7%) and 7 European dental schools (50%) responded having 10 to 15 students per group (Fig.6).

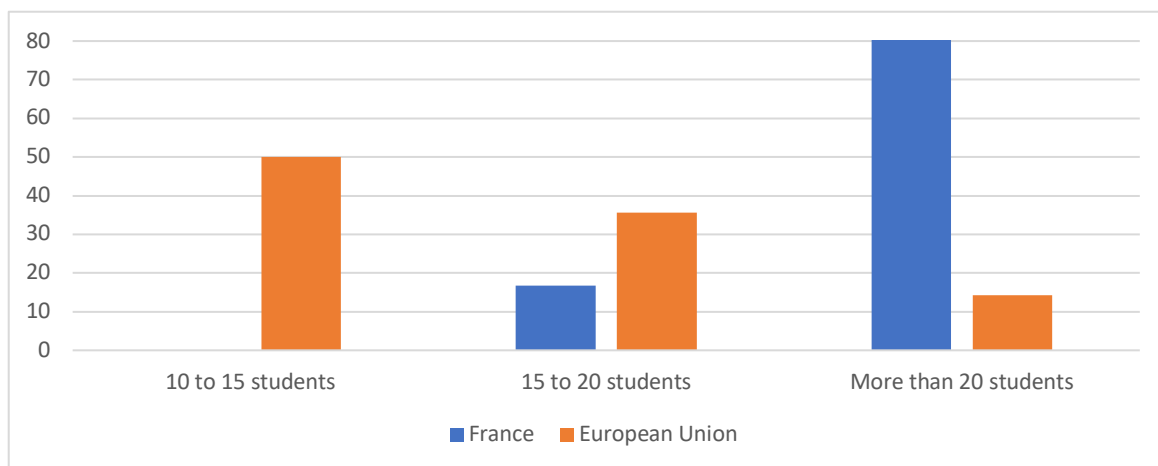


Figure 5 Number of students per groups during hands-on workshop

Size of groups had to be related with the number of instructors, 1 French and 5 European dental schools (35,7%) answered having only 1 instructor in charge of hands-on workshop. 7 French (66,7%) and 4 European dental schools (28,6%) answered having 2 instructors in charge. 3 French (25%) and 3 European dental schools (21,4%) answered having 3 instructors in charge. 1 European dental school (7,1%) answered having 4 instructors in charge and another one 6 instructors in charge. (Fig.5)

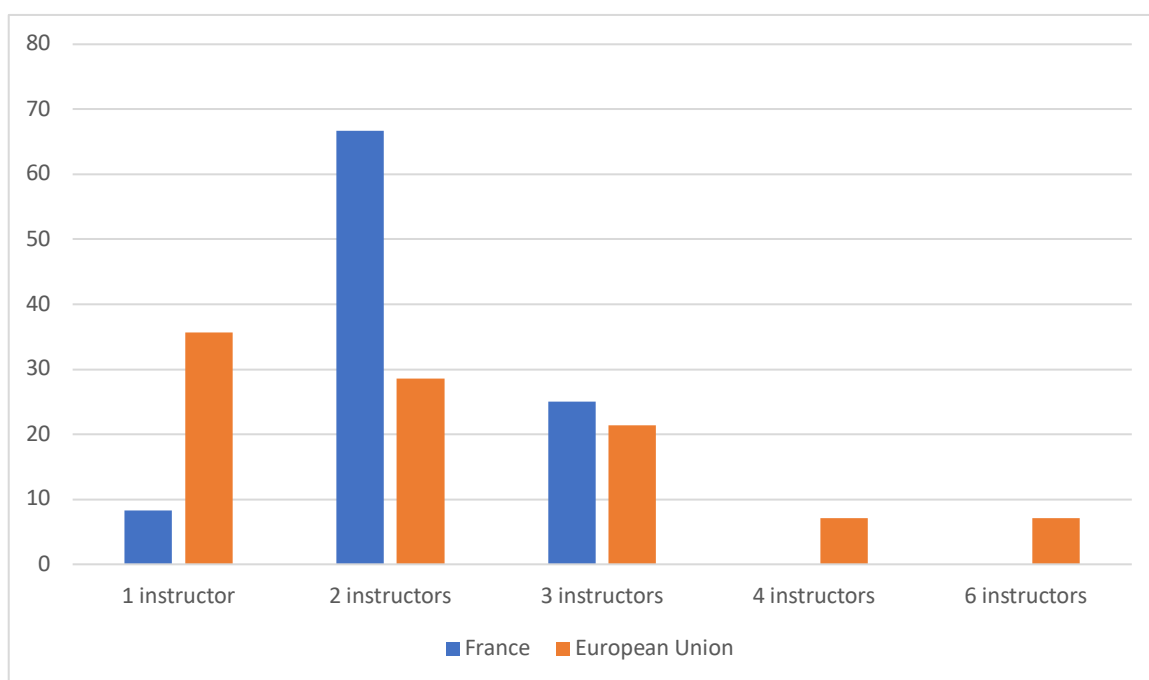


Figure 6 Number of instructors per groups during hands-on workshop

In almost all, French (10 Dental schools: 83,3%) and European (10 dental schools: 71,4%) students had quantitative objectives for endodontic graduation in hands-on workshop (Table 3).

In order to complete those quantitative objectives, every dental school fixed the number of every type of tooth required for graduation. 4 European dental schools (28,5%) answered they required 1 incisor for graduation during hands-on workshop. 4 French (33,3%) and 2 European dental schools (14,3%) answered they required 2 incisors for graduation. 1 European dental school (7,1%) answered they required 3 incisors for graduation. 3 French (25%) and 4 European dental schools (28,5%) answered they required 4 incisors for graduation. 1 European dental school (7,1%) answered they required 5 incisors for graduation. 2 French dental schools (16,8%) answered they required 6 incisors for graduation. 1 French dental school (8,3%) answered they required 7 incisors for graduation. 1 French (8,3%) and 1 European dental schools (7,1%) answered they required 8 incisors for graduation.

1 French (8,3%) and 3 European dental schools (21,4%) answered they required 1 premolar for graduation during hands-on workshop. 2 French (16,7%) and 6 European dental schools (42,9%) answered they required 2 premolars for graduation. 2 French (16,7%) and 1 European dental schools (7,1%) answered they required 3 premolars for graduation. 2 French (16,7%) and 1 European dental schools (7,1%) answered they required 4 premolars for graduation. 1 French (8,3%) and 1 European dental school (7,1%) answered they required 5 premolars for graduation. 1 French (8,3%) and 1 European dental schools (7,1 %) answered they required 6 premolars for graduation. 1 French dental school (8,3%) answered they required 7 premolars and another one answered they required 8 premolars for graduation.

2 European dental schools (14,3%) answered they required 1 molar for graduation during hands-on workshop. 3 French (25%) and 7 European dental schools (50%) answered they required 2 molars for graduation. 1 French (8,3%) dental school answered they required 3 molars for graduation. 2 French (16,7%) and 2 European dental schools (14,3%) answered they required 4 molars for graduation. 2 French (16,7%) and 1 European dental schools (7,1%) answered they required 5 molars for graduation. 2 French (16,7%) and 1 European dental schools (7,1 %) answered they required 6 molars for graduation. 1 French (8,3%) and 1 European dental schools (7,1%) answered they required 8 molars for graduation.

4 European dental schools (42,9%) answered they required 1 undifferentiated tooth for graduation during hands-on workshop. 2 French (16,7%) and 2 European dental schools (14,3%) answered they required 2 undifferentiated teeth for graduation. 2 European dental schools (14,3%) answered they required 3 undifferentiated teeth for graduation and 2 others responded 4 undifferentiated teeth. 1 European dental school (7,1%) answered they required 5

undifferentiated teeth for graduation. 1 French dental school (8,3%) answered they required 7 undifferentiated teeth for graduation. 1 European dental school (7,1 %) answered they required 8 undifferentiated teeth for graduation. 1 French (8,3%) answered they required 13 undifferentiated teeth for graduation, another one 14, another one 16, another one 17, another one 18 and another one more than 20 undifferentiated teeth (Table 2).

Table 2 Number minimum of incisors, premolar, molar and undifferentiated teeth for graduate during hands-on workshop

	France				Europe			
	Incisor	Premolar	Molar	Undiffer-entiated	Incisor	Premolar	Molar	Undiffer-entiated
0	8,3%	8,3%	8,3%	16,7%	0%	0%	0%	0%
1	0%	8,3%	0%	0%	28,6%	21,4%	14,3%	42,9%
2	33,3%	16,7	25%	16,7%	14,3%	42,9%	50%	14,3%
3	0%	16,7%	8,3%	0%	7,1%	7,1%	0%	14,3%
4	25%	16,7%	16,7%	0%	28,6%	7,1%	14,3%	14,3%
5	0%	8,3%	16,7%	0%	7,1%	7,1%	7,1%	7,1%
6	16,8%	8,3%	16,7%	0%	0%	7,1%	7,1%	0
7	8,3%	8,3%	0%	8,3%	0%	0%	0%	0%
8	8,3%	8,3%	8,3%	0%	14,3%	7,1%	7,1%	8,1%
13	0%	0%	0%	8,3%	0%	0%	0%	0%
14	0%	0%	0%	8,3%	0%	0%	0%	0%
16	0%	0%	0%	16,7%	0%	0%	0%	0%
17	0%	0%	0%	8,3%	0%	0%	0%	0%
18	0%	0%	0%	8,3%	0%	0%	0%	0%
>20	0%	0%	0%	8,3%	0%	0%	0%	0%

During hands-on workshops, 10 French (83,3%) and 14 European dental schools (100%) made available natural teeth during hands-on workshops. 2 French (16,7%) and 7 European dental schools (50%) used commercially available resin teeth. 4 French (33,3%) and 5 European dental schools (35,7%) used Resin block. 4 French (33,3%) and 1 European dental schools (7,1%) trained on custom made printed (Fig.7).

