Management of Anticoagulated Patients in Dentoalveolar Surgery: A Retrospective Study Comparing Bridging Versus Unpaused Vitamin K Antagonist Medication.

Mayte Buchbender (✉ mayte.buchbender@uk-erlangen.de)
Universitätsklinikum Erlangen  https://orcid.org/0000-0001-8295-9714

F Rößler
Universitätsklinikum Erlangen

Marco Kesting
Universitätsklinikum Erlangen

Gesche Frohwitter
Universitätsklinikum Erlangen

Werner Adler
Friedrich-Alexander-Universität Erlangen-Nürnberg

Andrea Rau
Universitätsklinikum Erlangen

Research article

Keywords: postoperative bleeding, dentoalveolar surgery, vitamin K, heparin

DOI: https://doi.org/10.21203/rs.3.rs-55563/v1

License: © This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

Objectives: The aim of this study was to investigate the occurrence of postoperative bleeding following dentoalveolar surgery in patients with either continued vitamin K antagonist medication or perioperative bridging using heparin.

Study design: A retrospective study was performed analyzing patients who underwent tooth extraction between 2012 and 2017. Patients were retrospectively allocated into two comparative groups: un-paused vitamin K antagonist medication versus bridging using heparin. A healthy, non-anticoagulated cohort with equivalent surgery served as a control group. Main outcome measures were: the occurrence and frequency of postoperative bleeding, the number of removed teeth, the surgical technique of tooth removal (extraction/osteotomy/combined extraction and osteotomy) and the prothrombin time.

Results: In total, 475 patients were included in the study with 170 patients in the group of un-paused vitamin K antagonist medication VG, 135 patients in the Bridging group BG and 170 patients in the control group CG. Postoperative bleeding was significant: CG vs. VG p=0.004; CG vs. BG p<0.001, BG vs.VG p<0.001. A significant correlation of number of the extracted teeth in the BG (p=0.014) and no significance in VG (p=0.298) and CG (p=0.210) and in the BG vs. VG and CG with p<0.001 in terms of surgical intervention extraction. No difference observed in terms of prothrombin time.

Conclusion: Bridging increases the risk for bleeding compared to un-paused vitamin K antagonist medication. The perioperative management of anticoagulated patients requires a well-coordinated interdisciplinary teamwork to minimize or at best avoid both: postoperative bleeding and thromboembolic incidences.

Introduction

Due to the increase in life expectancy and the rising number of patients with cardiovascular diseases, the number of anticoagulated patients continues to increase worldwide\(^1\). Although the therapeutic anticoagulation management of the underlying diseases (e.g., apoplexy, atrial fibrillation, coronary heart disease, peripheral arterial occlusive disease, heart valve replacement or thrombosis) is primarily an internal medicine issue\(^2\), blood-thinning medication plays also a major role in oral surgery. Dentoalveolar surgical procedures such as tooth extractions, tooth osteotomies or root tip resections are part of the everyday dental practice. For anticoagulated patients, they require a close interdisciplinary coordination between cardiologists, general practitioners and oral surgeons\(^3\). Inconsiderate perioperative disruption of the anticoagulative medication bears the risk of potentially lethal thromboembolic events for the patients. In their review, Wahl et al. reported 22 embolic events after discontinuation or reduction of anticoagulation, 6 of which ended fatally, whereas no fatal consequences were observed after postoperative bleeding with existing anticoagulation\(^4\). Although fortunately not being life-threatening in the vast majority of cases, postoperative bleeding following oral surgery causes severe discomfort for the patients, who might be hospitalized and may face follow-up operations for hemostasis.
Anticoagulation therapy can be carried out using various classes of drugs (e.g. vitamin K antagonists, heparin, direct oral anticoagulants), which all intervene differently in the coagulation cascade and have their assets and drawbacks. Despite the availability of substances, which are easier to handle (e.g. direct oral anticoagulants), the coumarin derivative and vitamin K antagonist Phenprocoumon (Marcumar®), is still widely used for the prevention of thromboembolic events in atrial fibrillation or following heart valve replacement or pulmonary embolism. There are widely discussed approaches to the management of vitamin K antagonists prior to oral surgery: suspension for several days\(^2,5\), temporary Bridging with heparin\(^6,7\), reducing the dosage without Bridging\(^8,9\) or unchanged dosages and hemostasis by local hemostatic measures\(^2,5,10,11\). Heparin offers the advantage of a good controllability due to its short half-life\(^12\). However, it is not recommended to interrupt the heparin therapy for surgical interventions\(^13\). In any case, preoperative coagulation lab testing is essential to evaluate the patients' level of anticoagulation\(^14\). When investigating bleeding risks in a cohort of 1884 patients who received a surgical intervention with an adjusted INR of > 2.0 and were either bridged with low-molecular-weight heparin or a placebo, Douketis et al. found the risk of bleeding was 1.3% in the placebo group and 3.2% in the experimental group\(^15\).

