International Journal of Community Medicine and Public Health
Alodaib W et al. Int J Community Med Public Health. 2025 Feb;12(2):913-919
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20250044

Systematic Review

Incidence of deep vein thrombosis following oral and maxillofacial surgery: a systematic review of reported cases and risk factors

Widad Alodaib[1], Bader Fatani[2], Muzun Alatyan[3]*

[1]Department of Oral and Maxillofacial Surgery, Prince Sultan Military Medical City, Riyadh, Saudi Arabia
[2]Department of General Dentistry, King Saud University, Riyadh, Saudi Arabia
[3]Department of Dental, King Saud University, Riyadh, Saudi Arabia

Received: 27 December 2024
Accepted: 14 January 2025

***Correspondence:**
Dr. Muzun Alatyan,
E-mail: Muzon20@hotmail.com

ABSTRACT

Venous thromboembolism (VTE) is a common and serious complication after surgery which can lead to significant health deterioration. VTE includes deep venous thrombosis (DVT) and pulmonary embolism (PE). Around 30 to 50% of DVT cases are symptomless, leading to possible underdiagnosis or misdiagnosis. This oversight can cause severe complications like acute pulmonary embolism and even death, along with chronic issues like post-thrombotic syndrome. DVT post-oral and maxillofacial surgery is uncommon, with few studies on its occurrence. This systematic review assesses published papers on DVT incidence after oral and maxillofacial surgery.

Keywords: Deep vein thrombosis, Deep venous thrombosis, Venous thromboembolism, Maxillofacial surgery, Craniofacial surgery

INTRODUCTION

Venous thromboembolism (VTE) is a prevalent and serious postoperative complication that can lead to significant morbidity and mortality. VTE encompasses deep venous thrombosis (DVT) and pulmonary embolism (PE). A century ago, Rudolf Virchow described the pathophysiology of DVT as a triad consisting of venous stasis, endothelial injury, and hypercoagulability. Later, the fibrinolytic state of patients was added as a fourth component.

It is estimated that 30 to 50% of DVT cases are asymptomatic and may go undiagnosed or misdiagnosed, potentially resulting in severe acute complications like acute pulmonary embolism and death, as well as chronic conditions such as post-thrombotic syndrome and chronic thromboembolic pulmonary hypertension (CTEPH).[1] Hospitalization is a key risk factor for VTE due to the presence of multiple predisposing conditions such as surgery, trauma, intravenous catheters, immobilization, pregnancy, and chronic illnesses. VTE rates in hospitalized surgical patients are up to 150 times higher compared to those in same-day surgery patients.[2] Patients with head and neck cancer typically undergo extensive resection and reconstruction, often presenting multiple significant risk factors for DVT and PE. These factors include advanced age, postoperative immobility, and prolonged surgeries, among others.

According to current criteria, most patients with head and neck cancer who undergo surgery are considered at high risk for developing VTE, particularly those undergoing simultaneous reconstruction.[3] The occurrence of VTE in oral and maxillofacial surgery appears low; however, precaution against thromboembolism may be warranted in patients with evident potential risk factors.[4] According to Lodders et al, in oncological oral and maxillofacial surgeries, the occurrence of complications appears to be rare, even among high-risk patients.[5] Deep vein thrombosis (DVT) following orthognathic surgery is rare, with limited published studies quantifying its occurrence

after oral and maxillofacial procedures. The overall rate of symptomatic DVT post-orthognathic surgery is classified as low risk by the second thromboembolic risk factors consensus group (THRiFT II). Studies have estimated DVT occurrence post-orthognathic surgeries to be very low, with different rates reported by various researchers. It is crucial to carefully assess the risk factors for DVT to determine the need for appropriate thromboprophylaxis based on individual risk levels.[6]

