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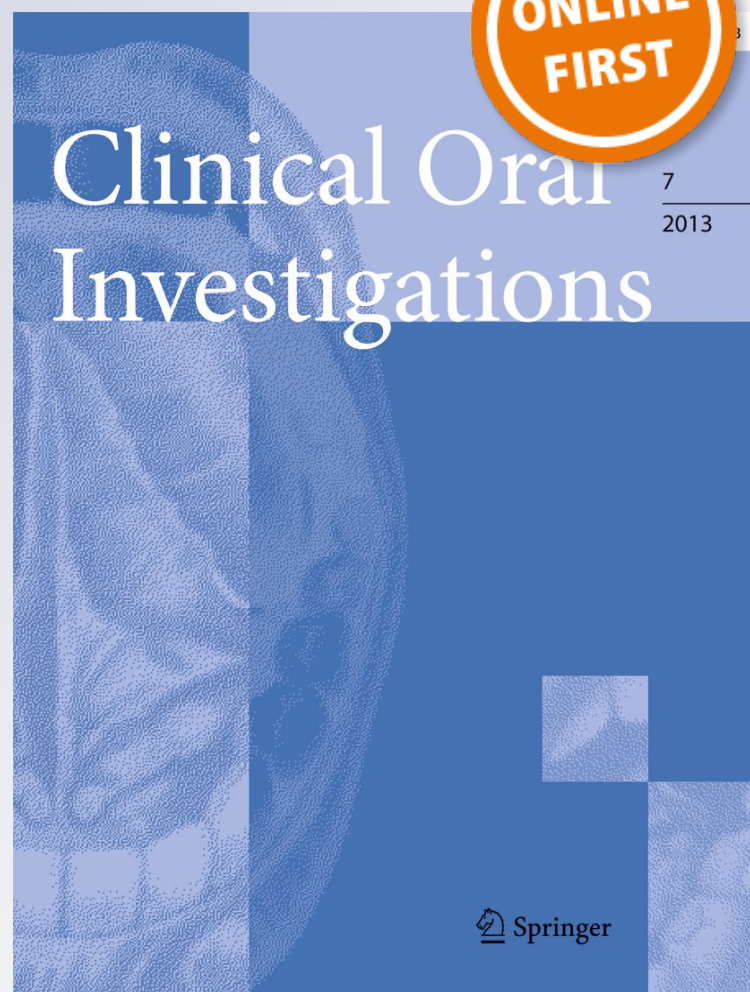
**Loredana Radoi, David Hajage, Caroline Giboin, Louis Maman, Virginie Monnet-Corti, et al.**

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# Perioperative management of oral anticoagulated patients undergoing an oral, implant, or periodontal procedure: a survey of practices of members of two dental scientific societies, the PRADICO study

Loredana Radoi<sup>1,2</sup> · David Hajage<sup>3</sup> · Caroline Giboin<sup>3</sup> · Louis Maman<sup>1,4</sup> · Virginie Monnet-Corti<sup>5,6</sup> · Vianney Descroix<sup>7</sup> · Isabelle Mahé<sup>8,9,10</sup>

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## Abstract

**Objectives** Studies on the perioperative management of patients on direct oral anticoagulants (DOACs) receiving oral invasive procedures are sparse. Moreover, the recommendations of the scientific societies on DOACs are discordant, and the practices are highly variable. We conducted a survey of general and specialized dentists in France to compare their practices concerning the management of patients receiving vitamin K antagonists (VKAs) and DOACs.

**Materials and Methods** Members of two dental surgical societies were invited to participate in the survey. One hundred forty-one practitioners answered an online questionnaire focusing on the periprocedural management of oral anticoagulated patients (participation rate, 17.8%).

**Results** Practitioners at hospitals or mixed practices and specialists treated significantly more anticoagulated patients and more frequently performed procedures with high hemorrhagic risk than practitioners with private practice and general dentists. Greater than 90% of practitioners did not modify the treatment for patients on VKAs and controlled the International Normalized Ratio (INR) preoperatively. Regarding DOACs, 62.9% of practitioners did not change the treatment, 70.8% did not prescribe any biological tests, and 13.9% prescribed an INR. Practitioners at hospitals and mixed practices and specialists had better training and knowledge about DOACs.

**Conclusions** This survey showed that anticoagulated patients were managed mostly by specialists in private or hospital care, notably when requiring oral procedures at high hemorrhagic risk.

**Clinical relevance** A growing proportion of anticoagulated patients are being treated by dentists in primary care. Consequently, they need training, especially concerning DOACs. Additionally, consensus recommendations are necessary for better coordination of stakeholders and patient safety.

Trial registration on [ClinicalTrials.gov](https://clinicaltrials.gov): NCT03150303.

**Keywords** Periprocedural management · Practices · Survey · Oral surgery · Anticoagulants · Vitamin K antagonists · Direct oral anticoagulants

## Introduction

Oral anticoagulant therapy is the cornerstone for treating venous thromboembolism and for preventing atrial fibrillation-

related stroke. Vitamin K antagonists (VKAs) have been the reference oral anticoagulants for several decennials. In 2011, a study of the Health Insurance Fund on anticoagulant consumption showed that 4% of the French population has received at least one anticoagulant refund [1]. Direct oral anticoagulants (DOACs) have been licensed since 2009 for medical indications. In 2013, they became available in France; since then, their prescription has been increasing dramatically. The majority of patients receiving anticoagulants were on VKAs, but a large number of patients initiated on anticoagulant were started on DOACs (more than 1 million patients on

✉ Loredana Radoi  
loredana.radoi@parisdescartes.fr

Extended author information available on the last page of the article

VKAs versus 265,000 patients on DOACs) [2]. Overall, from October 1, 2012, to September 30, 2013, almost as many naïve patients started treatment with DOACs as with VKAs: 235,000 patients on DOACs versus 252,000 patients on VKAs [3]. Alternately, switches from VKA to DOACs were encountered in approximately 100,000 patients during this period [3]. These data demonstrate extensive use of DOACs in everyday practice as first- or second-line treatments.