In general, available literature on this topic is heterogeneous. Whilst there is a relative consensus pro Bridging regarding major surgery, especially for small-to-medium-sized surgical interventions including oral surgery the recommendations differ considerably even in official guidelines\(^16,17\). It was therefore the aim of this study to analyze bleeding complications in a cohort of anticoagulated patients having oral surgery. A special focus was laid on the comparison of Bridging versus un-paused vitamin K antagonist medication.

**Materials And Methods**

A monocentric retrospective patient cohort analysis was performed in a German university dental clinic, including all patients with a permanent vitamin K antagonist medication, who had oral surgery done between 2012 and 2017 in the clinic or were transferred to the clinic for treatment following oral surgery. As a first step, patient search was conducted by screening the digital clinic documentation system (MCC®, Meierhofer AG, Munich, Germany) and the digital patient file (Soarian Clinicals®, Cerner Health Services, Erlangen, Germany) using the following key words: tooth extraction, tooth osteotomy, surgical intervention, tooth, bleeding event, Marcumar®, Bridging, heparin, anticoagulation and thromboembolic event. As a next step, further selection of patients was carried out, by including only patients, who had an oral surgical intervention (tooth extraction, tooth extraction and osteotomy or osteotomies). Both, in- and outpatients were considered. Furthermore, all patients with hemorrhagic diatheses or blood-thinning medication other than vitamin K antagonists (e.g. direct oral anticoagulants or platelet aggregation inhibitors) were excluded.

Depending on whether the vitamin K antagonist medication was temporarily paused and substituted by heparin perioperatively (=Bridging) or continued without interruption, we retrospectively allocated the selected patients into two groups: a Bridging group named **BG** and a vitamin K antagonist group named
Additionally, a control group of healthy patients without any anticoagulants, who had equivalent oral surgery, was added as a control group (named CG).

For each patient the following data was acquired from the digital patient file:

- Number of postoperative bleeding events (B0=no bleeding event, B1=one bleeding event, B2=two bleeding events, B3=three bleeding events, B4=four bleeding events)

- Surgical intervention and postoperative bleeding events (tooth extraction, tooth extraction and osteotomy, osteotomies)

- Prothrombin time = International ratio (INR)

Patients with incomplete documentation of the above listed information were not considered for the study. The primary outcome of the study was the frequency of postoperative bleeding in each group. Secondary outcomes were the type of surgery (tooth extraction with or without osteotomy), the number of extracted teeth and the INR. Ethical approval was obtained from the local medical faculty ethics committee (registration No.192_19Bc).

**Statistical analysis**

Statistical analysis was performed using the statistical programming language R V3.6.1 (R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria). The non-parametric Kruskal-Wallis and Mann-Whitney U tests were used, as well as the Chi-square test, Exact-Fisher’s exact test and Cochran-Mantel-Haenszel test. The level of significance was p<0.05 in all tests performed.

