Venous thromboembolism prophylaxis in foot and ankle surgery: a worldwide survey

Zambelli, R.; Frölke, S.; Nery, C.; Baumfeld, D.; Ortiz, C.; Cannegieter, S.; ... ; Rezende, S.M.

The Journal of Foot & Ankle Surgery 63 (2024) 59–63

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Venous Thromboembolism Prophylaxis in Foot and Ankle Surgery: A Worldwide Survey

Roberto Zambelli, MD[1,2,9], Sophie Frölke, BSc[3], Caio Nery, MD, PhD[4], Daniel Baumfeld, MD, PhD[5], Cristian Ortiz, MD[6], Suzanne Cannegieter, MD, PhD[7], Banne Nemeth, MD, PhD[7,8], Suely Meireles Rezende, MD, PhD[2]

[1] *Department of Orthopaedic Surgery, Mater Dei Healthcare Network, Belo Horizonte, Minas Gerais, Brazil*
[2] *Department of Internal Medicine, Faculty of Medicine, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil*
[3] *Renal Transplant Unit, Department of Internal Medicine, University Medical Center, University of Amsterdam*
[4] *Foot and Ankle Clinic, Albert Einstein Jewish Hospital, São Paulo, Brazil*
[5] *Orthopedic Department, Faculty of Medicine, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil*
[6] *Foot and Ankle Surgery, Clínica U de Los Andes, Santiago, Chile*
[7] *Department of Clinical Epidemiology, Leiden University Medical Center, Leiden, The Netherlands*
[8] *Department of Orthopaedic Surgery, Leiden University Medical Center, The Netherlands*
[9] *Department of Surgery, Faculty of Medical Sciences of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil*

ARTICLE INFO

Level of Clinical Evidence: 5

Keywords:
foot and ankle surgery
pulmonary embolism
questionnaire
survey
venous thromboembolism

ABSTRACT

Current recommendations on thromboprophylaxis for foot and ankle (FA) surgery are often inconsistent and generally based on weak evidence. The aim of this survey study was to evaluate the current practice among orthopedic surgeons regarding venous thromboembolism (VTE) prophylaxis following FA surgery. From February 2019 to March 2020, an online questionnaire was sent by e-mail to orthopedic societies across the world. The questionnaire was hosted by the International Society of Thrombosis and Haemostais RedCAP platform. Topics of interest were VTE rates following FA surgery, duration and type of thromboprophylaxis, bleeding complications, VTE risk factors for prophylaxis and use of risk assessment. A total of 693 FA orthopedic surgeons from all continents completed the survey of whom 392 (57%) performed more than 200 FA procedures per year. A total of 669/693 (97%) respondents stated that thromboprophylaxis is necessary in FA surgeries. When thromboprophylaxis was prescribed, half of surgeons prescribed it for the duration of immobilization. Acetylsalicylic acid, low molecular weight heparin and direct-oral anticoagulants were, in this order, the preferred choice. Acetylsalicylic acid and low molecular weight heparin were predominantly prescribed in North America and Europe, respectively. Previous deep vein thrombosis, immobility, obesity and inherited thrombophilia were considered the main risk factors indicative of thromboprophylaxis use. In this survey, most surgeons agree that thromboprophylaxis is indicated for FA surgery, but the prescription, type and duration of prophylaxis differs greatly with a large intercontinental discrepancy. These survey results could be a foundation for developing uniform guidelines to optimize thromboprophylactic strategies in FA procedures around the world.

The incidence of venous thromboembolism (VTE) in foot and ankle (FA) surgical patients varies between 0.8% and 23.5% (1-6). This great variability depends on study design, use of thromboprophylaxis, whether screening of subclinical VTE events was performed, type of procedure and individual risk factors. Although the overall incidence of VTE in FA surgery is thought to be low, FA patients who develop VTE have a higher estimated probability of morbidity and mortality than patients without VTE (3,6-8). Multiple studies found that subsets of FA patients are at a higher risk of VTE compared with other groups (2). For example, elective procedures are associated with a significantly lower VTE risk as compared with nonelective, trauma-related procedures (3).