Lowry et al, stated that DVT and PE occurrence in major maxillofacial surgeries is minimal. However, strict adherence to the guidelines recommended by THRIFT and similar groups in Europe and the USA for surgeries is advised.[7] Verlinden et al suggest that young patients with few risk factors undergoing elective orthognathic procedures or distraction osteogenesis and with short hospital stays have a low risk of developing thrombosis. They recommend restricting thromboprophylaxis to high-risk patients or as per hospital protocols.[8] Some studies discussed the occurrence of deep vein thrombosis following maxillofacial surgery.[9-18] However, there is no current systematic review discussing all the reported cases and their associated risk. This systematic review aims to evaluate published papers discussing the incidence of deep vein thrombosis following maxillofacial surgery.

METHODS

Elaboration

This systematic review followed the guidelines of the preferred reporting items for systematic review and meta-analyses protocols (PRISMA 2020). The acronym PICOS was used to answer the review question, "What is the incidence of deep vein thrombosis after oral and maxillofacial surgery?" The search strategy was applied to PubMed, Scopus, Google Scholar, and Web of Science without time restrictions. Figure 1 illustrates the flow chart for this study.

Eligibility criteria and selection process

For the selection process of the papers, we included all reports that discussed deep vein thrombosis after oral and maxillofacial surgery and were defined as inclusion criteria. The exclusion criteria were as out-of-scope reports, did not discuss cases of oral and maxillofacial surgery, non-English-language articles, and articles with no full text available. This systematic review did not include other systematic reviews, lab studies, clinical trials, or review articles.

The articles were selected in two stages. In the initial stage, reviewers examined the titles and abstracts of the papers based on set criteria to choose articles for full reading. In the next stage, reviewers individually evaluated the selected articles based on the criteria for full reading. We performed an extensive online search and literature review to assess the cases of deep vein thrombosis after oral and maxillofacial surgery. PubMed, Scopus, Web of Science, and Google Scholar databases were searched for articles published up to July 2024. Deep vein thrombosis and maxillofacial surgery were the terms included in the search.

Data extraction

Mendeley was utilized for managing references to gather all literature search papers. Two reviewers assessed the collected studies based on the PRISMA 2020 statement. Duplicate papers were then removed. Abstracts were reviewed to decide on inclusion, with at least one reviewer needed to deem them suitable. Full-text articles undergone careful review by two reviewers, focusing on research design and findings. Cited studies were also checked to ensure no relevant papers were missed during the search.

Disputes were settled through author discussions, and articles were only included when both reviewers agreed to meet the criteria. Mendeley served as the system for managing references and collecting all papers from the literature search. Articles were included only if the two reviewers agreed that they met all the determined criteria. Data from selected articles were collected and structured in an Excel spreadsheet according to the following criteria: (a) Author, (b) Year of publication, (c) Patients, (d) Case description, and (e) Outcome or conclusion.

RESULTS

The majority of case reports were published after the year 2010 which discussed DVT cases following various maxillofacial surgeries from diverse populations across multiple countries. These reports focused on DVT incidence after oral and maxillofacial surgeries, with ten papers detailing multiple cases.

They explored DVT occurrences and risk factors associated with maxillofacial procedures in both healthy and unhealthy individuals. Forouzanfar et al, examined patient records for symptoms and details concerning deep venous thrombosis (DVT) and pulmonary embolism (PE). Patients were not given thromboembolism prevention. The study group had a 0.5% occurrence of VTE. Analysis showed a connection between body mass index and length of hospital stay with thromboembolism. Patients who underwent pre-implant surgery with bone graft were found to be at risk.[4]

Azoubel et al, described a case of 22-year-old male twenty days post his orthognathic surgery, the patient showed symptoms of fainting, sweating, chills, and loss of sphincter control. He was admitted to the hospital where he initially received an intravenous 0.9% saline solution with oxygen through a mask. Doppler (VD) and echocardiography (Echo) tests were conducted, confirming a diagnosis of pulmonary thromboembolism.[6]

Clayburgh et al, study aimed to determine in advance the occurrence rate of venous thromboembolism (VTE) after major head and neck surgery in 47 patients. Three individuals (6%) were found to have clinically noticeable VTE: 2 cases of deep vein thrombosis and 1 case of pulmonary embolism.