**Results**

**General patient data**

As a result of the data analysis, a total of 475 patients were included in the study, distributed to the three groups as follows: Bridging group (BG: n = 135), vitamin K antagonist group (VG: n = 170) and control group (CG: n = 170). The overall mean age was 71.76 years. Mean age in the groups was as follows: 79.67 years (BG), 78.76 years (VG) and 58.49 years (CG) with a statistical significance between CG and BG/VG (p < 0.001).

**Postoperative bleeding events following oral surgery**

Postoperative bleeding occurred in 22 out of 170 patients (12.9%) in the control group, in 44 out of 170 patients (25.9%) in the vitamin K antagonist group and in 65 out of 135 patients (48.1%) in the Bridging group. Comparing the groups statistically, significant differences were found for the control group versus the Bridging group (p < 0.001) and the control group versus the vitamin K antagonist group (p = 0.004).
Furthermore, bleeding occurred significantly more often in the Bridging group than in the vitamin K antagonist group (p < 0.001), as shown in Fig. 1. The average number of postoperative bleeding events was 0.15 in the control group, 0.74 in the Bridging group and 0.29 in the vitamin K antagonist group, the number of postoperative bleeding events in the groups is presented in Table 1. There were significantly less bleeding events in the control group compared to the groups of anticoagulated patients (CG vs. BG: p < 0.001; CG vs. VG: p = 0.002). The comparison of the Bridging group and the vitamin K group revealed a higher number of bleeding events in the Bridging group (p < 0.001).

### Table 1

Showing the number of postoperative bleeding events within the three groups. B0= no postoperative bleeding, B1=postoperative bleeding, B2,B3,B4= two, three and four postoperative bleeding events.

| B  | Control group (n=170) | Bridging group (n=135) | Vitamin k-inhibitor group (n=170) |
|----|-----------------------|------------------------|----------------------------------|
| 0  | 148                   | 70                     | 126                              |
| 1  | 20                    | 40                     | 38                               |
| 2  | 1                     | 17                     | 6                                |
| 3  | 1                     | 6                      | 0                                |
| 4  | 0                     | 2                      | 0                                |

### Number and techniques of tooth removal

A total of 584 teeth were removed in the control group, 520 teeth in the Bridging group and 443 teeth in the vitamin K antagonist group. The procedures varied from single tooth extractions to row extractions of up to 24 teeth as a maximum. On average, 3.44 teeth were removed per procedure in the control group, 3.85 teeth in the Bridging group and 2.61 teeth in the vitamin K antagonist group. No significant difference was determined between the number of removed teeth and the number of postoperative bleeding events per procedure in the control group (p = 0.210) and in the vitamin K antagonist group (p = 0.298). The number of teeth had a significant impact on postoperative bleeding events in the bridging group (p = 0.014) as shown in Fig. 2. Teeth were removed by different surgical techniques, either by extraction or osteotomy or a combination of both. For the techniques osteotomy and combined extraction/osteotomy no significant differences were found related to bleeding events in the groups. For the technique tooth extraction there was significantly more postoperative bleeding found in the Bridging
group compared to the control group (p < 0.001) and the vitamin K antagonist group (p < 0.001) as shown
in Fig. 3.

Prothrombin time (International ratio)

The Prothrombin time or International ratio (INR) had been routinely determined before surgery and
additionally when postoperative bleeding occurred. Bridging group patients without postoperative
bleeding had an average INR of 1.4, whereas the average INR of those with bleeding was 1.45. In the
vitamin K antagonist group the average INR was 2.1 for patients without bleeding and 2.7 for those with
bleeding. The INR differed significantly between the groups of Bridging and vitamin K antagonist
medication (p < 0.001), but it did not significantly differ between the groups of bleeding/non-bleeding
patients (p > 0.05).