Current recommendations on thromboprophylaxis for FA surgery are often inconsistent and generally based on weak evidence (2,9-11). This might partly be explained by the large heterogeneity of VTE risks across different patient populations and FA procedures. Most

Financial Disclosure: R. Zambelli received the Reach-The-World Travel Grant as part of the Regional Training Center Program of the International Society of Thrombosis and Hemostasis.

Conflict of Interest: None reported.

The research was duly appreciated and approved by the ethics committee under number CAAE 11315219.3.0000.5149

Address correspondence to: Suely Meireles Rezende, MD, PhD, Department of Internal Medicine, Faculty of Medicine, Universidade Federal de Minas Gerais, Avenida Alfredo Balena, 190, Belo Horizonte, Minas Gerais, Brazil 30130-100.

E-mail address: srezende@medicina.ufmg.br (S.M. Rezende).

1067-2516/$ - see front matter © 2023 by the American College of Foot and Ankle Surgeons. All rights reserved.
https://doi.org/10.1053/j.jfas.2023.08.014

recommendations for thromboprophylaxis following FA surgery have been extrapolated from the total joint arthroplasty literature where the incidence of VTE is much higher (12). For example, the American Academy of Orthopaedic Surgeons advise on the use of prophylaxis for VTE following hip and knee surgery but refrain from comments on thromboprophylaxis for FA surgery (13). The society guidelines published by the American College of Chest Physicians and the American College of Foot and Ankle Surgeons recommend chemical and mechanical thromboprophylaxis for some groups of patients with specific risk factors undergoing FA surgery, such as those with Achilles' tendon rupture or with a personal history of VTE (11,14,15). In general, these guidelines do not recommend that physicians routinely use thromboprophylaxis in "isolated lower-extremity injuries distal to the knee" (3). In short, existing recommendations and guidelines do not agree on postoperative thromboprophylaxis or are non-existing at all. Hence, FA surgeons are insufficiently guided on VTE prophylaxis following surgery (6).

Several nationwide surveys among orthopedic surgeons have reported on the use of thromboprophylaxis in FA surgery (16-23). It appears that a substantial number of FA surgeons routinely uses some form of VTE prophylaxis without taking risk factors into account nor use risk assessment models (22). These surveys have also demonstrated that there is a wide variety of prophylactic regimens without clear patterns of use, including acetylsalicylic acid (ASA), low molecular weight heparin (LMWH), intermittent compression devices and other forms of prophylaxis (7). However, these surveys are geographically restricted and may reflect only a specific regional guidance for thromboprophylaxis. Therefore, the main objective of this international survey study was to evaluate the worldwide current practice and rationale among FA surgeons regarding VTE prophylaxis in elective and trauma FA surgery. Furthermore, this study aimed to explore factors that influence the prescription of thromboprophylaxis.

Materials and Methods

Based on previously published surveys on VTE prophylaxis, a 14-item online questionnaire was designed, covering topics related to thromboprophylaxis on FA surgery. Previously published studies were found using a literature search (PubMed and Cochrane Library) which yielded 8 articles specifically related to surveys on FA surgery (16-23). A pilot study was conducted to test the questionnaire (provided in the supplement appendix) by applying it to 10 FA surgeons from different hospitals and countries.

From February 2019 to March 2020, the questionnaire was sent by e-mail to FA surgery societies across the world. As some surgeons were affiliated with multiple societies, they received the invitation several times, but were able to fill the form only once, making it impossible to calculate the response rate. These societies included the American Orthopaedic Foot and Ankle Society, Australian Orthopaedic Foot and Ankle Society, Asian Federation of Foot and Ankle Surgeons, Latin American Federation of Foot and Ankle Surgeons (FLAMeCIPP), and European Federation of Foot and Ankle Surgeons. The Informed Consent Term was sent in the body of the email and participation in the survey started when the participant voluntarily included their email address in the predetermined field. The questionnaire was sent twice, with an interval of 1 month between them, to remind those who did not respond after the first message. Questionnaires were accepted if the data were complete; unverified or incomplete data were excluded.

The questionnaire was hosted by the International Society of Thrombosis and Haemostasis RedCap (Research Electronic Data Capture) platform (24,25). REDCap is a secure, web-based software platform designed to support data capture for research studies

The study was approved by Ethics Committee and data were analyzed using the Stata Statistical Software 14 (StataCorp LP, College Station, TX), to create the percentage tables and figures.