Additionally, two more individuals had superficial VTE in the lower extremities without any clinical symptoms. The authors concluded that the incidence of VTE in head and neck cancer patients revealed a slightly higher VTE rate.[11]

Moreover, Kakei et al, examined 133 consecutive patients who had both oral cancer removal and simultaneous reconstruction.[13]

After oral cancer surgery with simultaneous reconstruction, 26.3% of patients experienced VTE, with 2.3% having both DVT and pulmonary embolism, and 24.0% experiencing DVT alone.

The authors further explained that due to a high rate of VTE following significant oral and maxillofacial surgery, patients having oral cancer surgery with simultaneous reconstruction should undergo lower extremity venous duplex ultrasonography.[13]

In addition, according to Skorpil et al, the only factor that showed a significant association with VTE was the classification based on surgery time and duration.[16] More reported cases are reported in Table 1.

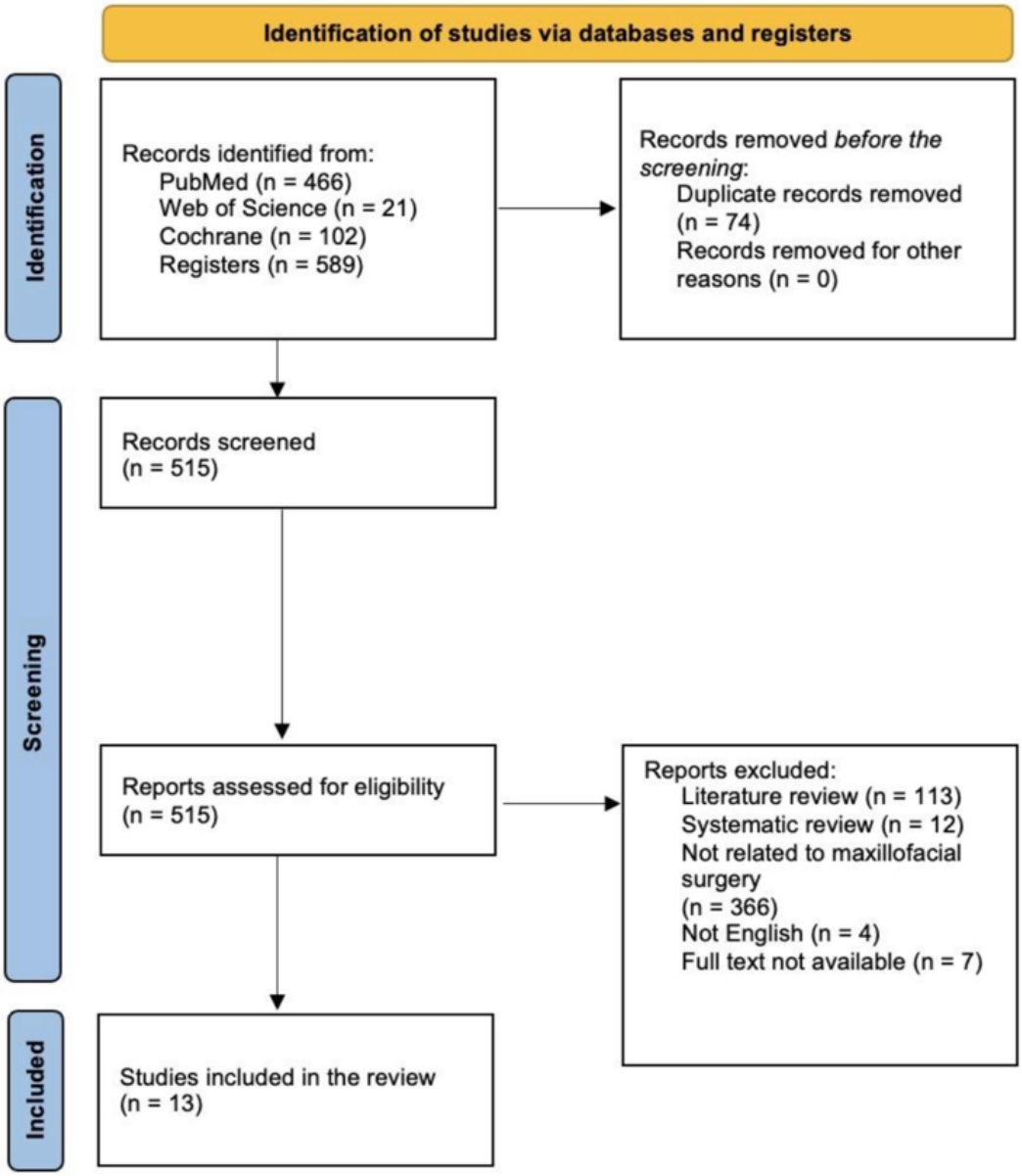

Figure 1: Study flowchart.

Table 1. Summary of reported cases.

Authors	Year	Patient/Patients	Case description	Outcome/conclusion
Samieirad et al[1]	2018	21-year-old woman	Patient with Class III malocclusion had bimaxillary orthognathic surgery (bilateral sagittal split osteotomy and Le Fort I osteotomy). One week after surgery, she developed deep vein thrombosis (DVT), experiencing sweating, chills, lower limb swelling, tenderness, and stiffness. DVT diagnosis was confirmed through D-dimer testing and venous Doppler sonography.	The patient was hospitalized in the intensive care unit for anticoagulant treatment and supportive care.
Wang et al[3]	2017	Patients who had oral and maxillofacial oncologic surgery were included in this retrospective research. The presence of VTE was detected and confirmed using CTA of the pulmonary artery or lower extremity ultrasonography in the study.	14 patients were found to have VTE, with 6 cases of PE, 7 cases of DVT, and 1 case of both DVT and PE. The average age of these patients was 62.07 years. Out of these cases, reconstruction was done in 12 patients, most of whom were diagnosed with malignancies. The average duration of surgery was 8.74 hours.	Careful attention should be made on the lower extremity deep venous cannula, as it showed a strong association with DVT based on the findings.
Forouzanfar et al[4]	2010	Patient records were examined for symptoms and details concerning deep venous thrombosis (DVT) and pulmonary embolism (PE). All patients filled out a questionnaire regarding symptoms related to DVT and PE. Patients were stratified by risk level, and the occurrence of documented DVT and PE was computed. The study included 411 patients with an average age of 32.	Patients were not given thromboembolism prevention. The study group had a 0.5% occurrence of VTE. Analysis using logistic regression showed a connection between body mass index and length of hospital stay with thromboembolism. Patients who underwent pre- implant surgery with bone graft were found to be at risk.	The occurrence of VTE in oral and maxillofacial surgery appears to be minimal, yet it may be reasonable to consider thromboembolism prevention for patients with evident risk factors.
Lodders et al[5]	2015	Patients were grouped based on their VTE risk level. Out of 233 patients in 244 operations (with an average age of (60.9 years), nearly all (97%) were identified as being at the highest risk for VTE.	The most typical symptoms for suspected cases included swelling in extremities, chest tightness, and blood expectoration. The rate of symptomatic VTE was 0.41%, with one man experiencing pulmonary embolism two days post-operation. There were no notable associations between the examined factors and symptomatic VTE.	Complications in oncological oral and maxillofacial surgeries appear uncommon, even in high-risk patients. While routine thromboprophylaxis is not advised, it may be considered for patients with clearly identified serious risk factors.
Azoubel et al[6]	2015	22-year-old male	Twenty days post his orthognathic surgery, the patient showed symptoms of fainting, sweating, chills, and loss of sphincter control. He was admitted to the hospital where he initially received intravenous 0.9% saline solution with oxygen through a mask. Venous Doppler (VD) and echocardiography (Echo) tests were conducted, confirming a diagnosis of pulmonary thromboembolism.	The patient stayed in the hospital for ten days, receiving anticoagulant medication for dissolving blood clots and painkillers for pain management. After the symptoms improved, follow-up tests were conducted, and no long-term issues were found.
Verlinden et al[8]	2014	4127 patients with an average age of 27 underwent elective orthognathic procedures or distraction osteogenesis, the occurrence of VTE was studied over a span of 42 years.	Two patients experienced symptomatic venous thromboembolism after their surgery, with one woman diagnosed with deep vein thrombosis (DVT) and one man diagnosed with both DVT and pulmonary embolism.	In young patients with few risk factors and short hospital stays, this kind surgeries carries a low risk of thrombosis. It may be wise to reserve thromboprophylaxis to high-risk patients or depending on the hospital protocols.

Continued.

Authors	Year	Patient/Patients	Case description	Outcome/conclusion
Babu et al[9]	2013	A 40-year-old woman with fractured left angle of mandible and a 44-year-old man with oral sub mucous fibrosis	Two instances of deep vein thrombosis (DVT) were identified in a patient—one case affecting the left ilio-femoropopliteal deep vein due to a fractured left angle of th mandible, and the other in the left peroneal vein due to oral sub mucous fibrosis. The conditions were diagnosed through clinical and color Doppler examinations.	Patients referred to a specialized vascular surgical unit at a higher institute for additional treatment.
Blackburn et al[10]	2006	129 consecutive patients' data were studied, these patients had orthognathic surgery under the care of one surgeon.	Two patients experienced symptomatic deep vein thromboses (DVTs) after their surgery, confirmed by venography, with one occurring in a proximal vein. Neither patient had a pulmonary embolism.	Two instances of VTE were seen in the bimaxillary osteotomy subgroup, with an incidence of 2.6%. This included one case of symptomatic VTE in a proximal vein, and there was no significant connection found between VTE and bimaxillary osteotomy.
Clayburgh et al[11]	2013	Determine in advance the occurrence rate of venous thromboembolism (VTE) after major head and neck surgery in 47 patients.	Three individuals (6%) were found to have clinically noticeable VTE: 2 cases of deep vein thrombosis and 1 case of pulmonary embolism. Additionally, two more individuals had superficial VTE in the lower extremities without any clinical symptoms.	The incidence of VTE in head and neck cancer patients revealed a slightly higher VTE rate.
Chen et al [12]	2008	6,759 surgeries were conducted, consisting of 1,591 head and neck reconstructions and 5,168 non- head and neck reconstructions, which encompassed free flaps, regional flaps, and other procedures.	While VTE incidence was below 1% in both groups, patients undergoing head and neck reconstruction had a notably higher VTE occurrence compared to those undergoing non- head and neck reconstruction ($p<0.05$).	Patients undergoing oncologic head and neck procedures, in comparison to those undergoing non-head and neck reconstruction, tended to be older, have longer anesthesia times, extended hospital stays, and a higher likelihood of requiring free flaps.
Kakei et al[13]	2016	133 consecutive patients who had both oral cancer removal and simultaneous reconstruction.	After oral cancer surgery with simultaneous reconstruction, 26.3% of patients experienced VTE, with 2.3% having both DVT and pulmonary embolism, and 24.0% experiencing DVT alone out of 133 patients.	Due to a high rate of VTE following significant oral and maxillofacial surgery, patients having oral cancer surgery with simultaneous reconstruction should undergo lower extremity venous duplex ultrasonography.
Moreano et al[14]	1998	12,805 total operations on adults done, patients who experienced a postoperative thromboembolic event following an otolaryngologic head and neck surgical procedure were recognized.	34 patients were identified with postoperative DVT, with an overall incidence of 0.3%. 24 patients also had a pulmonary embolus with an overall incidence of 0.2%. The rates of DVT in different subspecialties were as follows: head and neck surgery, 0.6%; otology/neurotology, 0.3%; head and neck trauma and plastic surgery, 0.1%; and general otolaryngology, 0.1%.	Postoperative pulmonary embolism is uncommon in otolaryngology-head and neck surgery, but when it does happen, it leads to substantial illness and raises the patient's care expenses.
Skorpil et al[16]	2012	479 patients underwent surgery for oral and maxillofacial trauma.	None of the patients in the study received any preventive prophylaxis treatment. Out of the 479 patients, one developed VTE (0.2%). This particular male patient, who had panfacial trauma, was considered high risk.	According to the study, the only factor that showed a significant association with VTE was the classification based on surgery time.

DISCUSSION

The likelihood of developing a DVT is influenced by various factors, categorized as major or minor. Major risk factors include age and the type and duration of surgery, with certain surgeries like neurosurgical or orthopedic procedures posing the highest risk, while vascular, gynecologic, and urologic surgeries also elevate the risk significantly. As described by Williams et al some minor risk factors for DVT include thrombophilic disorders, pregnancy, hormone therapy, oral contraception, varicose veins, obesity, and smoking. The risk of DVT increases with the number of these identified factors. Advanced age is a significant risk factor, especially for elderly individuals who are immobile. Specific surgeries, like lengthy neurosurgical or orthopedic procedures involving the hip, also pose high risks for postoperative DVT.

Additionally, oral contraceptives and hormone therapy can raise the risk of VTE based on dosage, duration, and hormone type. Ethnicity may also influence DVT risk, with Asians at a higher risk, followed by African Americans and then Latinos.[2] According to Lowry et al, in maxillofacial surgery, the occurrence of DVI and PE is minimal, likely because a large number of young, healthy patients are typically treated in this field. Despite this, as the specialty progresses, the risk factors for patients are rising, necessitating the provision of prophylaxis without justification.[7] Blackburn et al explained that Low-dose heparin significantly reduces the occurrence of venous thromboembolism. Low molecular weight heparin is now preferred over unfractionated heparin due to its comparable effectiveness and safety, and ability to be given once daily via subcutaneous injection without the need for monitoring. It is also less likely to cause thrombocytopenia and osteoporosis than unfractionated heparin. However, one drawback is that protamine sulfate is less effective as an antidote for it.

Evidence suggests that both unfractionated and low molecular weight heparin may also inexplicably reduce overall mortality in non-orthopedic surgery patients, apart from their preventative effects.[10] Chen et al further illustrated that Patients undergoing oncologic head and neck procedures, in contrast to those having non-head and neck reconstruction, tend to be older, have longer anesthesia durations, extended hospital stays, and a higher likelihood of requiring free flaps. It is advisable to provide suitable prophylaxis against VTE for cancer patients undergoing head and neck reconstruction whenever feasible.[12] Geerts et al study aimed to discuss preventing venous thromboembolism. According to the study (In major general surgery cases, it is advised to use low-molecular-weight heparin (LMWH), low-dose unfractionated heparin (LDUH), or fondaparinux for thromboprophylaxis.[17] Farr et al examined thromboembolic prophylaxis in maxillofacial surgery. According to the authors, most risk factors were considered when deciding on DVT prevention. The thromboembolic prophylaxis used in oral and maxillofacial surgery offers effective protection for patients at moderate and low-risk levels.[18] Amin et al study aimed to measure the anticipation of thromboprophylaxis and the ratio of surgical patients who acquire DVT or PE. The authors further explained that 1.6% of patients who underwent abdominal surgery experienced symptomatic DVT/PE, while 3.1% of orthopedic surgery patients had the same concern, with nearly 40% of cases occurring after the patient was discharged.[19]