Discussion

Anticoagulated patients continue to pose a challenge in everyday clinical practice\textsuperscript{18}. This is particularly
ture for surgical procedures, including oral surgery. On the one hand, discontinuation or Bridging of
anticoagulation can lead to thromboembolic events with a potentially lethal outcome\textsuperscript{4,19}. On the other
hand, intra- and postoperative bleeding can be burdensome for the patient and may complicate surgery
and wound healing. Nevertheless it can be controlled sufficiently by local hemostatic measures in the
majority of cases\textsuperscript{20}. As a result, the question whether to perform perioperative Bridging or to continue
vitamin K antagonist medication in oral surgery, is becoming an increasingly contentious issue. There
seems to exist a vague consensus pro Bridging when it comes to major surgical procedures such as
extensive oncological or reconstructive operations, but for small to moderate surgical procedures,
opinions and study results about the perioperative anticoagulation management differ widely. Clemm et
al. investigated bleeding complications of anticoagulated patients in dental implant surgery (implant
insertion and augmentative procedures). Comparing different anticoagulative schemes, they found a
bleeding risk of 12.5\% in a Bridging group (low-molecular-weight heparin), 6.7\% in the vitamin K
antagonist group, 1.4\% in a platelet aggregation inhibitor group and 0.6\% in a control group\textsuperscript{21}. In another
study by Bajkin et al. no significant differences in terms of postoperative bleeding following dental
surgery were found between the Bridging and Non-Bridging groups of a 214 patients cohort. In their 2015
systematic review, Kämmerer et al. found a strong evidence, that patients with vitamin K antagonist
medication undergoing minor oral surgery should not discontinue their medication in order to prevent
thromboembolic complications \textsuperscript{2}. This corresponds with the findings of our study. The probability for the
occurrence of postoperative bleeding as well as the frequency of bleeding events were significantly higher
in the Bridging group compared to the vitamin K antagonist group. As expected, the INR was significantly
lower in the vitamin K antagonist group than in the Bridging group, but surprisingly there were no
significant differences found within the groups comparing bleeding and non-bleeding patients. Other studies showed similar findings regarding the INR by not finding a correlation of bleeding events with the INR\textsuperscript{22}. In a study by Schmitt et al. in 2019, the INR (mean value in the bridging group, 1.67; mean value in vitamin-k-inhibitor group, 1.8) had no significant association with postoperative bleeding events. The incidence of bleeding events in the vitamin K antagonist group was 11.3%, which is quite similar to our result. In contrast, the bridging group, with an incidence of 0%, did not record a single event. However, the bridging group consisted of only 6 patients, and the vitamin-k-inhibitor group included 80 patients\textsuperscript{23}.

Postoperative bleeding event, were also recorded in correlation with the surgical intervention (single tooth extraction, serial tooth extraction or osteotomy). Single tooth extraction within the vitamin K antagonist group resulted in a rate of postoperative bleeding events of 10.5%, a rate of serial extraction of 16.7% and a rate of osteotomy of 10%. In the control group with 603 procedures, they found 0% postoperative bleeding events in single tooth and serial extractions and 1.3% in osteotomies. These results correspond to those of another study where 214 patients, who underwent tooth extraction of one to five teeth per procedure without a significant correlation\textsuperscript{24}. In our patient population, the occurrence of postoperative bleeding significantly correlated with the number of teeth removed within the bridging group and in terms of the surgical intervention extraction but not within osteotomy or within the other groups (VG and CG). This does not correspond with the findings of another author. Bleeding did not correlate with the extension of the surgical procedure\textsuperscript{2}. One reason for the increased postoperative bleeding in correlation with the number of teeth removed in the BG within this study may be that external patients were also included. Currently bridging of vitamin k is still common practice beyond the university hospitals for tooth removal. Therefore, it was not possible to differentiate between the other influencing factors (such as wound management or invasiveness during tooth extraction) that might be crucial in terms of bleeding, especially in the BG but also CG and VG. As these data could not be collected due to the retrospective design of the study.

In a review, Wahl et al. examined more than 2775 patients with dental procedures under bridging with heparin conditions. Postoperative bleeding occurred in 161 patients (6%), which needed intervention in four patients (0.14%) with more than local hemostatic measures\textsuperscript{4}. Additionally, other studies showed that local hemostatic measures were sufficient for hemostasis in most dental interventions of anticoagulated patients and that possible bleeding complications in anticoagulant patients undergoing dental surgery should be weighed against possible embolism complications before anticoagulation is bypassed\textsuperscript{10, 25−27}. In our patients, we observed, that only in the Bridging group local hemostatic measures had to be escalated in the case of multiple bleeding events. The observations in our patient population correlate with the findings of other studies and lead to the conclusion that patients do not benefit from Bridging in dental surgery\textsuperscript{28}. It was not possible to draw a line between the measures without too much bias within this patient population. This was because external patients with postoperative bleeding events were also included in the study. Thus, to a certain extent, no action cascade of the hemostatic measures could be carried out. These range from Tranexamic acid (Cyklokapron®, Pfizer Pharma GmbH, Berlin, Germany) with a bite swab and local compression, inserting hemostatic fillers (i.e. Oxycellulose, Tabotamp®
Johnson & Johnson Medical GmbH, Norderstedt, Germany; Collagen, Lyostypt® B. Braun Melsungen AG, Melsungen, Germany; Porcine gelatin, Gelastypt® Sanofi-Aventis Germany GmbH, Frankfurt am Main, Germany), bipolar electrocoagulation or bandage plate (acrylic splints) and local tight wound closure to stop postoperative bleeding.

However, also the continuation of vitamin K antagonists still poses a challenge. This is because even in this case, inconsiderable secondary bleeding may occur, although it can be easily treated by local hemostatic measures. Most medical specialists recommend adjusting or reducing the INR value without permanently leaving the therapeutic area. The risk of a lethal thromboembolic event, which is 0.2% in the literature and should not be disregarded.

There are shortcomings of this study that need to be discussed. First, the retrospective study design led to discrepancies between the groups in terms of group size and composition. The extent and type of the surgical procedure varied between the groups and since operations were performed by different surgeons, the surgical techniques varied to a certain extent.

Within the limitations of the current study, it can be concluded that postoperative bleeding events occur significantly more frequently in bridged patients than in patients with un-paused vitamin K antagonist medication. It therefore appears reasonable to continue vitamin K antagonist medication perioperatively for the investigated class of small-to-medium sized oral surgery cases. A close interdisciplinary collaboration between oral surgeons and other medicine specialists is essential to minimize perioperative risks for the patients.

Declarations

Ethical approval

Ethical approval was obtained from the local medical faculty ethics committee of the Friedrich-Alexander- University Erlangen- Nuremberg (registration No.192_19Bc).

Acknowledgements

FR (Felix Rößler) contributed to data acquisition, data analysis and interpretation to obtain the doctoral degree (Dr. med. dent.) at the Friedrich- Alexander- University Erlangen- Nuremberg.

Conflict of interest/Funding

The authors declare no conflict of interest or any external funding source.
References

1. Koskinas KC, Lillis T, Tsirilis A, Katsiki N, Giannoglou GD, Ziakas AG. Dental management of antiplatelet-receiving patients: is uninterrupted antiplatelet therapy safe? Angiology. 2012 May;63(4):245–7. PubMed PMID: 22500009.

2. Kammerer PW, Frerich B, Liese J, Schiegnitz E, Al-Nawas B. Oral surgery during therapy with anticoagulants—a systematic review. Clinical oral investigations. 2015 Mar;19(2):171–80. PubMed PMID: 25413495.

3. Doonquah L, Mitchell AD. Oral surgery for patients on anticoagulant therapy: current thoughts on patient management. Dental Clin N Am. 2012 Jan;56(1):25–41. vii. PubMed PMID: 22117941.

4. Wahl MJ, Pinto A, Kilham J, Lalla RV. Dental surgery in anticoagulated patients—stop the interruption. Oral surgery, oral medicine, oral pathology and oral radiology. 2015 Feb;119(2):136–57. PubMed PMID: 25577414.