Results

A total of 773 FA orthopedic surgeons from 49 different countries, including all continents, completed the survey. After exclusion of unverified or incomplete data (n = 80; 10.3%), 693 respondents were included in the analysis.

A total of 392/693 (56.5%) surgeons answered that they perform more than 200 FA procedures per year, indicative for their experience. In the previous 12 months, 480/693 (69.3%) respondents reported that at least 1 thromboembolic event (either a deep vein thrombosis [DVT] or pulmonary embolism) had occurred within their own or a colleagues' practice.

Table 1
Opinion of orthopedic surgeons on thromboprophylaxis in foot and ankle surgery

Outcome	Number of Surgeons Number/Total Number (%)
Prophylaxis against VTE in elective and traumatic foot and/or ankle surgery is	
Mandatory	161/691 (23)
Sometimes needed	508/691 (74)
Waste of time	22/691 (3)
Why do you prescribe prophylaxis?	
Prevents VTE which outweighs bleeding risk	342/680 (50)
Act in accordance with hospital/national guideline	157/680 (23)
Clinical experience shows a beneficial effect	70/680 (10)
Risk of complications is very small	111/680 (16)
Main reason to prescribe prophylaxis	
As answered before	289/494 (59)
Feel compelled by patients' request	8/494 (2)
For medico-legal reasons	170/494 (34)
Other, please specify	27/494 (5)

Abbreviations: FA; foot and/or ankle; VTE, venous thromboembolism.

Surgeons were questioned about their position on the need of VTE prophylaxis in orthopedic and FA surgeries (Table 1). Almost all FA surgeons (669/693, 97%) responded that thromboprophylaxis is mandatory or sometimes required. Only a few surgeons believed that thromboprophylaxis was not indicated due to a low VTE risk. Half of the respondents informed that they prescribe thromboprophylaxis from the standing point that VTE prevention outweighs the bleeding risk. Respondents were also asked if prescription of (type of) thromboprophylaxis was substantiated by local or national guidelines. Most surgeons (59%) reported that there were no hospital or national guidelines for VTE prophylaxis for FA surgery. If such guidelines would exist, 84% of surgeons answered that they would comply to them.

Previous DVT, immobility, obesity and inherited thrombophilia were considered the main risk factors indicative of thromboprophylaxis use (Table 2), which also applied to traumatic FA procedures. Age was often considered as a risk factor by the respondents, mainly when patients were aged over 60 y. For 92% of surgeons, immobility was considered a risk factor as any non-weightbearing immobilization (including cast). When asked for other risk factors other than the ones listed in the survey, the most commonly mentioned were 'smoking' and 'Achilles' surgery'. When asked about risk assessment models to evaluate and predict the risk for VTE in FA surgery, a third reported their use whereas

Table 2
Risk factors for prescription of thromboprophylaxis in foot and ankle surgery

Risk Factors for Prescription	Elective Surgery n = 275 (%)	Traumatic Surgery n = 225 (%)
Previous DVT	269 (98)	217 (96)
Immobility	180 (65)	157 (70)
Obesity	171 (62)	147 (65)
Inherited thrombophilia	171 (62)	146 (65)
Oral contraceptives	154 (56)	135 (60)
Venous stasis disease	143 (52)	122 (54)
Malignancy	148 (54)	124 (55)
Hindfoot surgery	85 (31)	79 (35)
Ankle replacement	97 (35)	54 (24)
Age	75 (27)	65 (29)
Diabetes	62 (23)	54 (24)
Pregnancy	45 (16)	37 (16)
Forefoot surgery	4 (1)	8 (4)
Ankle arthroscopy	6 (2)	5 (2)
Other	41 (15)	29 (13)

Abbreviations: FA, foot and ankle; DVT, deep vein thrombosis.

Table 3
Risk assessment models for venous thromboembolism in foot and ankle surgery

Outcome	Number of Surgeons Number/Total Number (%)
Use of risk assessment models	
Yes	215/685 (31)
No	470/685 (69)
Awareness of risk assessment models	
Yes	333/685 (49)
Risk assessment models in use	
Caprini	98 (29)
NICE	78 (23)
Padua	19 (6)
Plymouth	16 (5)
Nygaard	10 (3)
Roberts	6 (2)
L-TriP (cast)	3 (1)
Other	63 (19)
No	352/685 (51)

Abbreviations: FA, foot and/or ankle; L-TriP (cast); Leiden-Thrombosis Risk Prediction for patients with cast immobilization score; NICE, The National Institute of Health and Care Excellence; VTE, venous thromboembolism.

almost half of all respondents were aware of their existence (Table 3). Of these tools, the Caprini score and The National Institute for Health and Care Excellence guidance were the most popular.