According to Gong et al the symptoms of VTE are non-specific. Patients with risk factors should stay aware, focus on evaluating clinical possibilities, and increase their diagnostic awareness. Prompt anticoagulant or thrombolytic treatment post-diagnosis can improve survival rates.[20] Recent improvements in handling patients with suspected VTE have enhanced diagnostic precision and simplified and standardized management protocols. These protocols rely on clinical assessment, D-dimer tests, and imaging like compression ultrasound and computed tomography pulmonary angiography, ensuring a safe and cost-effective diagnosis for most patients.[21]

DVT and PE cannot be diagnosed based only on clinical signs due to their limited accuracy. Invasive imaging like phlebography and pulmonary angiography are costly and not always necessary. Non-invasive algorithms, including clinical assessment and D-dimer measurement, help identify patients who need imaging like compression ultrasonography for DVT and CT angiography for PE.[22] According to Agnelli et al, estimating the risk of recurrent venous thromboembolism involves a two-step process.

Patient and initial event characteristics, along with associated conditions, help determine the risk after stopping anticoagulant treatment. Additionally, D-dimer levels and residual thrombosis at treatment discontinuation correlate with the recurrence risk.[23] According to our systematic review, the reported incidence of deep vein thrombosis after oral and maxillofacial surgery is relatively low. The reported cases discussed variable risk factors including patients' health status, surgery time, and duration of hospital stay.

CONCLUSION

This current systematic review shows that the occurrence of deep vein thrombosis following oral and maxillofacial surgery is low. However, careful assessment of patient risk factors is important in order to avoid any unanticipated complications. Different hospitals and health care centres may incorporate diverse protocols for managing patients with a high risk of developing deep vein thrombosis. Nevertheless, the surgeon has the responsibility to assess each patient individually as well as to determine the risk factors which include surgery time, duration of hospital stay, and patient's own health status. Future studies should assess different risk assessment tools for evaluating deep vein thrombosis as