5. Al-Mubarak S, Rass MA, Alsuwyyed A, Alabdulaaly A, Ciancio S. Thromboembolic risk and bleeding in patients maintaining or stopping oral anticoagulant therapy during dental extraction. Journal of thrombosis haemostasis: JTH. 2006 Mar;4(3):689–91. PubMed PMID: 16460459.

6. Mehra P, Cottrell DA, Bestgen SC, Booth DF. Management of heparin therapy in the high-risk, chronically anticoagulated, oral surgery patient: a review and a proposed nomogram. Journal of oral maxillofacial surgery: official journal of the American Association of Oral Maxillofacial Surgeons. 2000 Feb;58(2):198–202. PubMed PMID: 10670599.

7. Johnson-Leong C, Rada RE. The use of low-molecular-weight heparins in outpatient oral surgery for patients receiving anticoagulation therapy. J Am Dent Assoc. 2002 Aug;133(8):1083–7. PubMed PMID: 12198988.

8. Bailey BM, Fordyce AM. Warfarin anticoagulant therapy. British dental journal. 1984 May 5;156(9):310. PubMed PMID: 6234009.

9. Bailey BM, Fordyce AM. Complications of dental extractions in patients receiving warfarin anticoagulant therapy. A controlled clinical trial. British dental journal. 1983 Nov 5;155(9):308–10. PubMed PMID: 6605757.

10. Zanon E, Martinelli F, Bacci C, Cordioli G, Girolami A. Safety of dental extraction among consecutive patients on oral anticoagulant treatment managed using a specific dental management protocol. Blood coagulation & fibrinolysis: an international journal in haemostasis and thrombosis. 2003 Jan;14(1):27–30. PubMed PMID: 12544725.

11. Martinowitz U, Mazar AL, Taicher S, Varon D, Gitel SN, Ramot B, et al. Dental extraction for patients on oral anticoagulant therapy. Oral surgery, oral medicine, and oral pathology. 1990 Sep;70(3):274–7. PubMed PMID: 2145537.

12. Aldridge E, Cunningham LL Jr. Current thoughts on treatment of patients receiving anticoagulation therapy. Journal of oral and maxillofacial surgery: official journal of the American Association of Oral and Maxillofacial Surgeons. 2010 Nov;68(11):2879–87. PubMed PMID: 20727633.
13. Al-Harkan AM, Al-Ayoub GA. Should antiplatelet and anticoagulant medications be discontinued before minor oral surgery procedures? Journal. 2012;78:c24. PubMed PMID: 22391112.

14. Mingarro-de-Leon A, Chaveli-Lopez B, Gavalda-Esteve C. Dental management of patients receiving anticoagulant and/or antiplatelet treatment. Journal of clinical experimental dentistry. 2014 Apr;6(2):e155-61. PubMed PMID: 24790716. Pubmed Central PMCID: 4002346.

15. Douketis JD, Spyropoulos AC, Kaatz S, Becker RC, Caprini JA, Dunn AS, et al. Perioperative Bridging Anticoagulation in Patients with Atrial Fibrillation. The New England journal of medicine. 2015 Aug 27;373(9):823–33. PubMed PMID: 26095867. Pubmed Central PMCID: 4931686.

16. Breuer G, Weiss DR, Ringwald J. 'New' direct oral anticoagulants in the perioperative setting. Curr Opin Anaesthesiol. 2014 Aug;27(4):409–19. PubMed PMID: 24790716. Epub 2014/07/01.

17. P K. Zahnärztliche Chirurgie unter oraler Antikoagulation/ Thrombozytenaggregationshemmung. 2017.

18. Eichhorn W, Burkert J, Vorwig O, Blessmann M, Cachovan G, Zeuch J, et al. Bleeding incidence after oral surgery with continued oral anticoagulation. Clinical oral investigations. 2012 Oct;16(5):1371–6. PubMed PMID: 22160538.