In case thromboprophylaxis was prescribed, ASA, LMWH and direct oral anticoagulants (DOACs) were the preferred choice (Table 4). Of DOACs, about three-quarters of surgeons used rivaroxaban. Overall, less mechanical prophylaxis was used in traumatic than in elective surgery. Warfarin was barely used (2%). When thromboprophylaxis was prescribed, about 50% of respondents used it for the total duration of immobilization.

The participants were asked about their continent of residence, and of those who answered (n = 666; 100%), 129 (19.4%) were from Europe, 292 (43.8%) from North America, 174 (26.1%) from Latin America, 37 (5.6%) from Oceania, 27 (4.1%) from Asia, 7 (1.1%) and from Africa. and. The preferred choice of thromboprophylaxis per continent is shown in Fig. The use of ASA was more common in North America as compared with the rest of the world. In Europe, LMWH was predominantly prescribed. DOACs are used less in North America and Europe, but more in South America and Africa.

Discussion

We performed a worldwide survey aimed to evaluate the rationale and current practices of thromboprophylaxis for FA surgery. A total number of 693 FA orthopedic surgeons worldwide completed the survey of whom the majority performed more than 200 FA procedures per year. About two thirds of respondents reported that, in their practice, at least 1 VTE event occurred in the previous year, emphasizing the frequency of this complication. Most surgeons responded that thromboprophylaxis was sometimes needed but the type of anticoagulant used varied in different continents. In case thromboprophylaxis was prescribed, previous DVT, immobility, obesity and inherited thrombophilia were considered the main risk factors indicative for thromboprophylaxis use.

Remarkably, more than half of the surgeons surveyed, reported that no hospital/national guidelines for VTE prophylaxis in FA surgery existed in their institution/country. This indicates that the existing recommendations and guidelines are not well known among orthopedic surgeons across the world. Despite the lack of uniform guidelines and recommendations, almost half of surgeons routinely prescribe thromboprophylaxis following surgery. In contrast, Gadgil and Thomas found that 19% of surgeons used thromboprophylaxis following either elective or trauma orthopedic FA surgery (18). In another survey study, up to 98% of FA surgeons responded that they use thromboprophylaxis for high-risk patients (22). Shah et al (20) conducted an e-mail-based survey of active AOFAS committee members about VTE prophylaxis, concluding that there is a wide variation in thromboprophylaxis within the FA community. This is confirmed by the findings from our worldwide survey which shows a large variety in prescription patterns.

Some risk factors are strongly associated with VTE following FA surgery and considered in guidelines, as multi-trauma, obesity, previous VTE immobility, inherited thrombophilia, use of hormone replacement therapy or oral contraceptives and a non-weightbearing status. (3,10,11,18,23,26,27) In our survey study, 4 risk factors were clearly indicative for thromboprophylaxis prescription: previous VTE, immobility, obesity and inherited thrombophilia. Less frequent but still often mentioned risk factors were smoking and Achilles' surgery. According to the American College of Foot and Ankle Surgeons, there is insufficient evidence supporting the role of smoking as a risk factor (11). This also accounts for sex, race/ethnicity, pregnancy, and cardiovascular risk factors (11). Regarding Achilles surgery, the risk of VTE in patients with an Achilles' tendon rupture is high, varying between 4.9% and 7.0%, but routine prescription of chemoprophylaxis is not supported with the current evidence available, except in high-risk patients (2,10,28).