The perioperative management of anticoagulant drugs for invasive procedures and the treatment of hemorrhagic complications in patients receiving VKAs have been drafted by the French National Authority for Health (*Haute Autorité de Santé*, HAS) and the Working Group on Perioperative Hemostasis (*Groupe d'Intérêt en Hémostase Périopératoire*, GIHP) [4]. In 2006, the French Society of Oral Surgery (*Société Française de Chirurgie Orale*, SFCO) published recommendations for oral surgery in patients on VKAs [5] and, more recently in 2015, recommendations for the perioperative management of antithrombotics in oral surgery [6]. The recommendations of these scientific societies are consensual for the management of VKAs: Continuation of treatment is recommended in the case of procedures with a low risk of bleeding (detailed in Table 1); in the case of procedure with a high risk of bleeding (detailed in Table 1), the thromboembolic risk during the drug interruption period must be individually assessed by the prescribing physician; if the thromboembolic risk is low and the intervention is associated with a high risk of bleeding, cessation of the anticoagulant for 48–72 h may be considered to reach an INR below 2 in the perioperative period; if both the thromboembolic risk and hemorrhagic risk are high (e.g., atrial fibrillation with a history of cardio-embolic complications, proximal deep venous thrombosis or pulmonary embolism within the first 3 months, or recurrent), heparin bridging at a curative dose is required during the period of VKA interruption. In contrast, recommendations concerning the management of patients receiving DOACs differ according to the scientific society. For GIHP and the French Study Group of Thrombosis and Hemostasis (*Groupe d'Etude sur l'Hémostase et la Thrombose*, GEHT), for procedures with a low risk of bleeding, it is suggested not to administer DOACs the evening prior to or the day of the procedure and to restart the treatment the day after the procedure [7]. For procedures with a high risk of bleeding, it is suggested to stop DOACs 5 days before the procedure and restart the treatment after the procedure, depending on the local hemostasis. Heparin bridging can be performed during the period without DOACs if the thromboembolic risk is high [7]. In contrast to these recommendations, the recent guidelines of SFCO recommend continuation of DOACs in the case of procedures with a low risk of bleeding [6], such as for patients on VKAs. In the case of oral surgery with a high risk of bleeding, the opinion of the prescribing physician is required to assess the thromboembolic risk: if it is low, DOACs can be stopped the day before and

resumed the day after the surgery (interruption of 48 h); if the thromboembolic risk is high, a longer discontinuation of DOACs with heparin bridging may be considered, but it must remain an exception [6]. These proposals of scientific societies on DOACs are based on expert opinion, have been determined without available clinical data concerning oral invasive procedures in patients receiving these drugs (unlike VKAs), and are conflicting. Therefore, it remains difficult for practitioners to choose one of the existing protocols in clinical practice. In addition, the recommendations make no distinction between DOACs, and their actual use by medical specialists, general practitioners and dentists is unknown and probably low. These observations suggest that practices are, to date, highly variable.

These arguments illustrate the need for a postmarketing survey of practices in this specific setting. We conducted a national survey in France, the PRADICO study (PRatiques Anticoagulants oraux DIRECTs Chirurgie Orale), among general dentists and specialists in oral surgery, implantology, and periodontology. The aim of this survey was to assess their knowledge about antithrombotics and their practices in the perioperative management of oral anticoagulants.

## Methods

A multidisciplinary collaboration was established between research teams working in different fields, namely, cardiology (IM), oral surgery, implantology, and periodontology (LR, LM, VD, VMC), and clinical research (DH, CG) to conduct a cross-sectional national survey of practices of members of two dental scientific societies when performing invasive procedures in patients receiving oral anticoagulants.

## Study population

The majority of the French oral surgeons or periodontists but also some general dentists with a special interest in oral surgery, implantology, and periodontology are members of the French Society of Oral Surgery (SFCO) or of the French Society of Periodontology and Oral Implantology (SFPIO). Together, these specialists are most likely to perform a wide range of invasive oral procedures, thus justifying the choice of the study population among the members of these dental societies. In addition to specialists practicing in France, both scientific societies have members settled in Europe or Africa. Since we aimed to evaluate professional practices, which are supposed to be based on the recommendations of SFCO and GIHP, the study was limited to the French members. A total of 792 practitioners were solicited to participate

**Table 1** Stratification of the risk of bleeding based on the type of oral surgical procedures and preventive measures according to the recommendations of the French Society of Oral Surgeons

Types of surgeries and invasive procedures	Preventive measures for bleeding complications
Procedures with no risk of bleeding	
Local anesthesia	Simple mechanical hemostasis
Supragingival scaling	
Procedures with low or moderate risk of bleeding	
Subgingival scaling and root planing	Measure of oral hygiene and teeth scaling before surgical procedures
Single extraction	Conventional surgical hemostasis <sup>a</sup>
Multiple extractions in the same quadrant	Tranexamic acid (in mouthwash, on gauzes)
Endodontic and periradicular surgery (lesion $\leq 2$ cm)	
Mucogingival surgery (except free mucosal graft harvesting at the palatal area)	
Preorthodontic surgery of impacted/included teeth	
Single implant placement	
Implant(s) release (placement of healing abutment)	
Oral mucosa excisional biopsy ( $\leq 1$ cm)	
Procedures with high risk of bleeding	
Multiple extractions in several quadrants	Same preventive measures as for procedures with low risk of bleeding
Extraction of impacted teeth	
Elective surgical extractions requiring a flap rising	Drugs derived from blood, based on human fibrinogen and thrombin
Multiple implants in several quadrants	Mono and bipolar electrocoagulation
Sinus lift surgery (crestal or lateral approach)	Minimally invasive surgical techniques (flapless and guided implant surgery, sinus lift by crestal approach, among others)
Apposition bone graft (in onlay)	
Particulate bone grafting and guided bone regeneration	
Enucleation of cysts and benign tumors (lesion $> 2$ cm)	
Closing an oral sinus communication	
Excision of pseudotumors and benign tumors of the oral mucosa ( $> 1$ cm)	

<sup>a</sup> Conventional surgical hemostasis: Mechanical hemostasis (compression + sutures)  $\pm$  absorbable local hemostatic agents (collagen or gelatin sponges, cellulose gauze)  $\pm$  synthetic glue (cyanoacrylate glue)

Factors aggravating the risk of per-operative bleeding: Mucoperiosteal detachment beyond the mucogingival line, lingual detachment, extraction(s) in inflammatory zone, periodontal disease, operating time  $> 1$  h (significant blood loss)

Critical locations: Floor of the mouth, mandibular symphysis, maxillary sinus

in the survey between October 1, 2016 and May 30, 2017, and 141 of them agreed (participation rate, 17.8%).

## Data collection

A semi-structured questionnaire consisting of 24 questions was constructed for the purpose of this survey. The questionnaire was formulated by the authors of the study and had both closed and open-ended questions (see Online Resource 1). Some questions had multiple possible answers, which was indicated. The questionnaire included questions about the following: (i) the profile of the practitioner (gender, time since graduation, type of health care facility of practice (public, private, or mixed), type of activity (general dentist, oral/maxillofacial surgeon, periodontist); (ii) experience with oral anticoagulants (number of patients on anticoagulants treated monthly, type of procedures performed); (iii) knowledge about DOACs (mechanism of action, adverse effects, and risks related to invasive oral procedures), and information/training on DOACs (if received, the source should be informed; if not, the practitioner was asked if he/she wanted to receive training or not); (iv) management of

anticoagulants in the periprocedural period (e.g., continuation, interruption, heparin bridging), biological tests prescribed preoperatively, and detailed descriptions of intraoperative hemostatic techniques. The questionnaire has been tested by 5 practitioners for 10 surgical procedures. Their feedback on comprehension of the questions and the time required to answer them helped us to improve the questionnaire. Then, the questionnaire was distributed on a secure platform ([ze-questionnaire.com](http://ze-questionnaire.com)) allowing online completion, answer storage, and data extraction. Each questionnaire remained open to responses for 2 months after establishment. An invitation to participate in the survey, containing the synopsis of the study and the link to the internet site of the platform [ze-questionnaire.com](http://ze-questionnaire.com), was emailed to the members of SFCO and SFPIO by the presidents of the two scientific societies (LM for SFCO; VMC for SFPIO). To increase the participation rate, four email reminders were sent, resulting in four consecutive questionnaire campaigns.

The study was approved by the French Ethics Committees (Committee for the Protection of Persons-CPP no. 16–670; Commission Nationale de l'Informatique et des Libertés-

CNIL n° 1,873,607) and registered at [ClinicalTrials.gov](https://clinicaltrials.gov) (identifier: NCT03150303).

## Statistical analysis

Qualitative variables were described as numbers and percentages, and quantitative variables were presented as numbers, means, and standard deviations. Quantitative variables with a skewed distribution were presented as medians and interquartile ranges (25th percentile – 75th percentile).

Practices when performing invasive procedures in oral anticoagulated patients were compared according to several characteristics of surgeons: years of experience, type of health care facility (private, hospital, mixed), and type of activity (general dentists or specialists).

The hemorrhagic risk induced by oral procedures was classified as none, low, and high, according to the recommendations of SFCO [6], as presented in Table 1. Categorical variables were compared using the chi-squared or Fisher's test, as appropriate. Continuous endpoints were compared using the Student's or Wilcoxon test, as appropriate.

Statistical analyses were performed using R software (version 3.3.3). All tests were two-sided, and a  $p$  value  $\leq 0.05$  was the threshold for statistical significance.

## Results

One hundred forty-one practitioners answered the questionnaire between October 1, 2016, and May 30, 2017, of which 59.6% were men and 40.4% women (Table 2). Among them, 36.7% had graduated less than 10 years prior and 31.7% more than 20 years. According to the type of health facility, the 30.5% of dentists had exclusive hospital practices, 32.6% exclusive private practices, and 36.9% mixed (private and hospital) practices. Regarding the type of activity, 34.8% of practitioners were general dentists, and 65.2% were specialists.

All participants usually consulted patients receiving anticoagulants: 95% on VKAs, 96.5% on DOACs, and 43.9% on heparins (Table 3). More than half of the practitioners treated less than 20 anticoagulated patients monthly, and one-third of them treated between 20 and 50 patients. Concerning DOACs, the majority of practitioners (approximately 88%) treated between 1 and 10 patients monthly.

The most common oral surgery procedures performed in anticoagulated patients were as follows: single dental extraction (95.7%), multiple extractions (82.9%), and single implant placement (69.5%); the most frequent periodontal procedures were as follows: scaling and root planing (62.4%), followed by periodontal surgery or mucogingival surgery (24.8%).