19. Wahl MJ. Dental surgery and antiplatelet agents: bleed or die. Am J Med. 2014 Apr;127(4):260–7. PubMed PMID: 24333202.

20. Schmitt CM, Rusche B, Clemm R, Neukam FW, Buchbender M. Management of anticoagulated patients in dentoalveolar surgery: a clinical comparative study. Clinical oral investigations. 2020 Aug;24(8):2653–62. PubMed PMID: 31713746. Epub 2019/11/13.

21. Clemm R, Neukam FW, Rusche B, Bauersachs A, Musazada S, Schmitt CM. Management of anticoagulated patients in implant therapy: a clinical comparative study. Clinical oral implants research. 2016 Oct;27(10):1274–82. PubMed PMID: 26592859.

22. Bajkin BV, Popovic SL, Selakovic SD. Randomized, prospective trial comparing bridging therapy using low-molecular-weight heparin with maintenance of oral anticoagulation during extraction of teeth. Journal of oral maxillofacial surgery: official journal of the American Association of Oral Maxillofacial Surgeons. 2009 May;67(5):990–5. PubMed PMID: 19375008.

23. Schmitt CM, Rusche B, Clemm R, Neukam FW, Buchbender M. Management of anticoagulated patients in dentoalveolar surgery: a clinical comparative study. Clinical oral investigations. 2019 Nov 12. PubMed PMID: 31713746.

24. Al-Mubarak S, Al-Ali N, Abou-Rass M, Al-Sohail A, Robert A, Al-Zoman K, et al. Evaluation of dental extractions, suturing and INR on postoperative bleeding of patients maintained on oral anticoagulant therapy. British dental journal. 2007 Oct 13;203(7):E15; discussion 410-1. PubMed PMID: 17694045.

25. Blinder D, Manor Y, Martinowitz U, Taicher S, Hashomer T. Dental extractions in patients maintained on continued oral anticoagulant: comparison of local hemostatic modalities. Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics. 1999 Aug;88(2):137–40. PubMed PMID: 10468454.
26. Douketis JD, Berger PB, Dunn AS, Jaffer AK, Spyropoulos AC, Becker RC, et al. The perioperative management of antithrombotic therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest. 2008 Jun;133(6 Suppl):299S-339S. PubMed PMID: 18574269.

27. Perry DJ, Noakes TJ, Helliwell PS, British Dental S. Guidelines for the management of patients on oral anticoagulants requiring dental surgery. British dental journal. 2007 Oct 13;203(7):389–93. PubMed PMID: 17934422.

28. Hong CH, Napenas JJ, Brennan MT, Furney SL, Lockhart PB. Frequency of bleeding following invasive dental procedures in patients on low-molecular-weight heparin therapy. Journal of oral maxillofacial surgery: official journal of the American Association of Oral Maxillofacial Surgeons. 2010 May;68(5):975–9. PubMed PMID: 20144498.

Figures

![Figure 1](image)

Figure 1

Showing the postoperative bleeding events within the different groups in relation to the interventions. B0= no postoperative bleeding, B1= postoperative bleeding event and the significances between groups (control vs. vitamin k antagonist p=0.004; control vs. bridging group p<0.001, bridging vs. vitamin k antagonist group p<0.001). Control group with patients n=170, bridging group n=135, vitamin k antagonist group n=170.
Figure 2

Showing the postoperative bleeding events within the different groups (control group, bridging group, vitamin K antagonist group) in relation to the number of extracted teeth. B0 = no postoperative bleeding, B1 = postoperative bleeding. With a significant correlation in the BG (p=0.014) and no significance in VG (p=0.298) and CG (p=0.210).

Figure 3

Showing the postoperative bleeding events within the groups (CG, BG and VG) in correlation to the surgical intervention (extraction; extraction and osteotomy; osteotomy). With no significances for osteotomy and extraction/osteotomy but within extraction in the BG to the VG and CG with p<0.001.