well as evaluate different health sector protocols for preventing deep vein thrombosis in patients undergoing different types of surgeries.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Samieirad S, Tohidi H, Eshghpour M, Hashemipour MA. An Unusual Case of Deep Vein Thrombosis After Orthognathic Surgery: A Case Report and Review of the Literature. J Oral Maxillofac Surg. 2018;76(12):2649.
2. Williams B, Indresano AT, O'Ryan F. Venous thromboembolism in oral and maxillofacial surgery: a review of the literature. J Oral Maxillofac Surg. 2011;69(3):840-4.
3. Wang Y, Liu J, Yin X, Hu J, Kalfarentzos E, Zhang C, Xu L. Venous thromboembolism after oral and maxillofacial oncologic surgery: Report and analysis of 14 cases in Chinese population. Med Oral Patol Oral Cir Bucal. 2017;22(1):115-21.
4. Forouzanfar T, Heymans MW, van Schuilenburg A, Zweegman S, Schulten EA. Incidence of venous thromboembolism in oral and maxillofacial surgery: a retrospective analysis. Int J Oral Maxillofac Surg. 2010;39(3):256-9.
5. Lodders JN, Parmar S, Stienen NL, Martin TJ, Karagozoglu KH, Heymans MW, et al. Incidence of symptomatic venous thromboembolism in oncological oral and maxillofacial operations: retrospective analysis. Br J Oral Maxillofac Surg. 2015;53(3):244-50.
6. Azoubel E. Postoperative deep vein thrombosis complication in orthognathic surgery—Case report. EC Dent Sci. 2015;1:173.
7. Lowry JC. Thromboembolic disease and thromboprophylaxis in oral and maxillofacial surgery: experience and practice. Br J Oral Maxillofac Surg. 1995;33(2):101-6.
8. Verlinden CR, Tuinzing DB, Forouzanfar T. Symptomatic venous thromboembolism in orthognathic surgery and distraction osteogenesis: a retrospective cohort study of 4127 patients. Br J Oral Maxillofac Surg. 2014;52(5):401-4.
9. Babu MR, Ramesh C, Thirumurugan K, Prasad GA. Deep vein thrombosis: A rare complication in oral and maxillofacial surgery: A review of two cases. Contemp Clin Dent. 2013;4(2):236-8.
10. Blackburn TK, Pritchard K, Richardson D. Symptomatic venous thromboembolism after orthognathic operations: an audit. Br J Oral Maxillofac Surg. 2006;44(5):389-92.
11. Clayburgh DR, Stott W, Cordiero T, Park R, Detwiller K, Buniel M, et al. Prospective study of venous thromboembolism in patients with head and neck cancer after surgery. JAMA Otolaryngol Head Neck Surg. 2013;139(11):1143-50.
12. Chen CM, Disa JJ, Cordeiro PG, Pusic AL, McCarthy CM, Mehrara BJ. The incidence of venous thromboembolism after oncologic head and neck reconstruction. Ann Plast Surg. 2008;60(5):476-9.
13. Kakei Y, Akashi M, Hasegawa T, Minamikawa T, Usami S, Komori T. Incidence of venous thromboembolism after oral oncologic surgery with simultaneous reconstruction. J Oral Maxillofac Surg. 2016;74(1):212-7.
14. Moreano EH, Hutchison JL, McCulloch TM, Graham SM, Funk GF, Hoffman HT. Incidence of deep venous thrombosis and pulmonary embolism in otolaryngology- head and neck surgery. Otolaryngol Head Neck Surg. 1998;118(6):777-84.
15. Van de Perre JP, Stoelinga PJ, Blijdorp PA, Brouns JJ, Hoppenreijs TJ. Perioperative morbidity in maxillofacial orthopaedic surgery: a retrospective study. J Craniomaxillofac Surg. 1996;24(5):263-70.
16. Skorpil N, van den Bergh B, Heymans MW, Forouzanfar T. Is thromboembolism prophylaxis necessary for low and moderate risk patients in maxillofacial trauma? A retrospective analysis. Int J Oral Maxillofac Surg. 2012;41(8):902-5.
17. Geerts WH, Bergqvist D, Pineo GF, Heit JA, Samama CM, Lassen MR, et al. Prevention of venous thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2008;133(6):381-453.
18. Farr DR, Hare AR. The use of thromboembolic prophylaxis in oral and maxillofacial surgery. Br J Oral Maxillofac Surg. 1994;32(3):161-4.
19. Amin AN, Lin J, Thompson S, Wiederkehr D. Inpatient and outpatient occurrence of deep vein thrombosis and pulmonary embolism and thromboprophylaxis following selected at-risk surgeries. Ann Pharmacother. 2011;45(9):1045-52.
20. Gong B, Xu Q, Pang Y, Hu J. Clinical features of patients with venous thromboembolism: 177 case analysis in 10 years. Zhonghua Wei Zhong Bing Ji Jiu Yi Xue. 2019;31(4):453-7.
21. Righini M, Le Gal G, Bounameaux H. Venous thromboembolism diagnosis: unresolved issues. Thromb Haemost. 2015;113(6):1184-92.
22. Bounameaux H, Perrier A, Righini M. Diagnosis of venous thromboembolism: an update. Vasc Med. 2010;15(5):399-406.
23. Agnelli G, Becattini C. Treatment of DVT: how long is enough and how do you predict recurrence. J Thromb Thrombolysis. 2008;25(1):37-44.

Cite this article as: Alodaib W, Fatani B, Alatyan M. Incidence of deep vein thrombosis following oral and maxillofacial surgery: a systematic review of reported cases and risk factors. Int J Community Med Public Health 2025;12:913-9.