Although VTE after orthopedic FA surgery is rare, 23% of our respondent surgeons always prescribe prophylaxis (1,2,4,29-31). Another 70% prescribe prophylaxis in specific situations. As most patients will not experience a VTE following surgery, currently, many patients are overtreated. It could be beneficial to target high-risk individuals to increase the risk-benefit ratio of thromboprophylaxis (10,32). However, defining a high-risk patient is challenging. To predict the risk of VTE, RAM have been developed to estimate an individual's risk for VTE (31,33-35). Half of surgeons are aware of the existence of RAMs and a small third of respondents makes use of them. This implies that a few surgeons deliberately chose not to use any. However, although several RAMs have been developed to guide of the use of thromboprophylaxis in the clinical patient, there is only 1 RAM dedicated for lower limb immobilization (31). Even though none of the 'general' RAMs developed for general surgery and hospitalized patients have been validated for use in FA surgery, they are still used by approximately 30% of surgeons (11,20,30,35,36,37).

Considering different types of thromboprophylaxis in FA surgery, insufficient evidence exists to support isolated use of ASA in high-risk patients, although it's currently prescribed and recommended for other orthopedic patients (7,11,32). LMWH is supported by mixed evidence but may be considered for higher risk patients who will be immobilized

Table 4
Type of thromboprophylaxis use in elective and traumatic foot and ankle surgery

Type of FA Surgery	Type of Prophylaxis (n = 693)						
	ASA	LMWH	DOAC	Compressive Stockings	External Foot and Leg Pumps	Subcutaneous Unfractionated Heparin	Warfarin
Elective surgery, n (%)	325 (47)	291 (42)	216 (31)	144 (21)	100 (14)	73 (11)	17 (2)
Traumatic surgery, n (%)	289 (42)	286 (41)	179 (26)	91 (13)	70 (10)	73 (11)	11 (2)

Abbreviations: ASA, acetylsalicylic acid; DOAC = direct oral anticoagulant; FA, foot and/or ankle; LMWH, low-molecular-weight heparin.

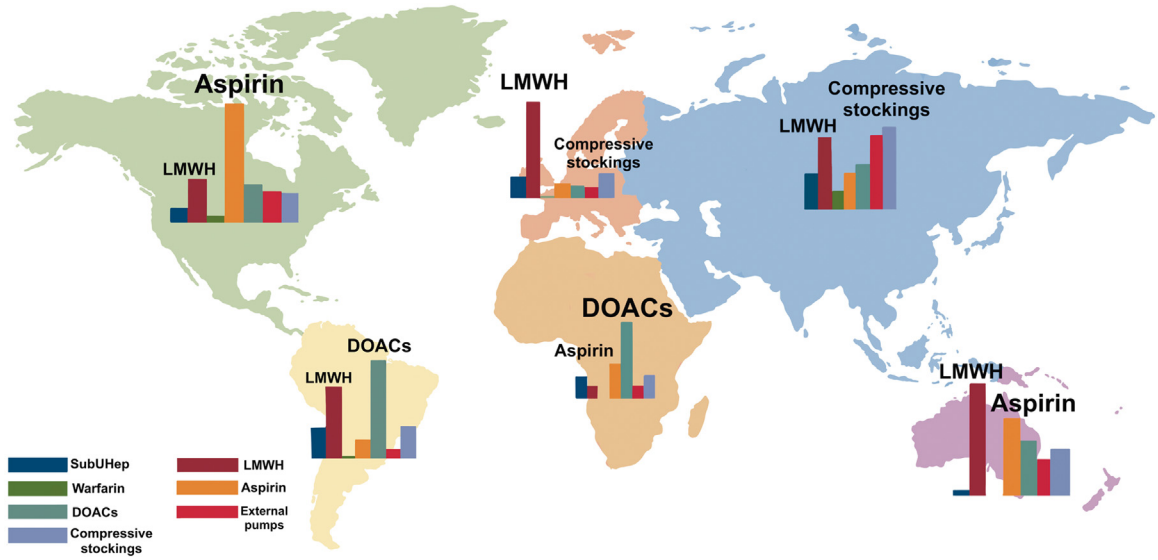

Fig. Infographic of type of thromboprophylaxis use in foot and ankle surgery per continent in a world map. The chart size represents the sample size. The y-axis is measured in percentages. This infographic is a visualization of the division in use of thromboprophylaxis type per continent in a world map. Abbreviations: DOACs, direct oral anticoagulants; LMWH, low-molecular-weight heparin.