Table 4 shows the comparisons between the number of treated patients, types of anticoagulants, and types of oral

procedures performed, according to several practitioner-related parameters: time since graduation, type of health-care facility of practice, and type of activity.

There was no significant difference between young graduates (< 10 years) and more experienced practitioners (10–20 years or > 20 years) concerning the number of patients on anticoagulants overall/on DOACs treated monthly or the type of anticoagulants. Moreover, the type of oral procedures performed was not related to the time since graduation.

There was a significant association between the type of practice and the number of anticoagulated patients treated monthly: practitioners with exclusive hospital practices or mixed (hospital and private) practices treated more patients ( $p = 0.04$ ) compared with dentists with private practices. In addition, patients on heparins were more likely treated by practitioners with hospital/mixed practices ( $p < 0.0001$ ); oral procedures without hemorrhagic risk were performed mostly in private practices ( $p = 0.04$ ), while interventions at high risk of bleeding were more frequently performed in hospital/mixed practices ( $p = 0.0006$ ).

There was a significant association between the type of activity and the number of patients on anticoagulants overall/on DOACs treated monthly, with specialists treating more patients than general dentists ( $p = 0.01$  and  $0.03$ , respectively). Concerning the type of anticoagulants, specialists more frequently treated patients on heparins or VKAs than general dentists ( $p = 0.04$  for both medications). Regarding the type of oral procedures, general dentists more often than specialists performed interventions without hemorrhagic risk ( $p < 0.0001$ ), and they less frequently performed procedures with a high risk of bleeding ( $p < 0.0001$ ).

Table 5 shows a comparison of the preoperative management of VKAs and DOACs, blood tests prescribed and intraoperative hemostasis protocols.

Regarding the perioperative management of VKAs, the majority of practitioners did not modify the treatment (93.6%); more than half of them made the decision about the management of anticoagulant therapy after consultation with the prescribing physician. A minority of study participants (less than 5%) modified the anticoagulants as follows: reduction of doses, discontinuation with or without heparin bridging, or switch from VKAs to DOACs. Concerning DOACs, practices were more varied: 62.9% of practitioners did not change the treatment, a quarter of them interrupted the treatment (with or without heparin bridging), and approximately 3% reduced the doses before invasive procedures. Three quarters of practitioners made their decision after consultation with the prescribing physicians.

The majority of practitioners prescribed an INR before performing an invasive oral procedure in patients on VKAs (98.6%); 17% of practitioners or fewer prescribed other biological tests (e.g., platelet count, prothrombin rate, activated partial thromboplastin time (aPTT), and bleeding time).

**Table 2** Main characteristics of the responding practitioners

		<i>n</i> = 141 (%)	
Gender	Men	84 (59.6%)	
	Women	57 (40.4%)	
Time since graduation (years)	< 10	51 (36.6%)	
	10–20	44 (31.7%)	
	> 20	44 (31.7%)	
	Missing	2 (1.4%)	
Type of health-care facility of practice	Hospital exclusively <sup>a</sup>	43 (30.5%)	
	Private office or private clinic exclusively	46 (32.6%)	
	Mixed (hospital and private practice)	52 (36.9%)	
Type of activity	General dentist activity	49 (34.8%)	
	Specialized dentist activity	Oral surgery and implantology	78 (55.3%)
		Periodontology and implantology	12 (8.5%)
		Oral surgery, periodontology, and implantology	2 (1.4%)

<sup>a</sup> Public hospitals and university hospitals

Concerning DOACs, the practices were highly variable: 70.8% of practitioners did not prescribe any test, while 13.9% performed an INR, 13.1% a platelet count, and 12.4% a prothrombin rate; other biological tests were less commonly prescribed (bleeding time, aPTT, dosage of circulating level of DOACs, and Hemoclot®).

**Table 3** Information about the management of anticoagulated patients by study participants

		<i>n</i> = 141 (%)
Patients on anticoagulant therapy seen in consultation and requiring oral procedures	Yes	141 (100%)
	No	0 (0%)
Type of anticoagulant therapy in patients under care	Vitamin K antagonists	134 (95.0%)
	Direct oral anticoagulants	136 (96.5%)
	Heparins	62 (43.9%)
Number of patients on anticoagulant therapy treated per month	< 20	84 (59.6%)
	20–50	51 (36.2%)
	> 50	6 (4.2%)
Number of patients on direct oral anticoagulants treated per month	None	8 (5.7%)
	1–5	79 (56.0%)
	5–10	45 (31.9%)
	> 10	5 (3.5%)
	Do not know	4 (2.8%)
	None	1 (0.7%)
Types of oral procedures performed by the practitioners themselves in patients on anticoagulants <sup>a</sup>	Scaling and root planing	88 (62.4%)
	Single dental extraction	135 (95.7%)
	Multiple dental extractions	117 (82.9%)
	Preprosthetic surgery	68 (48.2%)
	Periodontal surgery or mucogingival surgery	35 (24.8%)
	Endodontic/periradicular surgery	39 (27.7%)
	Single implant placement	98 (69.5%)
	Multiple implant placements	65 (46.1%)
	Pseudotumor/benign tumor or cyst excision	65 (46.1%)
	Biopsy	71 (50.4%)
	Preimplant surgery	5 (3.6%)

<sup>a</sup> Multiple responses were possible

**Table 4** Comparisons between the number and type of anticoagulants in treated patients and the type of oral procedures performed according to several practitioner-related characteristics

	Time since graduation (n = 141)		Type of practice (n = 141)			Type of activity (n = 141)		p*	Specialized dentist <sup>a</sup> (n = 92)
	< 10 years (n = 51)	10–20 years (n = 44)	> 20 years (n = 44)	Hospital exclusively (n = 43)	Private exclusively (n = 46)	Mixed (hospital and private) (n = 52)	General dentist (n = 49)		
<b>Number of patients on anticoagulants treated per month</b>									
< 20	35 (68.7%)	21 (47.7%)	27 (61.4%)	20 (46.5%)	34 (73.9%)	30 (57.7%)	36 (73.5%)	0.04	48 (52.2%)
≥ 20	16 (31.3%)	23 (52.3%)	17 (38.6%)	23 (53.5%)	12 (26.1%)	22 (42.3%)	13 (26.5%)		44 (47.8%)
<b>Type of anticoagulants in treated patients</b>									
VKAs	48 (94.1%)	43 (97.7%)	41 (93.2%)	42 (97.7%)	43 (93.5%)	49 (94.2%)	44 (89.8%)	0.70	90 (97.8%)
DOACs	49 (96.1%)	42 (95.5%)	43 (97.7%)	40 (93.0%)	45 (97.8%)	51 (98.1%)	47 (95.9%)	0.44	89 (96.7%)
Heparins	22 (43.1%)	22 (50%)	16 (36.4%)	29 (67.4%)	9 (19.6%)	24 (46.2%)	16 (32.7%)	< 0.0001	46 (50%)
<b>Number of patients on DOACs treated per month</b>									
0–5	34 (66.7%)	27 (61.4%)	26 (59.1%)	25 (58.1%)	31 (67.4%)	33 (63.5%)	33 (67.3%)	0.48	47 (51.1%)
≥ 5	17 (33.3%)	17 (38.6%)	18 (40.9%)	18 (41.9%)	15 (32.6%)	19 (36.5%)	11 (22.4%)		41 (44.5%)
<b>Oral procedures performed in patients on anticoagulants by hemorrhagic risk<sup>b</sup></b>									
None	33 (64.7%)	26 (59.1%)	29 (65.9%)	21 (48.8%)	34 (73.9%)	34 (65.4%)	47 (95.9%)	0.04	42 (45.7%)
Low/moderate	50 (98.0%)	44 (100%)	41 (93.2%)	43 (100%)	43 (93.5%)	51 (98.1%)	47 (95.9%)	0.20	90 (97.8%)
High	43 (84.3%)	38 (86.4%)	38 (86.4%)	40 (93.0%)	32 (69.6%)	49 (94.2%)	34 (69.4%)	0.0006	87 (94.6%)

\* Pearson's chi-squared test/Fisher's exact test for count data

<sup>a</sup> Dentists specialized in oral surgery, periodontology, and/or implantology

<sup>b</sup> Classification of oral procedures according to the hemorrhagic risk as presented in Table 1

VKAs, vitamin K antagonists; DOACs, direct oral anticoagulants



**Table 5** Comparison between pre- and per-operative management of vitamin K antagonists and direct oral anticoagulants performed by the participants

		Patients on VKAs <i>n</i> = 141 (%)	Patients on DOACs <i>n</i> = 141 (%)
Preoperative management of the treatment <sup>a</sup>	Discontinuation with perioperative heparin bridging	5 (3.6%)	10 (7.1%)
	Discontinuation without perioperative heparin bridging	4 (2.8%)	24 (17.1%)
	Reduction of doses	7 (4.9%)	4 (2.9%)
	Continuation of the treatment	132 (93.6%)	88 (62.9%)
	Switch VKA – DOAC	1 (0.7%)	–
	Decision after consultation with prescribing physicians	77 (54.6%)	106 (75.7%)
	48 h interruption with or without heparin bridging guided both by hemorrhagic and thromboembolic risks	–	1 (0.7%)
Blood tests prescribed preoperatively <sup>a</sup>	Bleeding time	7 (4.9%)	11 (8.0%)
	Platelet count	24 (17.0%)	18 (13.1%)
	Prothrombin rate	22 (15.6%)	17 (12.4%)
	INR	139 (98.6%)	19 (13.9%)
	Activated partial thromboplastin time	12 (8.5%)	9 (6.6%)
	Other (not specified)	2 (1.4%)	–
	Dosage of drug circulating level	–	4 (2.9%)
	Specialized tests (thrombin time, dilute thrombin time, Hemoclot®, among others)	–	2 (1.5%)
	None	1 (0.7%)	97 (70.8%)
Hemostasis protocols used perioperatively <sup>a</sup>	Sutures	140 (99.3%)	133 (97.1%)
	Intra-alveolar absorbable hemostatic materials	136 (96.5%)	130 (94.9%)
	Mechanical compression with dry gauzes	105 (74.5%)	103 (75.2%)
	Mechanical compression with gauzes soaked with 5% tranexamic acid	97 (68.8%)	92 (67.2%)
	Anti-fibrinolytic agents (e.g. tranexamic acid) in mouthwash	57 (40.4%)	60 (43.8%)
	Glues	30 (21.3%)	38 (27.7%)
	Oral hemostatic splints	9 (6.6%)	9 (6.6%)
	Other (homeopathy, essential oils)	1 (0.7%)	1 (0.7%)

<sup>a</sup> The total is higher than 141 because multiple responses were possible

INR, International Normalized Ratio; VKAs, vitamin K antagonists; DOACs, direct oral anticoagulants

The hemostasis techniques used during the surgical procedures were almost the same, whether the patient received VKAs or DOACs: sutures and absorbable hemostatic materials (95% of practitioners or more), compression with gauzes, dry or soaked with 5% tranexamic acid (approximately 75% and 68%, respectively), and tranexamic acid in mouthwash (approximately 40% for VKAs, 44% for DOACs); glues and oral hemostatic splints were used less frequently.

Thirty-five participants (24.8%) reported that, when they did not perform themselves surgical procedures, they referred the anticoagulated patients to a specialist with private practice (28.6%) and/or in a hospital setting with a department of oral/maxillofacial surgery or otorhinolaryngology (82.9%) (Table 6). Among these practitioners, 23 were general dentists (46.9%) and 12 were specialists (13.0%). However, no differences were observed when analyses were stratified by experience, type of practice and activity.

These results showed a great diversity in the management of anticoagulated patients, depending on the type of molecule (VKA or DOAC), type of practice and activity. For this reason, we were also interested in the training received by the study participants with a focus on DOACs (Table 7). We did not observe significant differences in training or knowledge about oral care in patients on DOACs by time since graduation. Nevertheless, differences were observed according to the type of health care facility of practice (better training and knowledge among practitioners with mixed/hospital practices than those with private practices,  $p = 0.003$ ), as well as the type of activity in favor of specialists ( $p = 0.04$ ).

Concerning training or information on DOACs, there was no significant difference by professional experience. Nevertheless, practitioners with hospital/mixed practices declared that they received more training and information through scientific societies than practitioners with private



**Table 7** Training and knowledge of study participants about the direct oral anticoagulants

	All participants (n = 141)	Time since graduation			Type of practice			Type of activity				
		< 10 years (n = 51)	10–20 years (n = 44)	> 20 years (n = 44)	Hospital (n = 43)	Private (n = 46)	Mixed (n = 52)	p*	General dentist (n = 49)	Periodontist/ oral surgeon (n = 92)	p*	
Training/knowledge about oral care in patients on DOACs												
Yes	123 (87.2%)	47 (92.2%)	37 (84.1%)	37 (84.1%) <sup>c</sup>	39 (90.7%)	34 (73.9%)	50 (96.2%)	0.003	39 (79.6%)	84 (91.3%)	0.04	
No	18 (12.8%)	4 (7.8%)	7 (15.9%)	7 (15.9%)	4 (9.3%)	12 (26.1%)	2 (3.8%)		10 (20.4%)	8 (8.7%)		
Source of training or information <sup>a</sup>												
Pharmaceutical laboratory	3 (2.4%)	0 (0%)	2 (4.5%)	1 (2.3%)	0.28	0 (0%)	2 (4.0%)	0.78	2 (5.1%)	1 (1.2%)	0.23	
Scientific society	91 (73.9%)	34 (66.7%)	29 (65.9%)	26 (59.1%)	0.71	35 (89.7%)	36 (72.0%)	0.01	23 (58.9%)	68 (80.9%)	0.009	
Journal articles	75 (60.9%)	28 (54.9%)	25 (56.8%)	20 (45.5%)	0.48	21 (53.8%)	35 (70.0%)	0.23	19 (48.7%)	56 (66.7%)	0.57	
Congresses	58 (47.2%)	22 (43.1%)	15 (34.1%)	19 (43.2%)	0.64	21 (53.8%)	21 (42.0%)	0.53	13 (33.3%)	45 (53.6%)	0.03	
Continuing education course	25 (20.3%)	13 (25.5%)	5 (11.4%)	7 (15.9%)	0.26	8 (20.5%)	10 (20.0%)	0.99	9 (23.1%)	16 (19.0%)	0.60	
Knowledge of the mechanism of action of DOACs <sup>a</sup>												
Yes	107 (86.9%)	42 (82.4%)	31 (70.5%)	32 (72.7%)	0.44	37 (94.9%)	42 (84.0%)	0.32	33 (84.6%)	74 (88.1%)	0.51	
No	16 (13.0%)	6 (11.8%)	9 (20.5%)	6 (13.6%)	4 (10.3%)	6 (17.6%)	6 (12.0%)		7 (17.9%)	9 (10.7%)		
Knowledge of the adverse effects of DOACs <sup>a</sup>												
Yes	99 (80.5%)	40 (78.4%)	28 (63.6%)	30 (68.2%)	0.23	31 (79.5%)	40 (80.0%)	0.34	27 (69.2%)	72 (85.7%)	0.007	
No	21 (17.1%)	6 (11.8%)	10 (22.7%)	5 (11.4%)	4 (10.3%)	9 (26.5%)	8 (16.0%)		12 (30.8%)	9 (10.7%)		
Knowledge of the risks associated with invasive oral procedures in patients on DOACs <sup>a</sup>												
Yes	115 (93.5%)	47 (92.2%)	34 (77.3%)	33 (75.0%)	0.27	34 (87.2%)	49 (98.0%)	0.27	39 (100%)	76 (90.5%)	0.54	
No	3 (2.4%)	0 (0%)	1 (2.3%)	2 (4.5%)	1 (2.6%)	2 (4.3%)	0 (0%)		0 (0%)	3 (3.6%)		
Wish to have training about oral care in patients on DOACs <sup>b</sup>												
Yes	17 (94.4%)	4 (100%)	6 (85.7%)	7 (100%)	1.00	3 (75%)	2 (100%)	0.33	10 (100%)	7 (87.5%)	0.44	
No	1 (5.6%)	0 (0%)	1 (14.3%)	0 (0%)	1 (25%)	0 (0%)	0 (0%)		0 (0%)	1 (12.5%)		

<sup>a</sup> Only subjects who responded “yes” to the first item

<sup>b</sup> Only subjects who responded “no” to the first item

<sup>c</sup> Pearson’s chi-squared test/Fisher’s exact test for count data

DOACs, direct oral anticoagulants

the patient [6]. The British Society of Haematology has proposed a similar approach [8].

Despite good practice recommendations, which aim to standardize the management of patients on VKAs, and the results of clinical studies, which have demonstrated the safety of oral procedures when continuing anticoagulants, discrepancies persist among professionals. In standard care, the person in charge of the management of oral anticoagulant treatment around invasive procedures is highly variable, from the oral surgeon/periodontist/general dentist to the general practitioner/cardiologist/other specialist; the responsibility of deciding how to manage this treatment (discontinuation, heparin bridging, or continuation) is not clearly identified. A Canadian survey of practices showed that VKAs were routinely discontinued by 70% of hematologists [9]. However, even on the dentist's side, knowledge of the recommendations seems disappointing, as shown in five previous surveys [10–14]. A French survey of general dentists and oral surgeons conducted in 2007, one year after the first French guidelines on the management of patients under VKAs in oral surgery, showed that only 56.7% of respondents performed invasive procedures in these patients [13]; 51.7% men and 48.3% women participated. No details about their distribution by time since graduation, type of care facility of practice or activity are available, making it difficult to compare the results of this study with those of our survey. Among participants, 15.9% systematically interrupted the VKAs, 25.3% set up heparin bridging, 42.9% applied various protocols, and only 16.5% continued the anticoagulant treatment. Overall, only 11.2% of practitioners were fully aware of the guidelines, notably young and female dentists; 30.3% stated that they were sufficiently trained to treat patients on VKAs, and 63.7% expressed a need for additional training. An Irish survey of general dentists found that 25% of respondents who carried out extractions on patients receiving warfarin did not check the INR before the procedures [14]. In a Dutch survey of general dentists, more than 50% of participants reported that they were not familiar with this test [11]. A survey conducted in the USA showed that 73% of oral and maxillofacial surgeons routinely used the INR in patients on VKAs requiring dental extractions, but only 21% of them relied on this method alone [12]. A Dutch survey among oral and maxillofacial surgeons found very variable management strategies for patients on antithrombotic medications regarding the preferred INR value and continuation or discontinuation of drugs prior to surgery [10]. The present study, conducted 11 years after the first French recommendations and 2 years after their update, showed that 95% of practitioners performed invasive procedures by themselves on patients receiving VKAs (the majority at low hemorrhagic risk), regardless of their experience, type of practice, or activity. Additionally, we observed a better awareness about the management of VKAs around invasive oral procedures in terms of continuation of treatment

(94% of practitioners), control of the INR (98%) and local hemostasis techniques (99% used at least intra-alveolar hemostatic materials and sutures). These findings demonstrate, first, the necessity of a time for recommendations to be disseminated and implemented, and second, the strong need for continuing education courses, especially for dentists in primary care.

French recommendations on DOACs are recent and differ according to scientific societies. Medical working groups (GIHP and GEHT) proposed recommendations in 2011 for the management of DOACs during the periprocedural period, without any distinction between DOACs [7]. For procedures with a low risk of bleeding, it is suggested to discontinue the DOAC the evening prior to the procedure and restart it after 36–48 h. For procedures with a high risk of bleeding, it is suggested to stop the DOAC 5 days before the procedure and restart it when local hemostasis is achieved. Heparin bridging can be performed during the period without DOACs if the thromboembolic risk is high. These careful strategies were developed considering three factors: variability of pharmacokinetics, absence of simple access for DOAC concentration measurements, and absence of a validated strategy to reverse the anticoagulant effect of DOACs. In contrast, the guidelines of SFCO have recommended the continuation of DOACs in cases of oral surgery with a low risk of bleeding [6]. For procedure with a high risk of bleeding, the opinion of the prescribing physician should be required to assess the risk of thromboembolic event: if this risk is low, DOACs can be stopped the day before and started the day after surgery (interruption of 48 h); if the risk is high, a longer discontinuation of the DOACs with heparin bridging may be considered [6]. The Scottish Dental Clinical Effectiveness Programme published in 2015, a slightly different guidance, suggested that if the hemorrhagic risk is low, oral procedure should be performed without interrupting the DOACs, and if it is high, patients should be advised to miss or delay the morning dose before oral treatment [15].

DOACs directly target a single factor within the coagulation cascade, have an immediate onset of action, more predictable pharmacokinetics, less drug interactions than VKAs and a short half-life in plasma (12–17 h for dabigatran, 5–13 h for rivaroxaban, 8–15 h for apixaban, and 10–14 h for edoxaban) [16]. Due to their wide therapeutic window, no biological monitoring is routinely recommended for DOACs. These drugs affect nonspecific coagulation tests (prothrombin time, aPTT), which are not correlated to the anticoagulant effect. Therefore, their prescription is not relevant to provide an estimate of the risk of bleeding with respect to an invasive procedure. More specifically, the measurement of INR, which is designed for patients treated with VKAs, has no meaning for patients on DOACs [6, 16]. In the present study, 13.9% of participants prescribed an INR before invasive procedures without realizing its lack of utility. Specific tests (e.g., modified thrombin time (Hemoclot®) and ecarin time (ECAT-T®)

for dabigatran; measurement of anti-Xa activity (Rotachrom® test, STA®-Liquid anti-Xa) for rivaroxaban and apixaban), although more sensitive and/or specific, are not available in current practices [16, 17].

Pending the dissemination of the recommendations and completion of more clinical studies on DOACs, to date, practices vary considerably regarding the perioperative management of patients and the blood tests performed, as demonstrated by the present study. Nevertheless, local hemostasis techniques were used systematically by the practitioners, regardless of the oral anticoagulation therapy.

As expected, in our survey, invasive oral procedures in anticoagulated patients were mostly performed by specialists in oral surgery, implantology, or periodontology, at a private and/or hospital practice. Indeed, in France, oral procedures in patients with medically complexed conditions are mainly performed by specialists at the request either of a general dentist or another doctor (cardiologist, internist, general practitioner or other specialist). Very few surgical interventions (mostly simple extractions) are performed in primary care by general dentists, whose main role consists of nonsurgical procedures (care of caries, endodontic treatments, placement of fixed or removable prostheses, scaling and root planing). Furthermore, the realization of invasive oral procedures in anticoagulated patients requires surgical equipment that has been adapted to the prevention and the care of per- and postoperative bleeding (e.g., instruments, hemostatic materials, and suture threads) and a good medical background. Specialists in oral surgery and periodontology combine all these conditions in their practices. Excluding the need for adapted surgical equipment, two other elements must be present for outpatients on VKAs: an INR lower than 4, and a procedure with a low hemorrhagic risk. Alternately, hospital care is recommended, especially if there is an associated medical risk [6]. Overall, few patients on DOACs were seen in consultation by study participants (88% of practitioners consulted less than 10 patients/month), but specialists treated more of these patients than general dentists. As expected, hospital practitioners treated more patients on heparin because the guidelines recommend patients at high risk of thromboembolism undergoing oral surgery at high hemorrhagic risk be treated in a hospital under heparin relay. Additionally, specialists treated more patients on VKAs and heparins than general dentists (for the same reasons, skill and an adequate surgical environment).

In 2015, a survey of UK otolaryngologists showed that clinical and pharmacological knowledge of newly licensed anticoagulant medications was poor, with respondents being more confident in the use of older versus newer forms of anticoagulants; all participants expressed the need for an educational resource on anticoagulants [18]. In 2016, an English survey, including hospital consultants (surgeons, anesthesiologists, gynecologists/obstetricians) and general practitioners

working in primary or secondary care, showed that 88%, 80%, and 50%, respectively, recognized rivaroxaban, dabigatran, and apixaban; when provided with a routine clinical situation, only 13.5%, 17.5%, and 16.8%, respectively, recognized that the hypothetical patient was anticoagulated, and 55–58% recognized that it was unsafe to proceed with invasive procedures [19]. In 2017, an Indian survey showed that DOACs were known to only 7.1% of dentists working in university hospitals [20]. Training and knowledge about oral care in patients on DOACs were better in the present study, since 87% of study participants declared an awareness of this topic; however, practitioners with hospital or mixed practices as well as specialists reported better training and information, particularly through congresses and scientific societies. When there was a lack of knowledge about this topic, all participants expressed a need for information and training, regardless of their experience, type of practice, or activity.

A limitation of our study was the relatively low rate of participation (17.8%), despite 4 email reminders, which might reflect a lack of concern of practitioners about the survey because they do not treat patients on DOACs, rather than fear of being evaluated on their practices (the questionnaire was anonymous). Nevertheless, the sample was sufficient to allow comparisons according to different practitioner-related characteristics.

A self-administered questionnaire may be less fully completed than a questionnaire administered in face-to-face interviews, but missing data were minimal in the present study.

Another limitation of the study was the low representativeness of general dentists (one third of the sample) compared with specialists. In addition, the general practitioners participating in the survey were members of two scientific societies, probably with a particular interest in some types of dentoalveolar surgery. It can therefore be assumed that their practices and knowledge were better than those of general dentists not belonging to scientific societies. This could have affected the results. A further analysis focusing on general dentists is needed.

## Conclusion

This French survey of practices for the management of anticoagulated patients requiring invasive oral procedures showed that the majority of care is performed by specialists in private and/or hospital practices, regardless of their professional experience. The results also emphasize an important desire of the practitioners for training and information, notably regarding the dental management of patients on DOACs, as well as the need to standardize the recommendations of the medical and dental societies for better coordination of stakeholders and patient safety. Studies based on real-life data are needed to address these issues.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflicts of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** For this survey, formal consent is not required.

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## Affiliations

Loredana Radoi<sup>1,2</sup>  • David Hajage<sup>3</sup> • Caroline Giboin<sup>3</sup> • Louis Maman<sup>1,4</sup> • Virginie Monnet-Corti<sup>5,6</sup> • Vianney Descroix<sup>7</sup> • Isabelle Mahé<sup>8,9,10</sup>

<sup>1</sup> Faculté de chirurgie dentaire, Département de médecine orale et de chirurgie orale, Université Paris Descartes, Paris, France

<sup>2</sup> Département de chirurgie orale, AP-HP, Hôpital Louis Mourier, Colombes, France

<sup>3</sup> Département Biostatistique Santé Publique et Information Médicale, Centre de Pharmacoépidémiologie (Cephepi), Sorbonne Université, CIC-1421, AP-HP, Hôpital Pitié Salpêtrière, Paris, France

<sup>4</sup> Département de chirurgie orale, AP-HP, Hôpital Charles Foix, Ivry-sur-Seine, France

<sup>5</sup> Département de parodontologie, AP-HM, Hôpital de la Timone, Marseille, France

<sup>6</sup> Faculté de Chirurgie Dentaire, Département de parodontologie, Université Aix-Marseille, Marseille, France

<sup>7</sup> Département d'odontologie, AP-HP, Hôpitaux Universitaires Pitié-Salpêtrière–Charles Foix, Paris, France

<sup>8</sup> Faculté de Pharmacie, Inserm UMR\_S1140, Paris, France

<sup>9</sup> Université Paris Diderot, Paris, France

<sup>10</sup> Hôpital Louis Mourier, AP-HP, Colombes, France