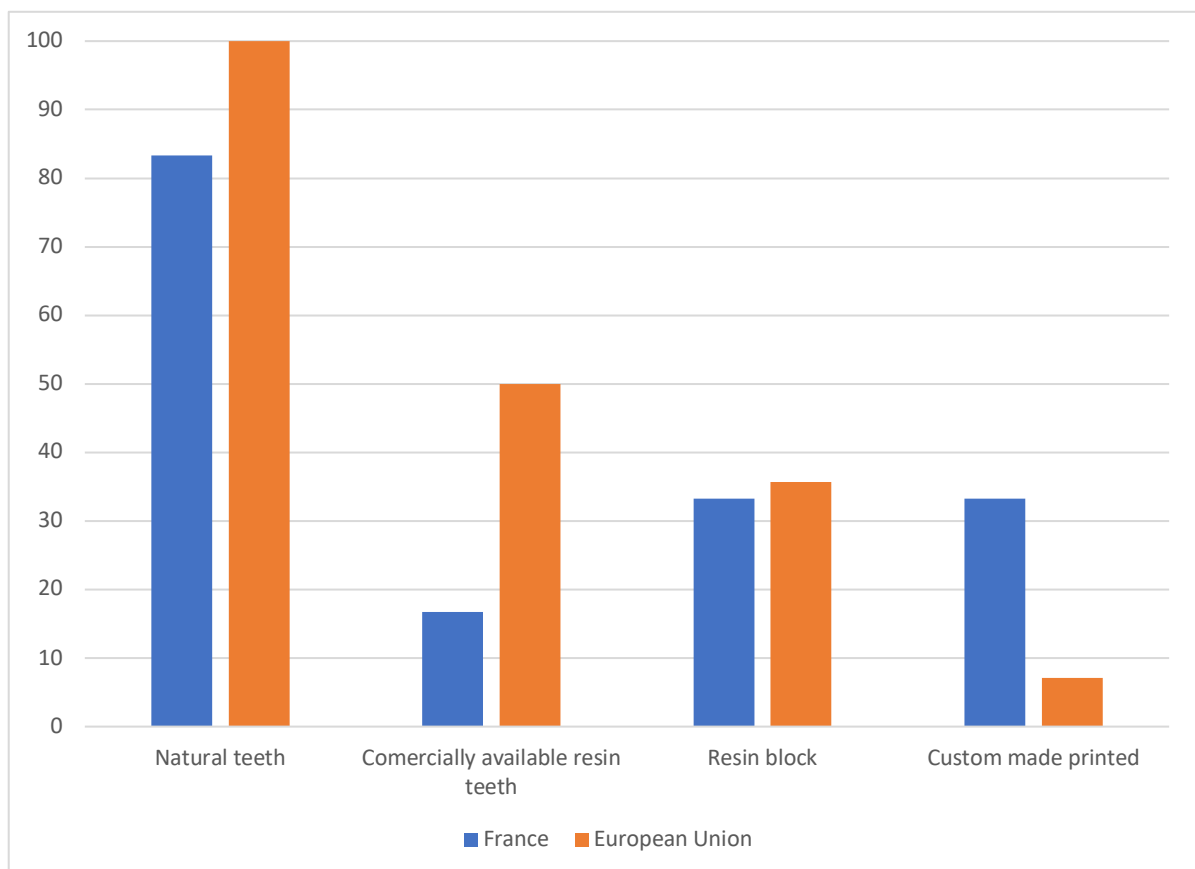


Figure 7 Type of teeth used during hands-on workshop

During preclinical, 6 French (50%) and 7 European dental schools (50%) asked to students to perform endodontic retreatment for graduation in hands-on workshops (Table 3).

Among the different methods taught for shaping, Manual stainless-steel file is most employed, 12 French (100%) and 12 European dental schools (85,7%) taught it. The second most employed method was continuous rotation, 11 French (91,7%) and 9 European dental schools (64,3%) taught it. Reciprocation motion was taught by 4 French (33,3%) and 5 European dental schools (35,7%). Manual NiTi file was taught by 3 French (25%) and 7 European dental schools (50%). 2 European dental schools (14,3%) taught dual continuous rotation and reciprocation method (Fig.8).

There were various NiTi sequences taught for shaping during hands-on workshops: Revo-s®: 1 French (8,3%) and 1 European dental schools (7,1%)), One Curve®: 3 French (25%) and 1 European dental schools (7,1%)), Protaper universal®: 1 French (8,3%) and 2 European dental schools (14,3%)), Protaper Next®: 1 French (8,3%) and 7 European dental schools (50%), Protaper Gold®: 5 French (41,7%) and 5 European dental schools (35,7%)), Reciproc®: 1 French (8,3%) and 3 European dental schools (21,4%), Wave One®: 3 French (25%) and 6 European dental schools (42,9%), One Shape®: 1 European dental school (7,1%), 2 shape®: 3 French dental schools (33,3%), Profile®: 1 French (8,3%), Race®: 1 European dental school (7,1%), Mtwo®: 3 European dental schools (21,7%), Sendoline S1®: 1 European dental school (7,1%) and Hyflex EDM®: 1 European dental school (7,1%) (Fig.9).

There were multiple root canal obturation's techniques taught. Cold lateral condensation was the most taught method, 7 French (58,3%) and 14 European dental schools (100%) taught it. Warm vertical compaction was taught by 3 French (25%) and 2 European dental schools (14,3%). Thermomechanical compaction was taught by 7 French (58,3%) and 2 European dental schools (14,3%). Association of Cold lateral condensation and thermomechanical compaction were taught by 7 French (58,3%) and 1 European dental schools (7,1%). Carrier

obturation was taught by 2 French (16,7%) and 3 European dental schools (21,4%). 1 European Dental school (7,1%) taught the single cone method (Fig.10).

During hands-on workshops dental dam was mandatory for 10 French (83,3%) dental schools and 11 European dental schools (78,6%) (Table 3).

Table 3 About preclinical education: Conditions of graduation, Endodontic retreatment and use of dental dam during hands-on workshop

	FRANCE		EUROPE	
	Yes	No	Yes	No
<i>Do students have quantitative objectives for endodontic graduation in hands-on workshop?</i>	83,3%	16,7%	71,4%	28,6%
<i>Do students have to perform endodontic retreatment for graduation in hands-on workshop?</i>	50%	50%	50%	50%
<i>Is dental dam mandatory in hands-on workshop?</i>	83,3%	16,7%	78,6%	21,4%

Clinical Education:

The most taught method for shaping during clinical practice was the continuous rotation who was used by 11 French (91.7%) and 9 European dental schools (64,3%). Manual stainless still file was taught by 10 French (83,3%) and 12 European dental schools (85,7%). Manual NiTi file was taught by 1 French (8,3%) and 8 European dental schools (8,3%). Reciprocation motion was taught by 3 French (25%) and by 5 European dental schools (35,7%). Association of continuous rotation and reciprocation motion were taught 3 European dental schools (21,4%) (Fig.8).

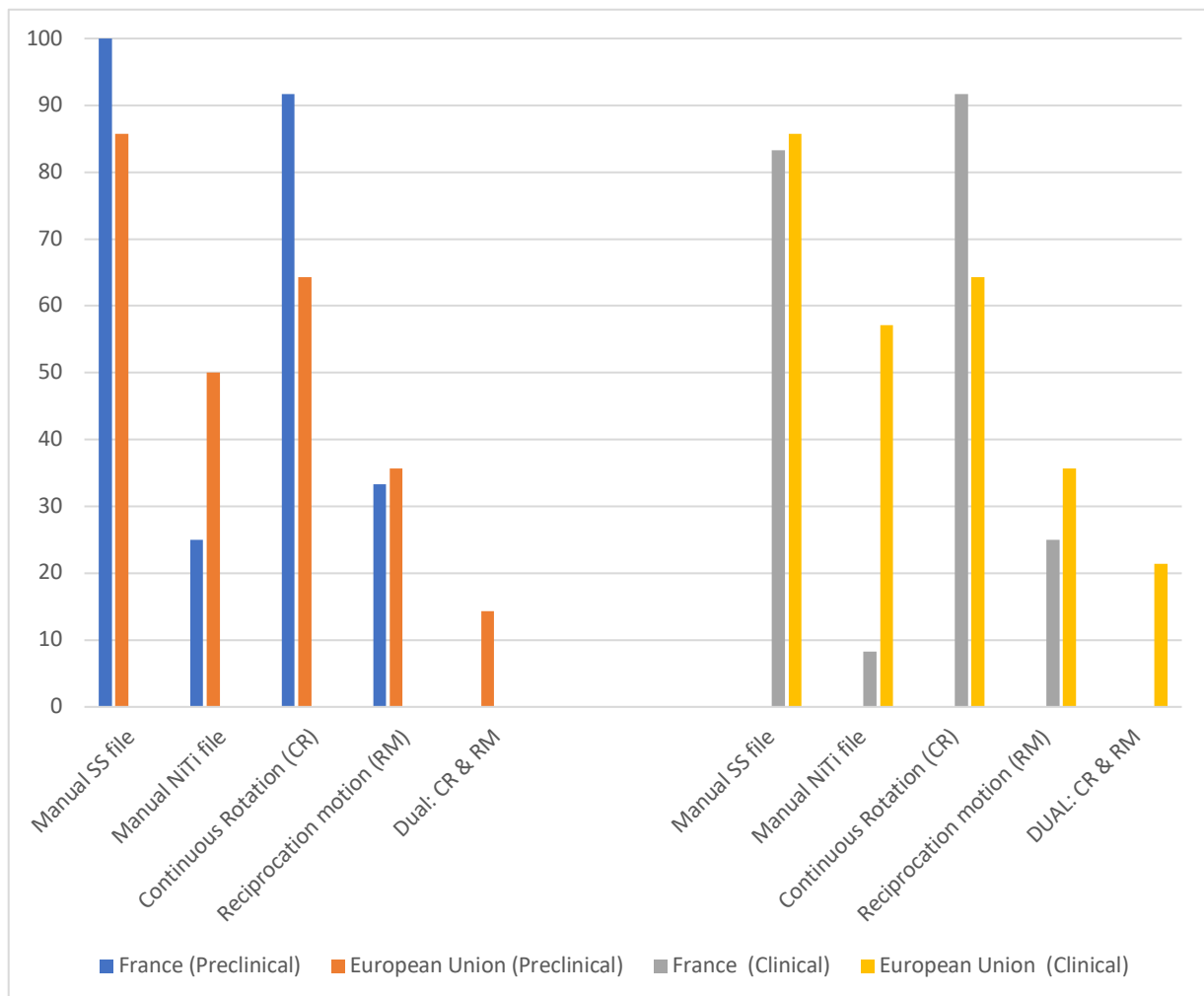


Figure 8 Shaping method taught during hands-on workshops and Method taught for shaping during clinical practice

There were various NiTi sequence taught for shaping during clinical practice. We found Revo-s®: 1 French (8,3%) and 1 European dental schools (7,1%), Hero Shaper®: 1 French dental school (8,3%), One Curve®: 2 French (16,7%) and 1 European dental schools (7,1%), Protaper universal®: 2 European dental schools (14,3%), Protaper Next®: 1 French (8,3%) and 7 European dental schools (50%), Protaper Gold®: 6 French (50%) and 5 European dental schools (35,7%), Mtwo®: 3 European dental school (21,7%), Reciproc®: 4 European dental schools (28,6%), Wave One®: 3 French (25%) and 7 European dental schools (50%), One Shape®: 1 European dental school (7,1%), 2 shape®: 2 French dental schools (16,7%), Profile®: 1 French (8,3%), Race®: 2 European dental schools (14,3%), Irace®: 1 European dental school (7,1%), Mtwo®: 3 European dental schools (21,7%), Sendoline S1®: 1 European dental school (7,1%), Hyflex EDM®: 1 European dental school (7,1%) (Fig.9).

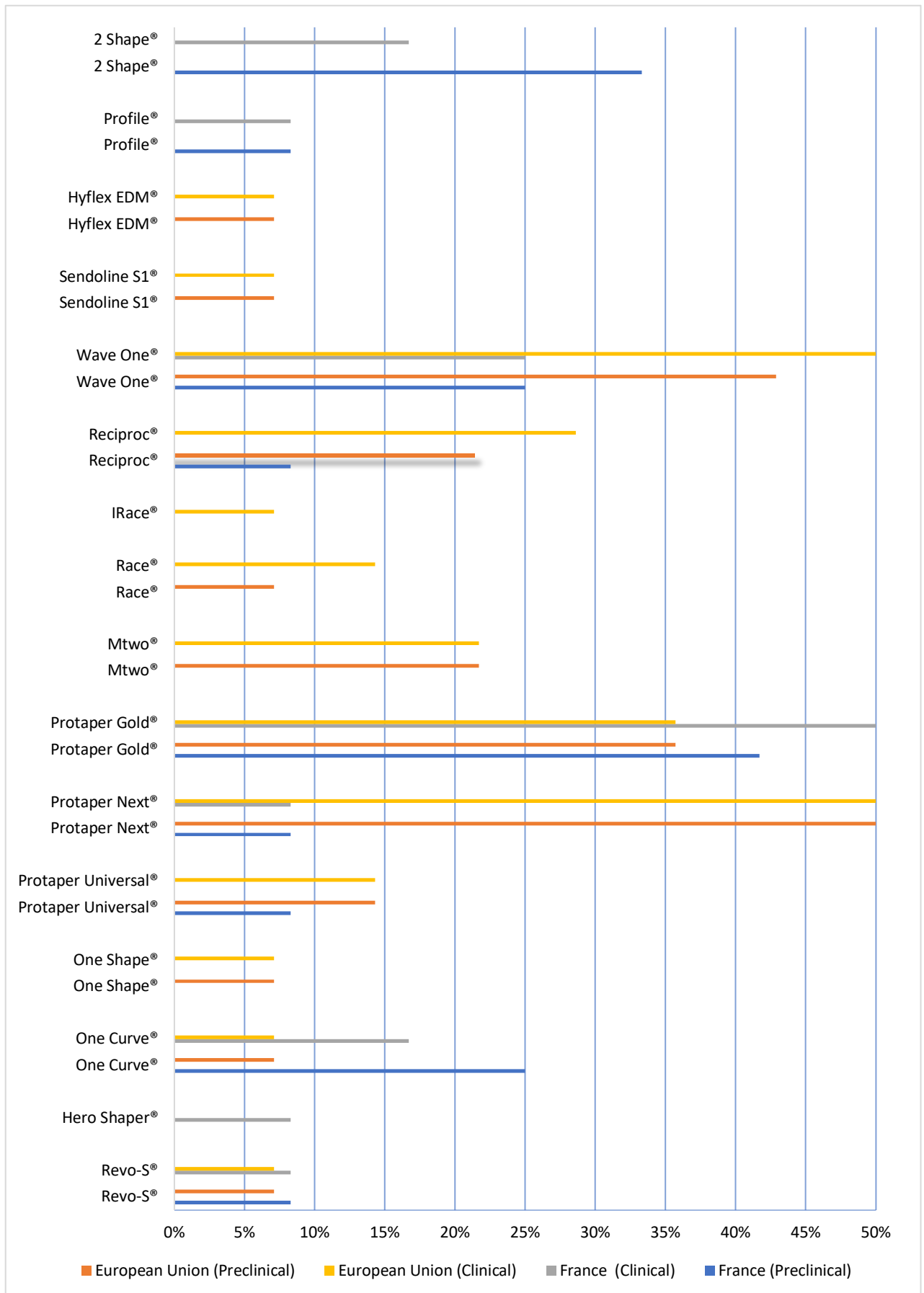


Figure 9 Different Ni-Ti sequence used during preclinical and clinical practice

About glide path, 6 French (50%) and 11 European dental schools (78,6%) taught it during clinical practice (Table 4).

Table 4 About clinical practice: Glide path, Endodontic retreatment, Vital pulp therapy and use of Dental dam during clinical practice

	France		European Union	
	Yes	No	Yes	No
<i>Is glide path taught during clinical practice</i>	50%	50%	78,6%	21,4%
<i>Do students have to perform endodontic retreatment for graduation in clinical practice?</i>	83,3%	16,7%	57,1%	42,9%
<i>Do you teach vital pulp therapy?</i>	100%	0%	100%	0%
<i>Is dental dam mandatory in clinical practice?</i>	100%	0%	100%	0%

The most common irrigating solution used was sodium hypochlorite during clinical practice. 1 French (8,3%) and 5 European dental schools (35,7%) taught it at a concentration under 2%. 11 French (91,7%) and 3 European dental schools (21,6%) taught at a concentration included between 2% and 3%. 6 European dental schools (42,9%) taught at a concentration superior to 3%. 10 French (83,3%) and 8 European dental schools (57,1%) taught EDTA during clinical practice. 2 French (16,7%) and 2 European dental schools (14,3%) taught chlorhexidine as irrigant. 1 European dental school (7,1%) taught citric acid as irrigant and another one taught physiological serum (Fig.11).

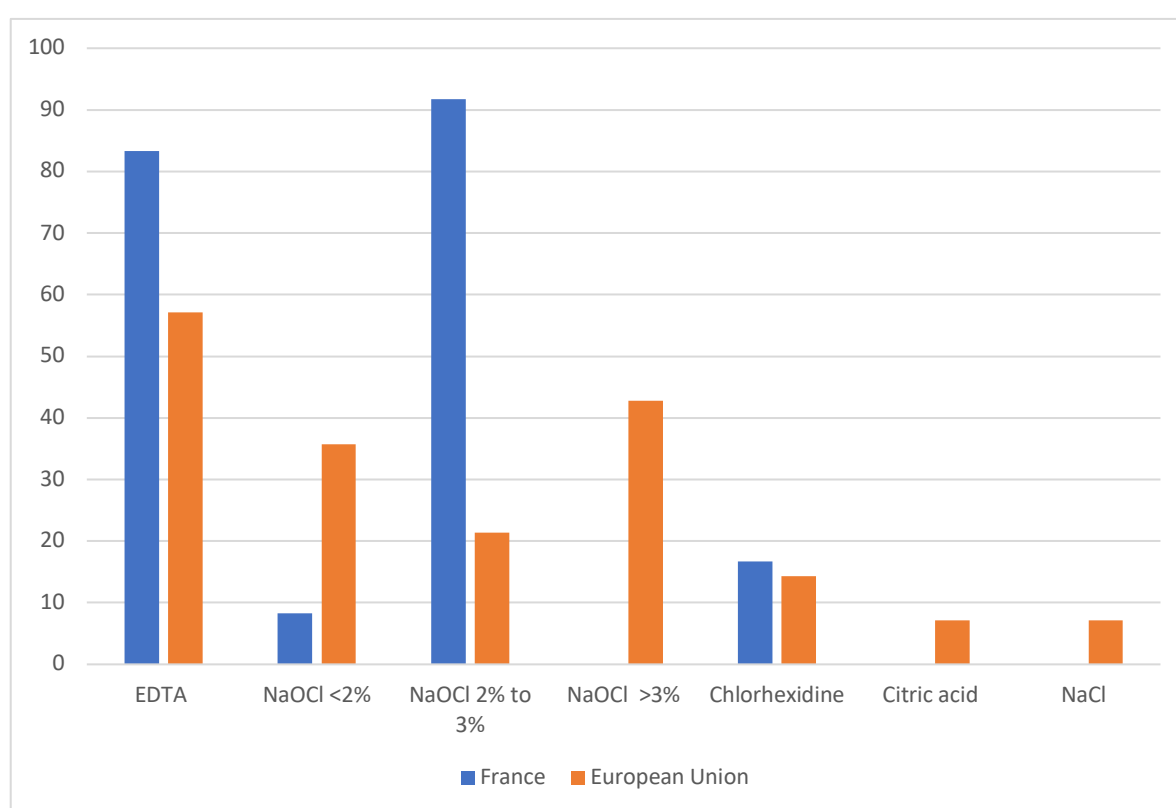


Figure 10 Irrigation solutions and concentration taught in clinical practice

Almost all responding, French (91,7%) and all European dental schools (100%) used Calcium hydroxide as inter appointment medication in clinical practice. 2 French Dental schools (16,7%) used Sodium hypochlorite as inter appointment medication, 2 others (16,7%) did not use anything (Fig.12).

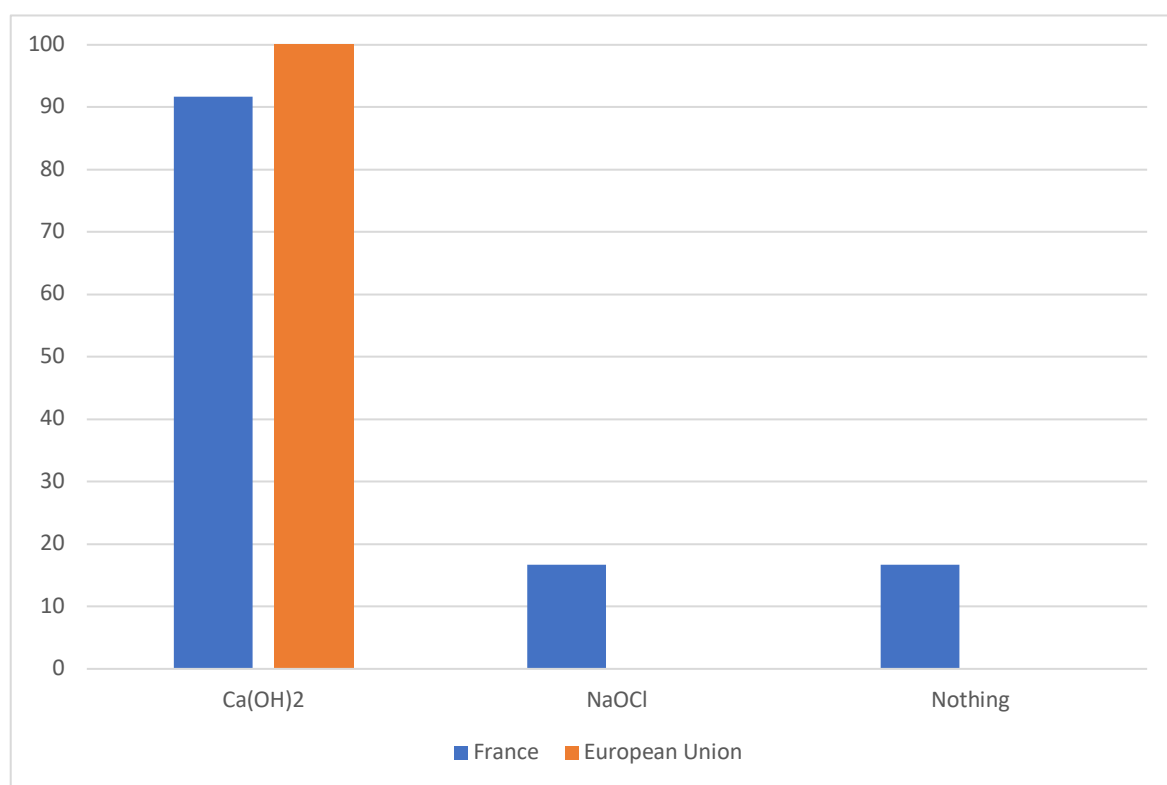


Figure 11 Inter appointment medication in clinical practice

The most common tooth filling materials used for inter appointment was Cavit®, 10 French (83,3%) and 13 European dental schools (92,8%) used it. GIC was used in 5 French (41,7%) and 6 European dental schools (42,9%). RMGIC was used in 5 French (41,7%) and 6 European dental schools (42,9%). Zinc oxide eugenol was used in 3 French (25%) and 6 European dental schools (42,9%). Composite was used in 2 European dental schools (14,3%) (Fig.13).

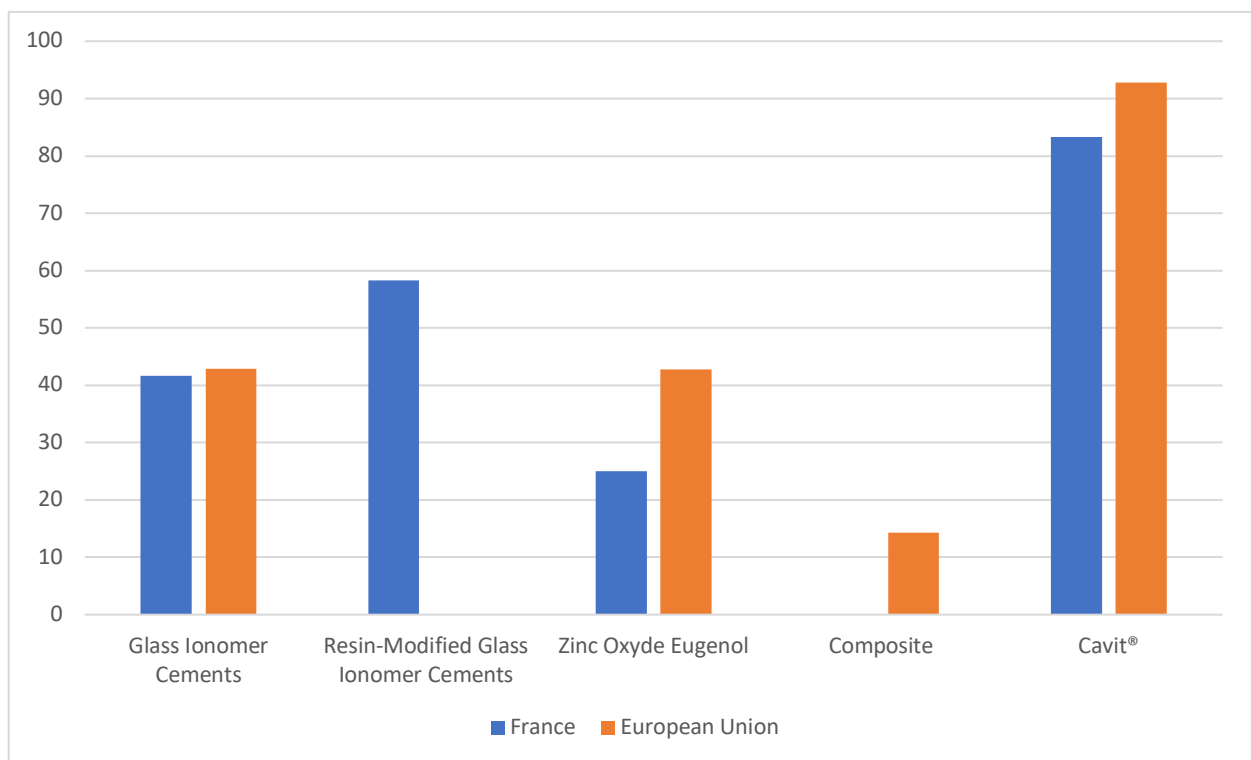


Figure 12 Tooth filling materials used for inter-appointment in clinical practice

The most common irrigation technique used was activation with the mastercone, 9 French (75%) and 8 European dental schools (57,1%) taught it. Active ultrasonic irrigation was used in 1 French (8,3%) and in 2 European dental schools (14,3%). Sonic irrigation was used in 1 French (8,3%) and in 5 European dental schools (35,7%). 4 European dental schools (28,4%) only used the needle as activation. 1 European dental school (7,1%) taught apical negative pressure in clinical practice and another one taught activation with a specific instrument. 4 French (33,3%) and 1 European dental schools (7,1%) did not use anything (Fig.14).

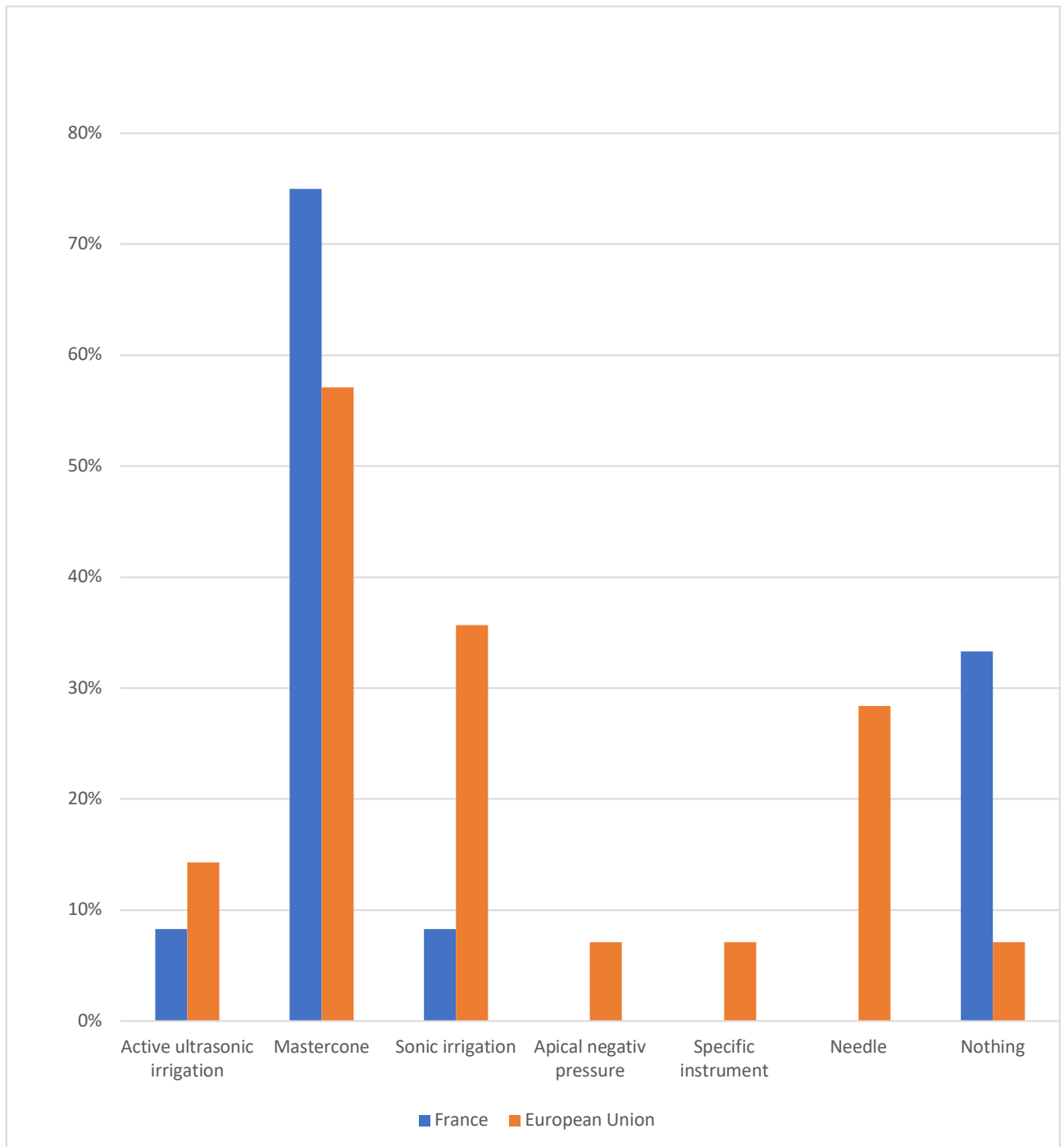


Figure 13 Irrigation activation's technique in clinical practice

The most common root canal obturation technique used was cold lateral condensation, it was taught in 6 French (50%) and in 13 European dental schools (92,9%). Warm vertical compaction was taught in 2 French (16,7%) and in 3 European dental schools (21,4%). Thermomechanical compaction was taught in 7 French (58,3%) and in 2 European dental schools (14,3%). Association of cold lateral condensation and thermomechanical compaction

were taught in 6 French (50%) and in 1 European dental schools (7,1%). 1 French (8,3%) and 2 European dental schools (14,3%) taught single cone obturation. 2 European dental schools (14,3%) taught carrier obturation technique and 1 French dental school (8,3%) used only endodontic sealer in clinical practice (Fig.10).

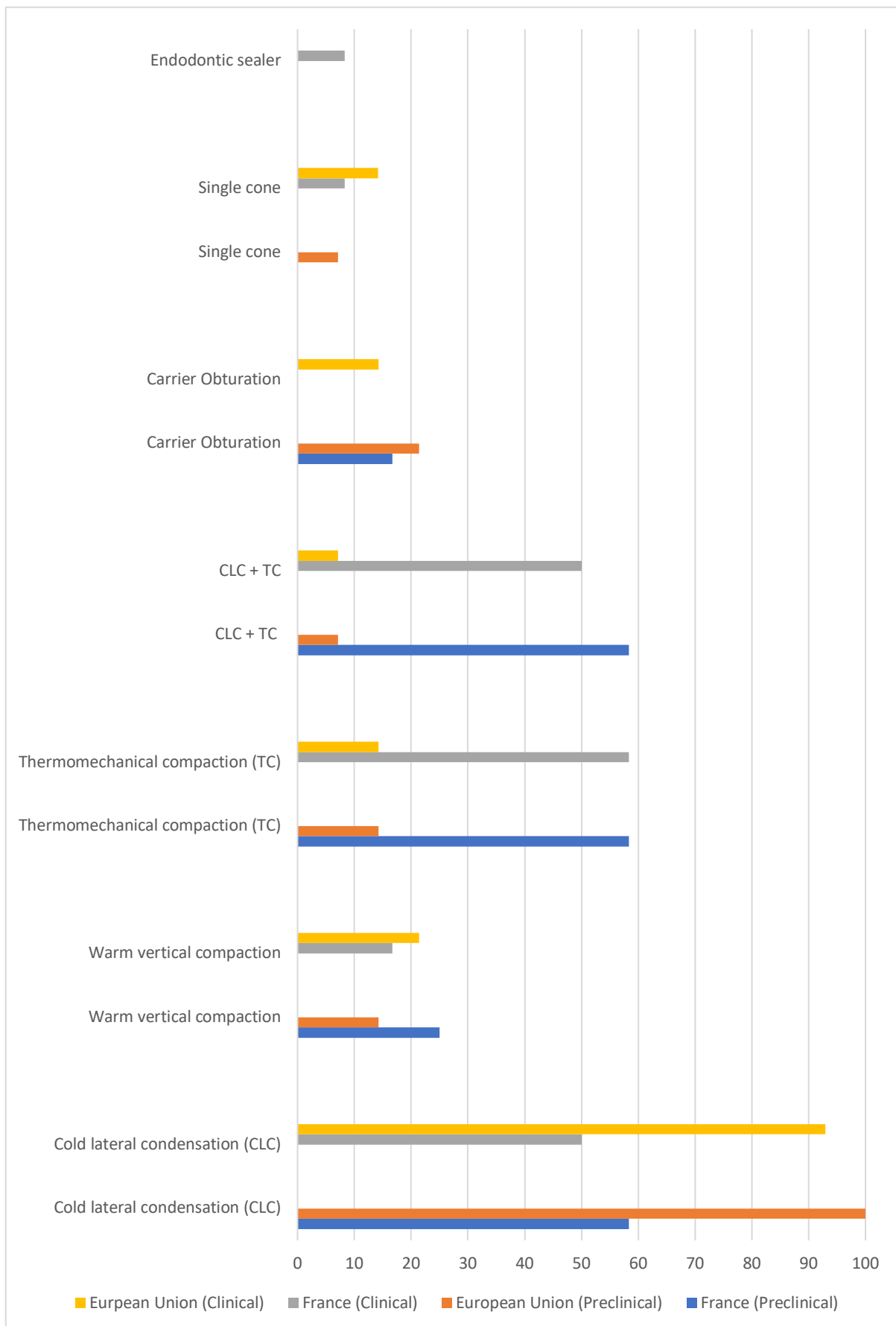


Figure 14 Obturation techniques taught during preclinical and clinical practice

As endodontic sealer 10 French (83,3%) and 3 European dental schools (21,4%) taught Zinc oxide eugenol-based cement in clinical practice. 5 French (41,7%) and 6 European dental schools (42,8%) used Calcium silicate cement. 10 European dental schools (71,4%) used resin-based cement and 2 others (14,3%) used silicone-based cement. 1 French dental school (8,3%) taught calcium hydroxide-based cement (Fig.15).

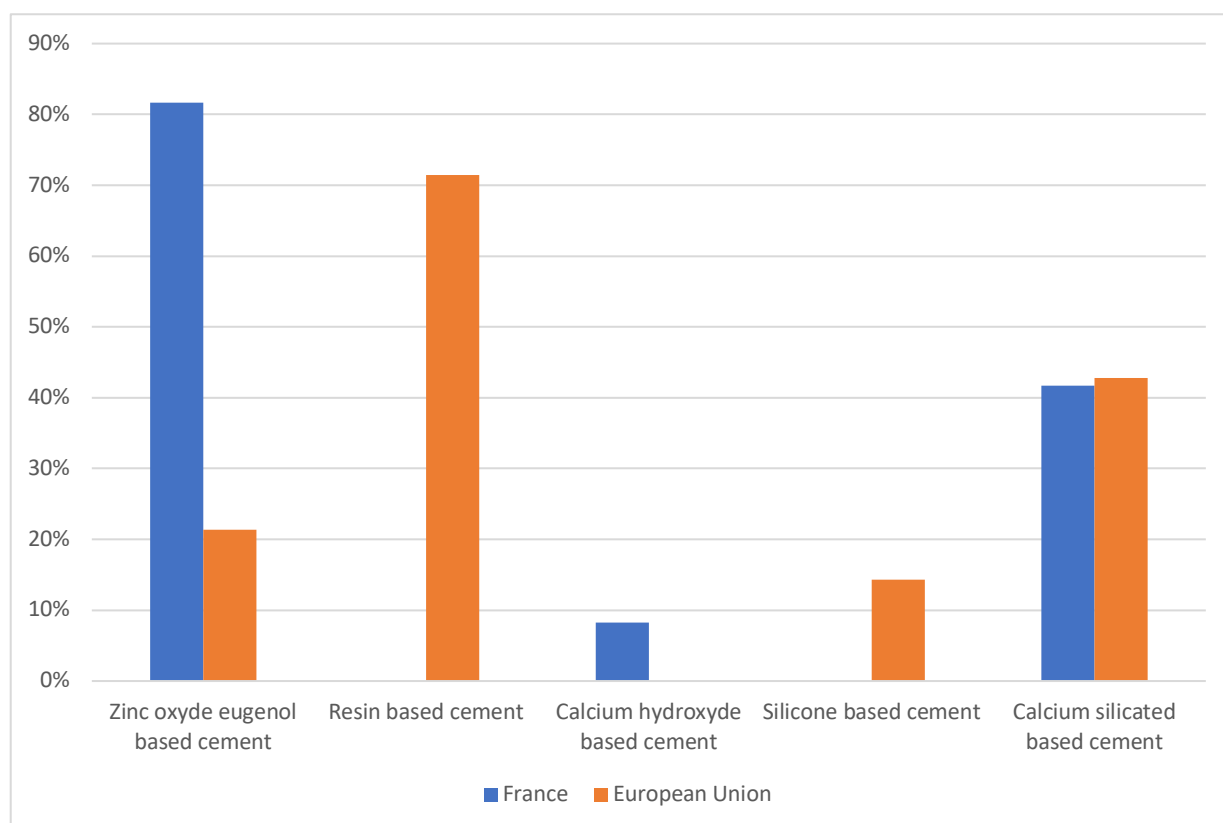


Figure 15 Endodontic sealers taught in clinical practice

10 French (83,3%) and 8 European dental schools (57,1%) answered that students had to perform endodontic retreatment for graduation in clinical education (Table 4).

About the optical magnification, 3 French (25%) and 5 European dental schools (35,7%) made available magnification loupes in clinical practice. 3 French (25%) and 1 European dental schools (7,1%) answered that students had personal magnification loupes. 6 French (50%) and 10 European dental schools (71,4%) made available surgical operating microscope. 1 French dental school (8,3%) made available magnification loupes and surgical operating microscope. 3 French (25%) and 3 European dental schools (21,4%) had nothing available (Fig.16).

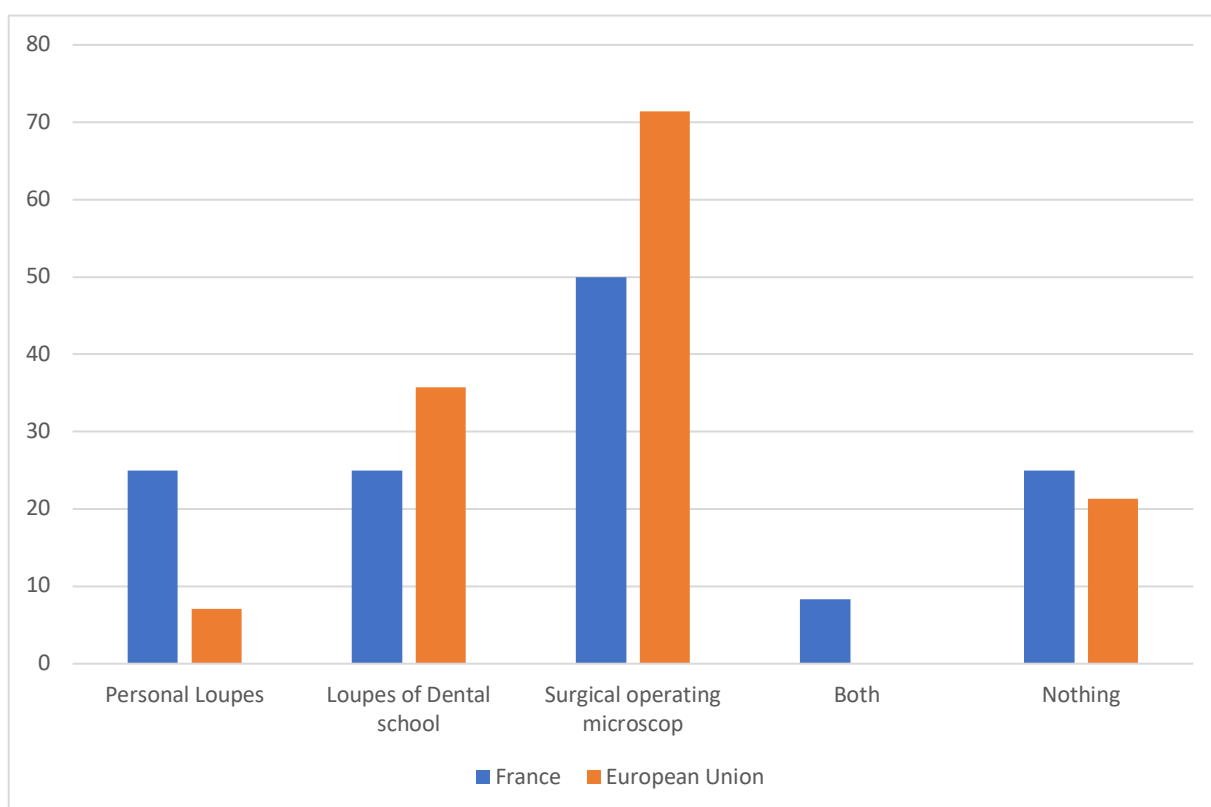


Figure 16 Optical magnifications in clinical practice

All French (100%) and 8 European dental schools (57,1%) used phosphor plate sensor for X-ray exams in clinical practice. 1 French (8,3%) and 8 European dental schools (57,1%) used digital plate sensor. 1 European dental school (7,1%) used silver X-ray (Fig.17).

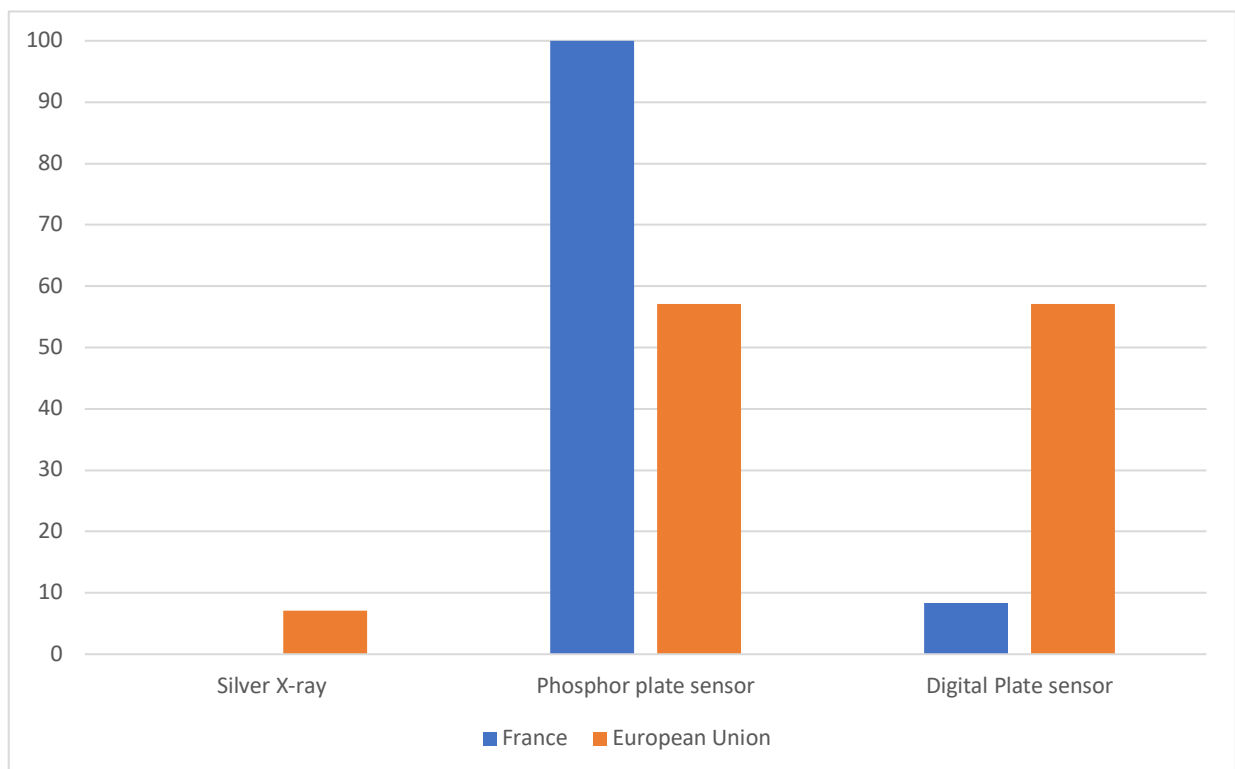


Figure 17 X-ray exams available in clinical practice

CBCT with small FOV was available for students in clinical practice in 11 French (91,7%) and in 8 European dental schools (57,1%). Large FOV was available in 6 French (50%) and in 3 European dental schools (21,4%). 3 European dental schools (21,4%) did not make CBCT available (Fig.18).

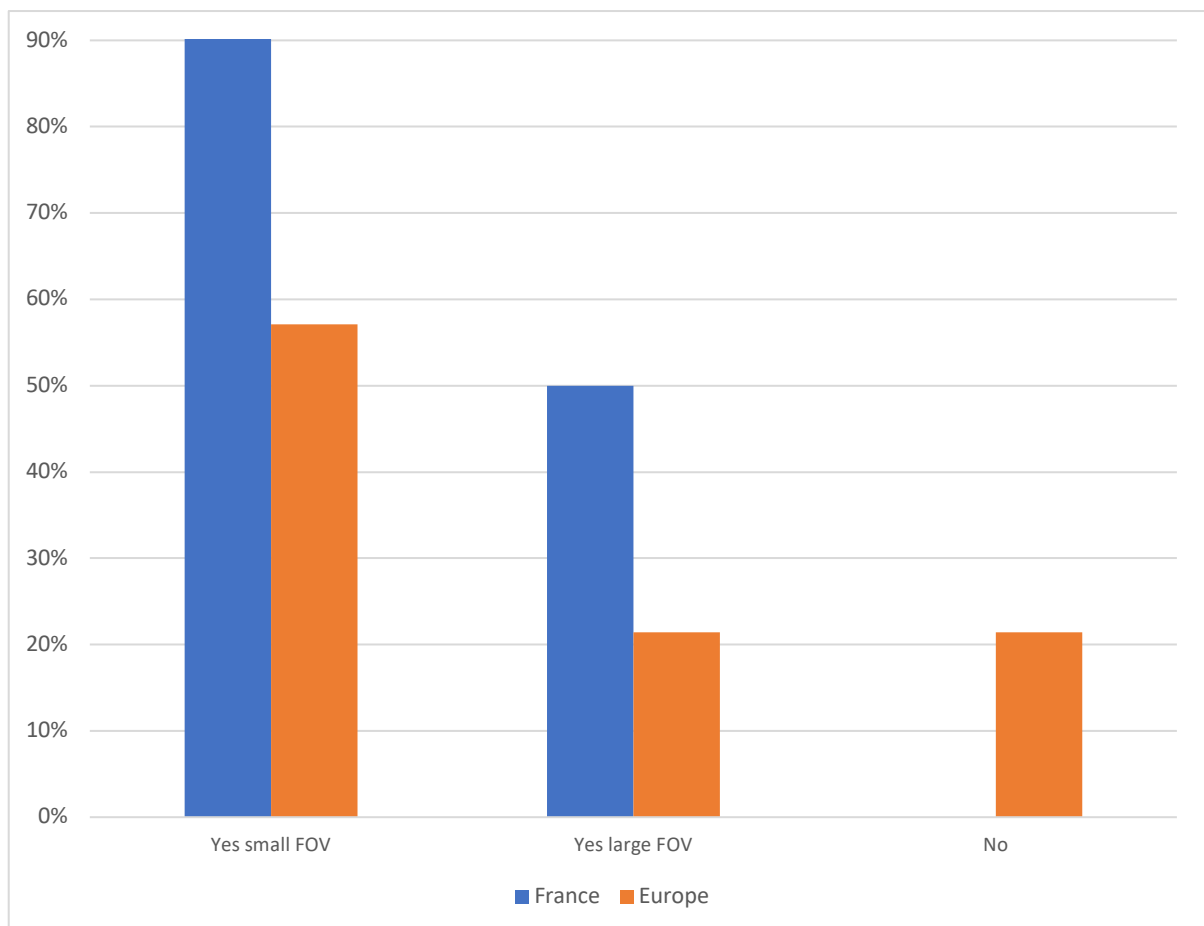


Figure 18 CBCT available for students in clinical practice

Students used CBCT alone in 3 French dental schools (25%). They used CBCT under supervision in 4 French (33,3%) and in 8 European dental schools (57,1%). In 7 French (58,3%) and in 6 European dental schools (42,9%) students were not trained (Fig.19).

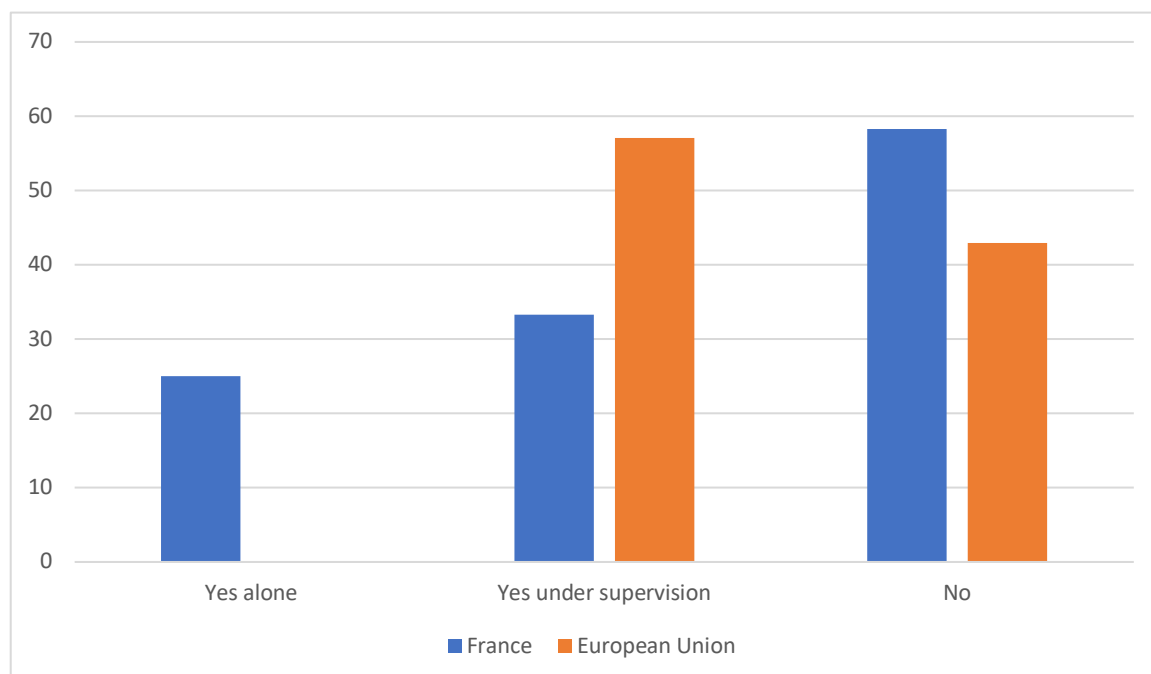


Figure 19 How are students trained to use CBCT

Acute irreversible pulpitis required 2 visits in 1 European dental school (7,1%). Chronic irreversible pulpitis required 2 visits in 1 European dental school (7,1%). Pulp necrosis without sign of infection required 2 visits in 2 European dental schools (14,3%). Infected pulp necrosis required 2 visits in 9 French (75%) and in 6 European dental schools (42,9%). Pulpal canal mineralization required 2 visits in 1 European dental school (7,1%). External resorption required 2 visits in 4 French (33,3%) and in 5 European dental schools (35,7%). Internal resorption required 2 visits in 6 French (50%) and in 4 European dental schools (28,4%). No apical constriction required 2 visits in 4 French (33,3%) and in 1 European dental schools (7,1%). Root canal not cleaned and not dried required 2 visits in 12 French (100%) and in 11 European dental schools (78,6%). In 1 European dental school (7,1%) they systematically used 2 visits for endodontic treatment. Lack of time in 2 French dental schools (16,7%) required 2 visits. Endodontic retreatment required 2 visits in 1 European dental school (7,1%). 1 European dental school (7,1%) answered never required 2 visits (Fig.20).

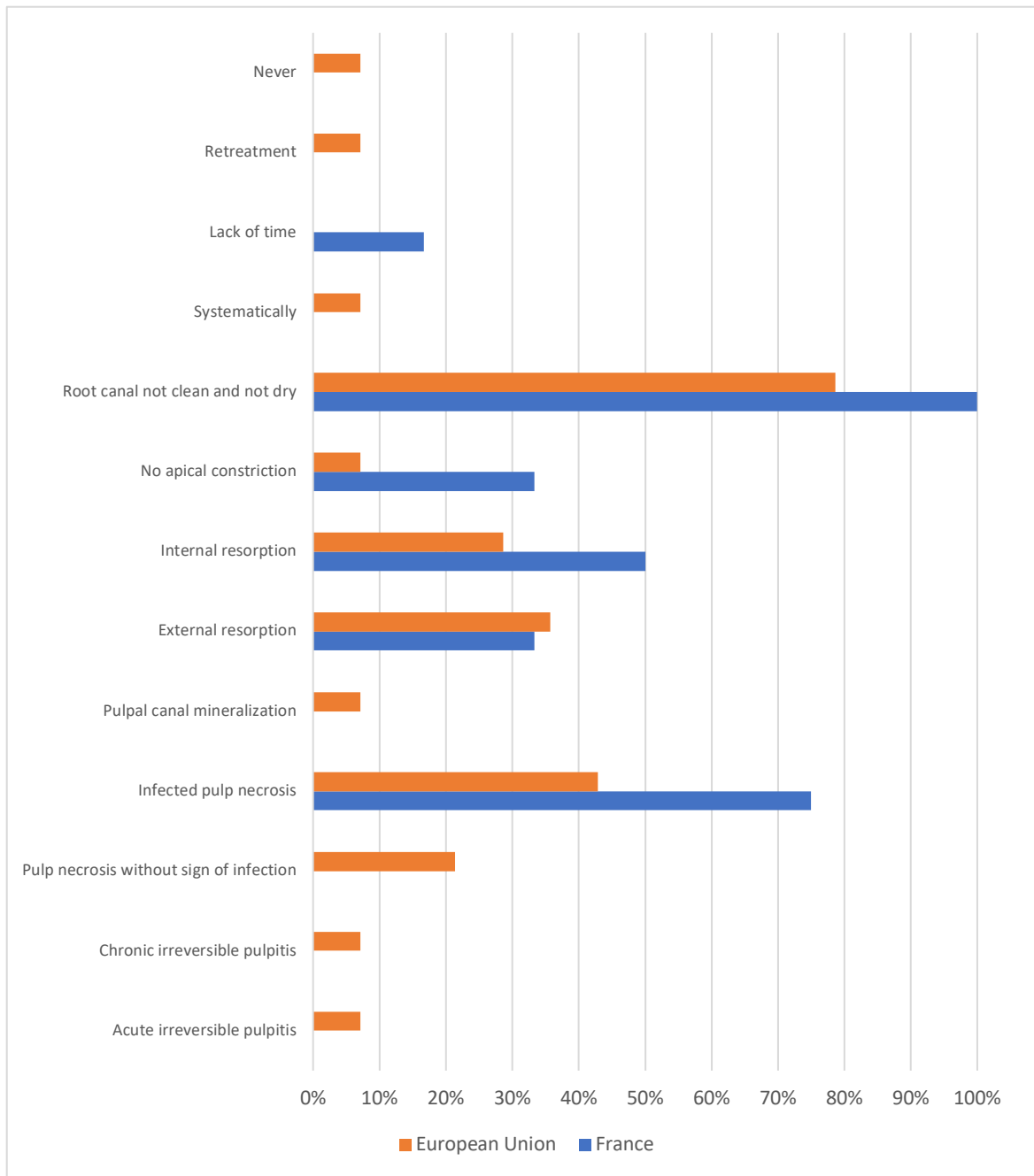


Figure 20 Situations that requires 2 visits during endodontics procedures according to respondents

All French and European dental schools taught vital therapy and made dental dam mandatory during clinical practice (Table 4).

Discussion

The aim of the current study was to evaluate endodontic undergraduate education by comparing France to other European countries using an online questionnaire. Principal interest of the study was to bring a response on uniformity of endodontic education among Europe. A similar survey was published in 1991, in which English dental schools were compared to some other countries in Europe and United states (1). The principal finding of the study was the limited time devoted to preclinical practice in UK. In 1997, a study was published in order to evaluate undergraduate education. Results revealed that time devoted to preclinical was increased but many topics recommended was not approached (2). More recently, in 2018 a study was published on the evaluation of endodontic undergraduate education in United Kingdom (3). They concluded that endodontic education has evolved in positive ways in UK. The time devoted to preclinical was increased and most of schools followed ESE undergraduate recommendations (5).

Since 1991, the European Society of Endodontology published the ESE guidelines (5) which are recommendations destined to European dental schools for preclinical and clinical practice. These guidelines are competence's recommendations: "Be competent at; Have knowledge of; Be familiar with". ESE is aware that time devoted to each step of endodontic education differs between every schools. An extract of the guidelines resumed this approach *"the quality and consistency of student performance are more important than simply the quantity of clinical exposure"*. ESE also published quality guidelines for endodontic treatment which are good practices recommendations (16). In France, HAS also published good practices recommendations (17). All those publications are used by CNEOC (which is a college of teachers of the 16 dental schools in France with the purpose of making available educational resources) to develop endodontic pedagogic document destined to French students, endodontic staff, dental practitioner (18).

Response rate was 75% in France and 26% in European dental schools. It was representative of French dental schools and shows high engagement of the French endodontic departments. Concerning European dental schools, only 14 responses did not reflect undergraduate education. We only had a small sample of the 33 different countries. However, it is a preview of European endodontic education. The lower response rate in European dental schools could be explained by date of mailing (End of August 2019 during summer holidays), length of the survey (30 questions), type of questionnaire (Online survey was employed and certainly not all e-mails were opened). The way to obtain mailing addresses could also explain

the difference of response rate. Regarding French dental schools, strategy was more developed. First, we contacted CNEOC to obtain its approval to realize the study. Then we mailed the questionnaire and made two reminders. Finally, we made a last reminder at CNEOC congress. Regarding European Dental schools we used the ESE website to retrieve them, but we made no reminder.

Results of the current survey should be relativized. We made the choice to not determinate criteria for countries' selection in order to have a maximum of participants. There were multiple points that differ such as economic situation, education system, health system. It means that some schools may benefit of subventions. Some schools may benefit of distinct endodontic department. Furthermore, between the different countries and even within country conditions differed like school's infrastructure or number of students.

The survey revealed that in France and in Europe, time devoted to endodontic theoretical and preclinical education was largely superior to 30 hours during entire curriculum. However, this question did not explore intervals above 30 hours. So, we can suppose there was a difference of numbers of hours between the different dental schools. In 1991, Dummer found 45 hours of PC education for European dental schools (Only 4 European Dental schools included) vs 14 hours for UK dental schools (15 of 16 dental schools) (1). Al Raisi & Al in 2019 found that in UK the number of PC training had well evolved (3).

In order to complete endodontic education, many dental schools in France and Europe made available teaching materials of different types. Teaching materials were endodontic script, videos/files from internet/intranet or lectures print-out. Al Raisi & Al came to the same conclusion (3). Some dental schools answered "others" but did not precise the type. In 1991, Dummer concluded that teaching materials were not widely spread in United Kingdom contrary to other European and American dental schools (1). Results of the survey revealed stated intention of all dental schools to improve education framework by making available many different teaching materials. ESE encouraged contemporary additional learning resources (5).

A difference appeared between French and other European dental schools concerning groups during hands-on workshop. In France, size of groups was bigger than other European countries. This information had to be put into perspective with number of instructors. In France, with one exception, all dental schools had a minimum of 2 instructors. In Europe, results were

very heterogeneous. Some dental schools had only one instructor and some others had 3 or more instructors. ESE undergraduate guidelines attached importance not only to number of instructors or students per group but in the student-staff ratio (5). One again, interval submitted for number of students per group was not precise enough. Therefore, it was impossible to estimate the student-staff ratio. This ratio reflected the importance accorded to endodontic education or resources available in dental schools.

In France and Europe during preclinical practice, the most common used type of teeth was natural teeth. It is an economical solution and it is a good reproduction of clinical situation (19). Paradoxically, natural teeth was not allowed in France during hands-on workshops due to ethical reasons (20). Natural teeth had some drawbacks such as the risk of cross-infection, brittleness due methods of conservation and lack of calibration. Indeed, natural teeth present different anatomy and in fact different level of complexity contrary to other types of teeth who have standardized anatomy (21). Custom made printed, Resin blocks or commercially available resin teeth respond to ethical and infection problems. Commercially available resin teeth (Same anatomy for each student) are an equitable way to evaluate students' achievement. But there is not a large variety of anatomy and they are much more expensive (22). Resin blocks are not enough close to real anatomical situation but a good way to make first move in endodontic procedures. It seems that Custom made printed are the best alternative choice to natural teeth. From natural teeth scan, identical teeth are made of resin by 3D impression. It offers possibility to have different anatomical situation (different level of complexity, large range of anatomical situation, radio opacity). Price of this technology has been decreasing and it is a hope they will be more used in the future.

Shaping methods taught were the same in preclinical and clinical practices in France and Europe. This choice reflect the dental schools desire to prepare students as well as possible to clinical practice. The two principal methods were the manual technique and continuous rotation. ESE guidelines do not make any recommendation (5). HAS recommends the use of Ni-Ti rotary instrument and manual shaping for catheterism and very curved canal (17).

As for shaping method, root canal obturation's methods taught were the same in preclinical and clinical practice. Historically, the cold lateral technique was reported as the gold standard obturation method (23). In our survey, this technique was the most common taught technique in European dental schools. In French dental schools this technique was often used too in association with thermomechanical obturation. French dental schools tried to potentiate root canal obturation by cumulate advantages of 2 techniques. However, we do not know conicity of gutta cone used for cold lateral condensation.

ESE undergraduate guidelines recommend “to be familiar with methods of enhancing irrigant action, including the use of ultrasound” (5). HAS recommend using sodium hypochlorite and EDTA for final rinse (17). All respondent schools used sodium hypochlorite. Large majority of French and approximately half of European dental schools used EDTA. Some others irrigants were also used but we had no information on the situation of use. Dummer in 1991 concluded that all European and American schools used Sodium hypochlorite contrary to United Kingdom. The present results revealed progress. Almost all European dental schools taught enhancing irrigant method. In France results were incoherence, 33,3% of French dental schools responded not teaching any enhancing irrigation technique but 75% responded teaching activation with mastercone. It revealed a misunderstanding of this question or a wrong submitted answer.

Almost all French and all European dental schools used Ca(OH)_2 as inter-appointment medication. ESE undergraduate guidelines recommend to “be competent at medicating root canals” (5). In French and European dental schools many situations required 2 visits for root canal treatment and thus the use of Ca(OH)_2 . Results revealed that one situation in particular (Root canal not clean and not dry) made unanimity in French and European dental schools. HAS recommends 2 visits only in this situation (17). According to HAS, the survey selection revealed that there was no significant difference in using 2 visits on the root canal treatment success (24).

Concerning tooth filling materials for inter-appointment, Cavit® was the most widely used. It is easy to fill, do not fear humidity, easy to remove and not so expensive. It fulfils the ESE report of 2006 criterias (25).

Optical magnifications were widespread in French and European dental schools. ESE undergraduate guidelines recommend being initiated but results revealed that a significant number of dental schools did not make them available (5). Another significant number of schools responded that students used their personal loupes. Magnification are not mandatory and may be considered as expensive tools for dental students. Countries with higher living standards are advantaged.

All French dental schools used phosphor plate sensor in clinical practice. Other European dental schools used either phosphor plate either digital sensor. All French and a large part of European dental schools made CBCT available. ESE undergraduate guidelines recommend having knowledges on principles of CBCT (5). Approximately half French and European dental schools initiated their students to use it on their own or under supervision. It revealed willingness of dental schools to train students to most recent techniques.

With this in mind, all French and European dental schools taught vital pulp therapy and made mandatory dental dam.

Conclusion

Generally, results of the current survey revealed homogeneous of endodontic undergraduate education in the different dental schools compared. Some differences exist highlighted priority of dental schools in certain techniques. The survey seems to display an equivalent level between European students. Dental schools most often follow recommendation of the European Society of Endodontic which could explain the harmonization. Dental schools made available for her student the most recently techniques and materials. In order to deliver the excellence of endodontic education.

III. CONCLUSION

Cette étude a permis de démontrer que beaucoup d'efforts sont réalisés au sein de chaque faculté afin de mettre en application les données acquises, avérées et scientifiques en utilisant des référentiels tels que les recommandations de l'ESE ou ceux élaborés par le CNEOC. La mise en place de ces recommandations profite aux étudiants. En effet en harmonisant le niveau de pratique et de connaissance avec des standards élevés, cela offre aux étudiants une formation d'excellence. De plus avec la reconnaissance du diplôme entre les pays membres de l'Union Européenne, les étudiants qui feront le choix de la mobilité auront plus d'aisance pour débiter leur exercice professionnel. Par conséquent ces mesures sont profitables au patient car sa prise en charge n'en sera que meilleure.

Ainsi malgré un cadre juridique européen peu précis entourant la reconnaissance du diplôme de Chirurgien-dentiste, l'enseignement a été dans l'ensemble standardisé. Cela a été rendu possible grâce à l'action d'instances comme l'ESE par ses publications à l'échelle internationale ou encore par le Comité National des Enseignants en Odontologie Conservatrice à l'échelle nationale. En effet le CNEOC met à disposition des étudiants des fiches cliniques d'endodontie mais ne se limite pas seulement à ces aides pédagogiques puisqu'il collabore avec d'autres collègues à l'échelle internationale. C'est grâce à la collaboration entre ces différentes instances que l'amélioration de l'enseignement est possible.

Malgré les efforts de chaque acteur en faveur du développement de l'enseignement initial de l'endodontie il existe encore des axes d'amélioration (Le type de dents utilisées en TP, la pratique du retraitement qui n'est pas démocratisée, la mise à disposition d'aides optiques qui est à améliorer). Il y a fort à parier que dans le futur les différents acteurs vont encore mettre en place des mesures visant à améliorer l'enseignement initial de l'endodontie et il sera donc intéressant de renouveler une enquête à ce sujet.

Dans cette optique le questionnaire sera à améliorer aussi bien au niveau des questions (pour calculer un ratio étudiant/enseignant notamment) que dans les propositions de réponses (les intervalles à élargir afin de pouvoir mieux comparer les heures de cours par exemple). Il serait judicieux également de réfléchir à l'inclusion des pays car on retrouve dans notre enquête des pays dont le niveau de vie n'est pas comparable.

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SABOURIN (Clément) – Enquête sur l’enseignement initial de l’endodontie en France et à l’étranger –52 f. ; 20 fig. ; 4 tabl. ; 25 ref. ; cm (Thèse :Chir. Dent. ; Nantes ; 2020)

RESUME :

Le but de cette étude était d’évaluer l’enseignement de l’endodontie dans différentes facultés en France et à l’étranger. Pour cela un questionnaire en ligne a été envoyé aux chefs de département d’Odontologie Conservatrice et d’Endodontie des 16 facultés Françaises et de 53 Facultés Européennes. Ce questionnaire s’intéressait à l’enseignement théorique, l’enseignement préclinique et l’enseignement clinique. 12 facultés Françaises et 14 facultés Européennes ont répondu à cette enquête. Les résultats semblent mettre en évidence une homogénéité de l’enseignement initial de l’endodontie à travers les facultés d’Europe ainsi que le respect dans l’ensemble des recommandations de l’ESE.

RUBRIQUE DE CLASSEMENT : Odontologie - Endodontie

MOTS CLES MESH:

Dent traitée par endodontie – Tooth, Nonvital
Enquête et questionnaires – Survey and questionnaires
Enseignement dentaire – Education, Dental

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