(29,38-43). The evidence for mechanical prophylaxis is less strong and inconclusive, although it is routinely used (6,7,11). Our results show that the use of ASA in North America is higher compared to the rest of the world. The same accounts for the use of LMWH in Europe, while the use of DOACs is not as high. These results corroborate with those presented in a previous survey of American and British FA surgeons in 2006, which showed that ASA and LMWH were the most frequently used agents among AOFAS members and British Orthopaedic Foot Surgery Society members, respectively (18).

Half of surgeons prescribe thromboprophylaxis for the complete duration of immobilization. It is important to mention that the immobilization itself, a condition closely related to FA surgical interventions, is a major independent risk factors for VTE besides the surgical procedure, and there are strong recommendations to use any type of prophylaxis in this group of patients (3,10,27). Current recommendations for the duration of LMWH therapy is that it should ideally be continued for the duration of immobilization (11,26).

To the best of our knowledge, this is the largest questionnaire performed to date among orthopedic surgeons regarding thromboprophylaxis in FA procedures and the first study performed globally. Some limitations of this study are worth mentioning. Firstly, we were unable to calculate the response rate, since the questionnaire was sent to continental societies which include surgeons that are affiliated to multiple societies, although they could only answer the questionnaire once. Secondly, although all respondents answered the number of VTE events that they had seen in the year before answering the survey, the design of this study cannot state the incidence of VTE in FA surgery. The ideal design for determine the incidence of a giving disease should be a cohort study. Lastly, Europe, North and South America represent most of the respondent group and, therefore, reduces the generalization of our results.

In conclusion, despite the low VTE rate in FA surgery, a great majority of surgeons stated that thromboprophylaxis can be needed. Current practice regarding VTE prophylaxis in FA surgery shows that ASA, LMWH and DOACs are mostly prescribed, although intercontinental discrepancies exist. This survey shows that FA surgeons considered that certain evidence-based risk factors are associated with the development of VTE, contributing to the knowledge on the importance of risk assessment to guide the thromboprophylaxis in FA surgery. Development of international guidelines to help FA surgeons to choose the best thromboprophylaxis strategy, becomes paramount for a safer clinical practice focused on each patient specifically.

Author's contributions

R. Zambelli collected the data, conducted the analysis, drawn the figures and wrote the manuscript. S. Frölke and B. Nemeth, designed the study, reviewed the data analysis and intellectually reviewed the manuscript. C. Ortiz, C. Nery, D. Baumfeld designed the study and intellectually reviewed the manuscript. S. Rezende and S. C. Cannegieter designed the study, reviewed the data analysis, and intellectually reviewed the manuscript.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Federal University of Minas Gerais, Brazil.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent to publish

Not applicable.

Acknowledgments

The authors thank Marco Tulio Costa, João de Carvalho Neto, Gabriel Khazen, Santiago Guerrero, Cesar de Cesar Netto, François Linz, Yasuhiro Tanaka, Mandeep Dhillon and Anthony Cadden for their support and effort to spread this Survey to foot and ankle surgeons around the world. We also thank AOFAS Research Committee for their contributions during the approval process. Finally, we thank ISTH, especially Shannon Brooks and her team, for providing support for inserting the questionnaire in the ISTH RedCap.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1053/j.jfas.2023.08.014.

References

1. Ahmad J, Lynch M-K, Maltenfort M. Incidence and risk factors of venous thromboembolism after orthopaedic foot and ankle surgery. Foot Ankle Spec 2017;10:449–454.
2. Calder JDF, Freeman R, Domeij-Arverud E, van Dijk CN, Ackermann PW. Meta-analysis and suggested guidelines for prevention of venous thromboembolism (VTE) in foot and ankle surgery. Knee Surg Sports Traumatol Arthrosc 2016;24:1409–1420.
3. Huntley SR, Abyar E, Lehtonen EJ, Patel HA, Naranje S, Shah A. Incidence of and risk factors for venous thromboembolism after foot and ankle surgery. Foot Ankle Spec 2018;5. 193864001876974–10.
4. Makhdom AM, Cota A, Saran N, Chaytor R. Incidence of symptomatic deep venous thrombosis after Achilles tendon rupture. J Foot Ankle Surg 2013;52:584–587.
5. Pedersen MH, Wahlsten LR, Grønborg H, Gislason GH, Petersen MM, Bonde AN. Symptomatic venous thromboembolism after Achilles tendon rupture: a nationwide Danish cohort study of 28,546 patients with Achilles tendon rupture. Am J Sports Med 2019;47:363546519876054.
6. Richey JM, Weintraub MLR, Schuberth JM. Incidence and risk factors of symptomatic venous thromboembolism following foot and ankle surgery. Foot Ankle Int 2019;40:98–104.
7. Chien BY, Dixon T, Guss D, DiGiovanni C. Venous thromboembolism disease prophylaxis in foot and ankle surgery. Orthop Clin North Am 2018;49:265–276.
8. Prince RM III, Lubberts B, Buda M, Guss D, DiGiovanni CW. Symptomatic venous thromboembolism after non-operatively treated foot or ankle injury. J Orthop Res 2019;37:190–196.
9. Carr P, Ehredt DJ, Dawoodian A. Prevention of deep venous thromboembolism in foot and ankle surgery. Clin Podiatr Med Surg 2019;36:21–35.
10. Delegates* TI-VF & A. Recommendations from the ICM-VTE: foot & ankle. J Bone Joint Surg Am 2022;104(suppl 1):163–175.
11. Fleischer AE, Abicht BP, Baker JR, Boffeli TJ, Jupiter DC, Schade VL. American college of foot and ankle surgeons' clinical consensus statement: risk, prevention, and diagnosis of venous thromboembolism disease in foot and ankle surgery and injuries requiring immobilization. J Foot Ankle Surg 2015;54:497–507.
12. Chao J. Deep vein thrombosis in foot and ankle surgery. Orthop Clin North Am 2016;47:471–475.
13. Jacobs JJ, Mont MA, Bozic KJ, Valle CJD, Goodman SB, Lewis CG, Yates ACJ, Boggio LN, Watters WC, Turkelson CM, Wies JL, Sluka P, Hitchcock K. American Academy of Orthopaedic Surgeons clinical practice guideline on: preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty. J Bone Joint Surg Am 2012;94:746–747.
14. Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, Ortel TL, Pauker SG, Colwell CW. *Prevention of VTE in Orthopedic Surgery Patients: Antithrombotic Therapy and Prevention of Thrombosis*. 9th ed., American College of Chest Physicians Evidence-Based Clinical Practice Guidelines, 2012.
15. Kearon C, Akl EA, Ornelas J, Blaivas A, Jimenez D, Bounameaux H, Huisman M, King CS, Morris TA, Sood N, Stevens SM, Vintch JRE, Wells P, Woller SC, Moores L. *CHEST Guideline and Expert Panel Report*. 20162016.
16. van Adrichem RA, van Oosten JP, Cannegieter SC, Schipper IB, Nelissen RGHH. Thromboprophylaxis for lower leg cast immobilisation and knee arthroscopy: a survey study. Neth J Med 2015;73:23–29.
17. Batra S, Kurup H, Gul A, Andrew JG. Thromboprophylaxis following cast immobilisation for lower limb injuries—survey of current practice in United Kingdom. Injury 2006;37:813–817.
18. Gadgil A, Thomas RH. Current trends in thromboprophylaxis in surgery of the foot and ankle. Foot Ankle Int 2007;28:1069–1073.
19. Iqbal HJ, Dahab R, Barnes S. UK national survey of venous thromboembolism prophylaxis in ankle fracture patients treated with plaster casts. Foot Ankle Surg 2012;18:157–159.
20. Shah K, Thevendran G, Younger A, Pinney SJ. Deep-vein thrombosis prophylaxis in foot and ankle surgery: what is the current state of practice? Foot Ankle Spec 2015;8:101–106.
21. Testroote M, Morrenhof W, Janzing H. Prevention of venous thromboembolism in patients with below-knee immobilisation of the leg–survey of current practice in The Netherlands. Acta Chir Belg 2011;111:32–35.
22. Weisman MHS, Holmes JR, Irwin TA, Talusan PG. Venous thromboembolic prophylaxis in foot and ankle surgery: a review of current literature and practice. Foot Ankle Spec 2017;10:343–351.
23. Wolf JM, DiGiovanni CW. A survey of orthopedic surgeons regarding DVT prophylaxis in foot and ankle trauma surgery. Orthopedics 2004;27:504–508.
24. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, McLeod L, