

Dental implant surgery and risk of bleeding in patients on antithrombotic medications: A review of the literature



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Objectives. This literature review was performed to assess the risk of bleeding in dental implantation procedures in patients taking antiplatelet drugs (APs), oral anticoagulants (OACs) and direct oral anticoagulants (DOACs).

Study Design. MEDLINE and SCOPUS databases were searched for English language publications through October 2019, using the keywords “dental implants,” “dental implantation,” “anticoagulants,” “platelet aggregation inhibitors,” and “hemorrhage.” Reference lists of relevant articles were also hand searched. Collected data regarding dental implantation procedures, type of medications (APs, OACs and DOAC), and postoperative bleeding episodes were analyzed.

Results. Nine studies were included in the review. Postoperative bleeding occurred in 10 (2.2%) of 456 of cases involving dental implant placements; in all of those cases, bleeding was controlled with the use of local hemostatic agents. The bleeding incidence in patients on antiplatelet medications was 0.4% (range 1 of 253 to 1 of 261). Among those taking oral anticoagulants, the bleeding incidence was 5.7% (range 6 of 105 to 6 of 113), and among those on direct oral anticoagulants, the bleeding incidence was 3.3% (3 of 90). The numbers of more extensive surgical procedures (i.e., sinus lift and bone augmentation procedures) were small, and additional information regarding the surgery, the specific antithrombotic used, or bleeding was often not provided, so further analysis was not possible.

Conclusions. Evidence supports continuing OACs, DOACs, or APs during dental implant surgery. (Oral Surg Oral Med Oral Pathol Oral Radiol 2020;130:522–532)

Antiplatelet and anticoagulant drugs are widely used in the long-term prevention and treatment of arterial and venous thrombosis. Antiplatelet drugs (APs), such as aspirin, dipyridamole, and thienopyridines (clopidogrel, ticlopidine, and prasugrel), are most commonly used in patients who have ischemic cardiovascular diseases, cerebrovascular diseases, and peripheral arterial disease.^{1–3} Because of their different mechanisms of action, these drugs are sometimes combined as dual antiplatelet therapy. The combination of low-dose aspirin and clopidogrel is commonly used, especially in the prevention of thrombotic complications after percutaneous insertion of coronary stents.^{4,5}

Warfarin, acenocoumarol, and phenprocoumon are the most commonly used oral anticoagulants (OACs). These drugs are vitamin K antagonists indicated in the prevention and treatment of venous thromboembolism in patients with atrial fibrillation, mechanical prosthetic heart valves, deep vein thrombosis, or pulmonary embolism.⁶ The International Normalized Ratio (INR) is used for monitoring the effects of OACs. The therapeutic range of INR values is 2.0 to 3.0 in most cases.⁵ For patients with higher risk of thromboembolism,

such as those with mechanical prosthetic heart valves, an INR range up to 3.5 is therapeutic.^{6–8}

Direct thrombin inhibitors and factor Xa inhibitors have recently been introduced into clinical practice. These drugs, referred to as *direct oral anticoagulants* (DOACs), are indicated to prevent stroke or systemic embolism in patients with atrial fibrillation and for the prevention of thrombosis after elective hip and knee surgery.^{9,10} Compared with vitamin K antagonists, DOACs have certain advantages: rapid onset and direct mode of action, predictable anticoagulant response, wide therapeutic index, limited drug and food interactions, and no need for routine monitoring of their effects.¹¹ Oral surgery in patients on antithrombotic therapy is challenging, and the risk of bleeding needs to be balanced against thromboembolic risk caused by drug interruption. As a frequent oral surgical procedure, dental extraction in patients on antithrombotic medications has been widely studied over the past 2 decades. Virtually all studies and recent reviews of the literature have shown that tooth extraction can be safely performed without interruption of antiplatelet and antithrombotic therapies if proper local hemostatic measures are used.^{12–15} In contrast, the literature on the

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Statement of Clinical Relevance

Evidence from published reports supports implant placement without interruption of therapy with antiplatelet drugs, oral anticoagulants, and direct oral anticoagulants. The risk of bleeding associated with more extensive dental implant surgery requires further study.

safety of dental implantation procedures (including single or multiple implant placement, bone augmentation, sinus lift procedures, and implant uncovering) in patients taking APs, OACs, and DOACs has not been thoroughly reviewed, even though implant placement could be considered a high-risk procedure in patients taking antithrombotics.^{16,17} Although there are individual studies focused on implantation procedures in patients taking antithrombotics, we could not find any reviews regarding implantation procedures exclusively.^{18–32} Although the clear majority of these reviews came to the same conclusion—that is, antithrombotic medications should be continued for oral surgery procedures—Bensi et al.³² concluded that patients on DOACs have a significantly higher postoperative bleeding risk compared with healthy patients, and the authors called for further study. Therefore, the aim of this study was to determine the safety of dental implantation procedures in patients taking APs, OACs, and DOACs on the basis of findings from a review of the literature.

MATERIALS AND METHODS

The literature review was done by searching the MEDLINE and SCOPUS databases, using the keywords “dental implants,” “dental implantation,” “anticoagulants,” “platelet aggregation inhibitors,” and “hemorrhage.” The inclusion criteria were therapy with APs, OACs, DOACs or dual therapy; history of dental implant placement; and monitoring for bleeding done during the postoperative period. Hand searching, including searching the reference list of relevant articles, also was also employed. The search included the period from 1970 to October 2019. The date of the last search was October 17, 2019. Only English language reports of studies with a minimum number of 5 patients were included. These reports and data were analyzed by 2 authors (B.B. and M.W.), focusing on dental implantation procedures and types of medications. The results were assessed by all 3 authors, and any disagreement was resolved through discussion and adjudication by consensus among the 3 authors. One study of patients taking OACs was excluded because bleeding complications were not addressed in the study.³³

RESULTS

Nine studies were identified and analyzed (Figure 1). Because of the small number of studies and the limited number of patients included in the studies, a meta-analysis was not possible. There were 4 studies of patients taking DOACs,^{17,34–36} 1 study of patients taking OACs,³⁷ 1 study of patients taking APs,³⁸ and 3 studies of patients taking different anticoagulant and antiplatelet drugs (Table I).^{39–41} In most studies, only patients who required single or multiple implant placements were included. Only 2 studies reported more extensive

surgical procedures, such as sinus lift and bone augmentation procedures.^{37,40}

Dental implant placements in patients taking APs

Our review showed that dental implants were placed in at least 253 patients taking APs, including some on dual clopidogrel and aspirin therapy. In the 4 studies involving APs, bleeding was consistently not a major concern, with an overall reported bleeding rate of 0.4% (range 1 of 253 to 1 of 261) (Table II). In the 1 instance of bleeding, this complication was controlled by using local hemostatic measures (Table III).

Dental implant placements in patients taking OACs

Our review showed that dental implantation procedures (mostly implant placements) were done in greater than 105 therapeutically anticoagulated patients (INR < 3.5). Some of these patients were taking APs at the same time. The overall reported bleeding rate was 5.7% (range 6 of 105 to 6 of 113) (see Table II). Local hemostatic measures were enough to control all bleeding complications (see Table III).

Dental implant placements in patients taking DOACs

DOAC use was reported in 6 studies. Two studies reported no difference in postoperative bleeding complications after single or multiple implant placements in healthy patients versus those taking rivaroxaban³⁵ or dabigatran.³⁶ The overall reported bleeding rate in patients on continued DOACs for implant surgery (mostly single or multiple implant placements) was 3 of 90 (3.3%) (see Table II). All bleeding complications were reported to have been easily controlled by using local hemostatic measures (see Table III).

Dental implantation procedures in patients receiving anticoagulation therapy

In most studies, single or multiple implant placement was the only reported procedure.^{34–36,38,39} In several studies, more extensive surgical procedures, such as sinus lift and bone augmentation procedures, were reported.^{17,37,39,40} However, the numbers of these procedures were small, and often they provided no additional information regarding the surgery, the specific anticoagulant used, or bleeding, so further analysis was not possible.

DISCUSSION

Dental implant surgery is considered a predictable and highly successful treatment, and the number of implant placements has been increasing over the past several decades. Along with the increasing number of implantation procedures, the attitude toward implant placement in patients with comorbidities, such as diabetes,

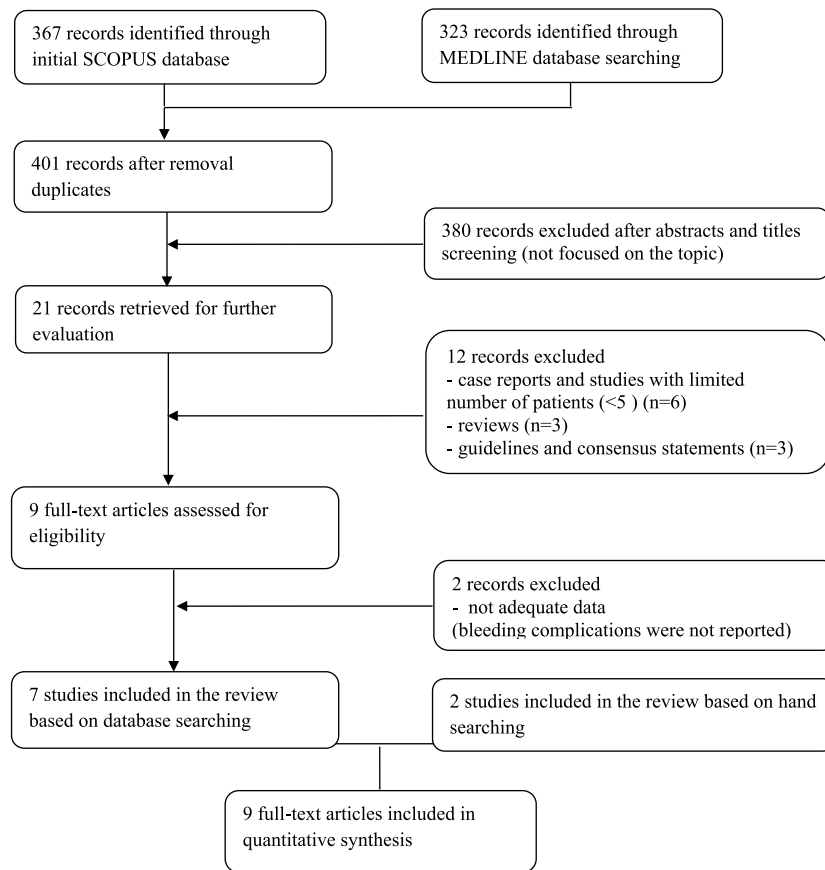


Fig. 1. Flow diagram detailing article selection.

osteoporosis, cardiovascular diseases, head and neck cancer, and so on, has changed over the years. Recent evidence has shown that there are very few absolute medical contraindications for dental implantation procedures.⁴² On the basis of summative reviews, Diz et al⁴³ and Kullar and Miller⁴⁴ concluded that there are very few absolute medical contraindications for dental implantation procedures, emphasizing that the degree of systemic disease control may be far more important than the nature of the disorder itself.

It has been stated that dental implant placement can be safely performed in patients taking anticoagulants without therapy interruption. However, these statements are mainly based on expert opinion rather than evidence-based data.^{21,45} Most authors have asserted that trauma during dental implant placement is similar to trauma during tooth extraction.^{21,45} The Academic Centre for Dentistry Amsterdam considers placement of up to 3 implants a safe procedure in therapeutically anticoagulated patients.³⁹ However, some authors consider implant placement in patients taking anticoagulants to be a high-risk procedure.^{16,17}

The safety of dental implantation procedures in patients taking APs, OACs, and DOACs has been the focus of several recent studies. Because bleeding risk

may differ with different medications, we analyzed these studies with respect to the type of dental implant procedure and the medications taken.

Aspirin, clopidogrel, ticlopidine, and dipyridamol are the APs most commonly used in the prevention and treatment of ischemic cerebrovascular and cardiovascular diseases and after coronary stent placement.¹⁻³ Persons taking APs may experience prolonged bleeding time. However, the test for bleeding time is not a reliable predictor of possible bleeding complications after oral surgical procedures. Platelet function analysis is more sensitive, but this test is not typically used in everyday practice.^{38,46} Many studies show that minor oral surgical procedures can be safely performed in patients taking single and dual antiplatelet therapy without therapy interruption.^{13,47-49} A recently published review of the literature reported that of at least 1283 patients taking single or dual APs, in at least 2343 dental surgical procedures, including at least 2308 single or multiple, simple or surgical dental extractions in at least 1334 visits, no more than 35 patients (2.7% of patients and 2.6% of visits) had bleeding complications requiring local measures for hemostasis, and only 2 patients (0.2%) needed more than local hemostatic measures.¹⁵ Our review showed

Table I. Dental implant surgery in patients on antithrombotic medications (N = 9 studies)

Author	Design	No. of patients on AT	Anticoagulant medication	Surgical procedures	INR range in patients taking OACs*	Study arms	Local hemostasis	Postoperative bleeding	Treatment of bleeding complications	Comments
Bacci et al., 2011 ³⁷	P	50 (159 implant placements)	OACs	Single and multiple implant placement, sinus lift	1.8–2.98	Group 1: Patients taking OACs Group 2: healthy individuals	TA, sutures	Group 1: 2 of 50 Both cases on the 2nd day after the procedures Group 2: 3 of 109	Wound compression with gauze saturated with TA	No difference in postoperative bleeding in patients taking OACs and control group
Broekema et al., 2014 ³⁹	P	8	OACs, APs	Implant placement	The authors imply INR 1.8–3.5 within 72 hours preoperatively but the study was not specific as to the implant patients	Group 1: Patients taking anticoagulants Group 2: healthy individuals	TA, sutures	Group 1: 0 of 8 Group 2: 0 of 7	N/A	Small number of patients included in the study and not specified how many patients were on specific AT, OACs or APs
Clemm et al., 2015 ⁴⁰	P	117 (30 OACs, 8 LMWH bridging OACs, 16 DOACs 63 APs)	OACs, LMWH, APs, DOACs	Single and multiple implant placement, single and multiple implant exposure, sinus lift and bone augmentation	2.62 ± 0.52 1.95 ± 0.47 for LMWH bridging group	Group 1: Patients taking AT Group 2: Healthy individuals	Sutures, collagen, electro-coagulation	Group 1: 4 of 117 (2 of 30 OACs, 1 of 8 LMWH bridging OACs, 1 of 63 APs, 0 of 16 DOACs) Group 2: 3 of 447	Wound compression with gauze saturated with TA, additional suturing	Patients taking OACs had a significantly higher risk of postoperative bleeding (easily controllable) compared with healthy patients. The extensiveness of surgery had no effect on bleeding frequencies. AT should be continued in patients undergoing implant surgery and bone grafting procedures.
Gandhi et al., 2019 ³⁴	Case series	6 (18 implant placements)	DOACs	Single and multiple implant placement	N/A	Patients taking DOACs	Cellulose, TA	0 of 6	N/A	Benefits of CAD-CAM (computer-aided design/

(continued on next page)

Table I. Continued

Author	Design	No. of patients on AT	Anticoagulant medication	Surgical procedures	INR range in patients taking OACs*	Study arms	Local hemostasis	Postoperative bleeding	Treatment of bleeding complications	Comments
Gómez-Mor- eno et al., 2016 ³⁵	CC	18	DOACs (rivaroxaban)	Single and multi- ple implant placement	N/A	Group 1: Patients taking DOACs Group 2: Healthy individuals	TA, sutures	Group 1: 1 of 18 Group 2: 2 of 39	Wound compres- sion with gauze saturated with TA	computer-aided manufacturing) stent-guided flapless approach Dental implants in patients taking rivaroxaban can be performed safely without drug interruption
Gómez-Mor- eno et al., 2018 ³⁶	CC	29	DOACs (dabigatran)	Single and multi- ple implant placement	N/A	Group 1: Patients taking DOACs Group 2: Healthy individuals	TA, Sutures	Group 1: 2 of 29 Group 2: 2 of 42	Wound compres- sion with gauze saturated with TA	Dental implants in patients taking dabigatran can be performed safely providing 12 hours have passed since the last dose
R	176 (148 APs, 10 OACs, 2- DOACs, 15	APs + OACs, 1 APs + DOACs) (218 implanta- tion procedures)	APs, OACs, DOACs	Single and multi- ple implant placement, sinus lift	Not specified	Patients continued AT for implant surgery	Not specified	2 of 176; 1 patient on aspirin and warfarin experi- enced bleeding on the 7th day postoperatively; INR about 2.8 on day of sur- gery and at all follow-up visits; the other patient INR between 2.1 and 3.5 on day of surgery, but 4.1 on the 5th day when bleeding occurred	In the first case cautery and lidocaine; In the second case withdrawal of OACs for 2 days by physician	Postoperative bleeding was infrequent in patients taking AT
	P	42	Aps		N/A		Sutures		N/A	

(continued on next page)

Table I. Continued

<i>Author</i>	<i>Design</i>	<i>No. of patients on AT</i>	<i>Anticoagulant medication</i>	<i>Surgical procedures</i>	<i>INR range in patients taking OACs*</i>	<i>Study arms</i>	<i>Local hemostasis</i>	<i>Postoperative bleeding</i>	<i>Treatment of bleeding complications</i>	<i>Comments</i>
Tabrizi et al., 2018 ³⁸				Two implants placement per procedure		Group 1: Patients taking clopidogrel Session 1: Therapy continued Session 2: Therapy stopped for 5 days Group 2: Patients taking aspirin Session 1: Therapy continued Session 2: Therapy stopped for 5 days		No patient experienced severe bleeding or hematoma		Continuous use of APs did not increase bleeding after the placement of dental implant. The use of single stage implant system might be of benefit.
Zeevi et al., 2017 ¹⁷	Cross-sectional	18 (32 implant placements in 9 patients and 11 bone augmentation procedures in 9 patients)	DOACs; Some of them on concomitant AP therapy	Single and multiple implant placements, bone augmentation	N/A	86% of 72 dental surgical patients in the overall study continued anticoagulation and 14% withdrew therapy for 24 hours, but the study was not specific as to the implant patients	Suture only; or suture combined with either gelatin, cellulose, or TA at surgeon's discretion	0 of 18	N/A	There were no postoperative bleeding complications in implant patients.

APs, antiplatelet drugs; AT, anticoagulation therapy; CC, case control; DOACs, direct oral anticoagulants; INR, international normalized ratio; LMWH, low-molecular-weight heparin; N/A, not applicable; OACs, oral anticoagulants; P, prospective; R, retrospective; TA, tranexamic acid.

*Where reported, it was no higher than INR 3.5.

Table II. Bleeding incidence after dental implant surgery in patients on continued antithrombotic therapy

Author	APs bleeding incidence	OACs bleeding incidence	DOACs bleeding incidence	Overall bleeding incidence
Bacci et al., 2011 ³⁷	N/A	2 of 50	N/A	2 of 50
Broekema et al., 2014 ³⁹	< 8	< 8	N/A	0 of 8 (not specified whether patients were on AP or OAC)
Clemm et al., 2015 ⁴⁰	1/63	2/30	0 of 16	3 of 109
Gandhi et al., 2019 ³⁴	N/A	N/A	0 of 6	0 of 6
Gómez-Moreno et al., 2016 ³⁵	N/A	N/A	1 of 18	1 of 18
Gómez-Moreno et al., 2018 ³⁶	N/A	N/A	2 of 29	2 of 29
Rubino et al., 2019 ⁴¹	0 of 148	2 of 25*	0 of 3*	2 of 176
Tabrizi et al., 2018 ³⁸	0 of 42	N/A	N/A	0 of 42
Zeevi et al., 2017 ¹⁷	N/A	N/A	0 of 18	0 of 18
	Total	Total	Total	Total
	1 of 253	6 of 105	3 of 90	10 of 456
	(1 of $\geq 253 \leq 261$) [†]	(6 of $\geq 105 \leq 113$) [†]	3.3%	2.2%
	0.4%	(5.7%)		

APs, antiplatelet drugs; DOACs, direct oral anticoagulants; OACs, oral anticoagulants.

*Some patients on dual AP/OAC or AP/DOAC therapy were included as OAC or DOAC.

[†]Although there was a bleeding incidence of 0/8 AP and OAC patients, Broekema et al.³⁹ did not specify how many patients were in each of the 2 groups.

an even lower bleeding complication rate of 0.4% (1 of 253 patients) requiring local measures for hemostasis after implant placement in patients taking APs (and none requiring more than local measures).

The most common indications for long-term oral anti-coagulant therapy are atrial fibrillation, mechanical prosthetic heart valves, deep vein thrombosis, and

pulmonary embolism. Many studies confirm that the risk of thrombosis in case of therapy interruption outweighs the risk of bleeding in therapeutically anticoagulated patients during minor oral surgical procedures, if proper local hemostatic measures are provided.^{12,39,41,50–52} A recent review of the literature showed that patients taking OACs have a higher postoperative bleeding risk

Table III. Postoperative bleeding cases

Authors	Medication	Number of patients	Procedure	Site	Day of bleeding	How controlled
Clemm et al., 2016 ⁴⁰	APs	1	Implant exposure	4, 6, and 8 areas	Not specified	Additional suturing, wound compression with tranexamic acid gauze
Clemm et al., 2016 ⁴⁰	OACs	1	Implant placement	29	Late (not more specific)	Wound compression with tranexamic acid gauze
Clemm et al., 2016 ⁴⁰	OACs	1	Multiple implant placement (4)	Mandibular interforaminal region	Early (not more specific)	Additional suturing, wound compression with tranexamic acid gauze
Bacci et al., 2011 ³⁷	OACs (warfarin)	2	Implant placement	Not specified	2nd day postoperatively	Compressed gauze soaked in tranexamic acid
Rubino et al., 2019 ⁴¹	OACs and APs (warfarin and aspirin)	1	Implant placement	Not specified	5th day postoperatively (INR about 2.8 on day of surgery and at all follow-up visits; the other patient undergoing implant placement INR between 2.1 and 3.5 on day of surgery, but 4.1 on the 5th day when bleeding occurred)	Cautery and lidocaine
Gómez-Moreno et al., 2016 ³⁵	rivaroxaban	2	≥ 1 implant placement	Not specified	Not specified	Biting on tranexamic acid-soaked gauze
Gómez-Moreno et al., 2018 ³⁶	dabigatran	1	≥ 1 implant placement	Not specified	Not specified	Biting on tranexamic acid-soaked gauze

APs, antiplatelet drugs; OACs, oral anticoagulants.

after minor dental surgery compared with healthy controls, but local hemostatic measures effectively stopped the bleeding.²⁷ Another review of the literature reported that greater than 99% of patients who continued OACs had no postoperative bleeding requiring more than local hemostatic measures. In more than 5431 patients who underwent greater than 11,381 surgical procedures, bleeding that required more than local hemostatic methods occurred in only 31 (~0.6%) patients. Many of these patients had INR levels higher than the level currently considered therapeutic. However, among at least 2673 patients whose oral anticoagulant therapy was reduced or withdrawn for at least 2775 visits for dental procedures, there were 22 embolic complications (0.8% of therapy cessations), including 6 fatal events (0.2% of therapy cessations).¹⁴ Our review of the literature showed that the overall reported bleeding rate after dental implantation procedures in patients taking OACs is 6 of 105 (5.7%). All bleeding complications were mild and easily controlled with local hemostatic measures.

In the last few years, direct thrombin inhibitors (dabigatran) and factor Xa inhibitors (rivaroxaban, apixaban, and edoxaban) have been introduced in clinical practice for the prevention of stroke and systemic embolisms in patients with atrial fibrillation and for the prevention of thrombosis after major orthopedic surgery.^{9,10} Not requiring routine monitoring of effects is a major advantage of DOACs compared with OACs. Recent published studies have suggested that dental extractions can be safely performed in patients taking DOACs if proper hemostatic measures are used.^{53,54} Two studies in patients taking rivaroxaban and dabigatran concluded that dental implant placement can be performed safely without therapy interruption.^{35,36} The overall reported bleeding rate in patients on continued therapy with DOACs after implant surgery, mostly single or multiple implant placements, is 3 of 90 (3.3%). In contrast, postoperative bleeding events are not reduced by interrupting DOAC use, even when more invasive procedures are performed.⁵⁵

The most commonly used local hemostatic agents in patients taking anticoagulants after tooth extraction are absorbable gelatin or collagen sponges, oxidized regenerated cellulose, fibrin glue, chitosan, and antifibrinolytics applied directly into the wound via gauze saturated with tranexamic acid or in the form of a mouthwash solution.⁵⁶ For dental implantation procedures, the trend of using surgical guides and the minimally invasive flapless approach in patients taking anticoagulants can be beneficial,^{34,57} but it is not used or advocated by all providers.⁵⁸

The extensiveness of the surgical procedure is a factor that can play a significant role in the incidence of postoperative bleeding in patients taking anticoagulant

therapy¹² and can modify the surgeons' approach.^{59,60} More extensive surgical procedures, such as bone grafting and sinus lift, were reported in few reviewed studies.^{17,37,40,41} The limited number of these procedures and lack of data regarding the type of anticoagulant treatment precluded further analysis. Some authors have concluded that the extensiveness of surgery has no effect on bleeding frequencies.⁴⁰ However, some authors have suggested interrupting DOACs for at least 24 hours for dental procedures requiring osteotomy and graft surgery.⁵⁵

Several cases of life-threatening bleeding after implant placement resulting from perforation of the lingual cortex and subsequent hematoma in the floor of the mouth have been reported.^{16,61} Serious bleeding complications after sinus lift procedures also have been reported.^{62,63} Although anticoagulant therapy was not associated with any of the reported cases of severe hemorrhage, it can be assumed that anticoagulant medications might exacerbate such situations. High-risk surgery in these patients should, therefore, be performed by an experienced surgeon who has hemostatic measures at his disposal.

The benefits of interrupting anticoagulation therapy for dental implant placement (less risk of bleeding) must be weighed against the risks of a possible fatal or debilitating stroke or heart attack resulting from such an interruption. This review found only a few cases of postoperative bleeding with implant placement, all of which were easily treated with local hemostatic measures. Although such cases may have occurred, we are unaware of any reports in the published literature of patients on antithrombotic medication suffering fatal bleeding after a dental procedure; all patients who suffered bleeding complications in published reports apparently made full recoveries.⁶⁴ However, although the risk is low, there have been many reports of embolic complications (some fatal and some presumably permanently debilitating) after interruption of antithrombotic therapy for dental procedures.^{65–76} Thus, the accumulating data on continuation or interruption of antithrombotic therapy strongly favor continuing antithrombotic therapy before, during, and immediately after invasive dental procedures.^{15,18–31,77}

This review has some limitations. It is a narrative review, not a systematic review, and thus, the quality of the included studies and any bias present in them were not evaluated. Only English language articles were included. Heterogeneity is another limitation of our analysis because some studies included different dental implantation procedures (including single or multiple implant placement, sinus lifts, bone grafting, and/or implant uncovering) and different antithrombotic medications. An additional limitation is our decision to include five patients as the lower limit of

inclusion, creating potential issues with reliability and external validity. At least one systematic review and two narrative reviews of dental surgery in patients on antithrombotic medications have included studies with even fewer patients (including case reports), but none of these studies focused solely on dental implant surgery.^{14,32,78} In addition, analysis of factors that can affect bleeding risk, such as extensiveness of surgical procedures and INR value in patients taking OACs was not possible.

CONCLUSIONS

Based on a review of the literature, the findings support dental implant placement without interruption of OACs, DOACs, or APs, if proper local hemostatic measures are used. The reviewed studies do not provide strong evidence regarding the safety of more extensive surgery such as bone grafting and sinus lift procedures in patients on continuous antithrombotic therapy. Strictly designed prospective studies with higher numbers of patients stratified regarding dental implantation procedures and types of medications, APs, OACs, and DOACs are necessary to arrive at firmer conclusions.

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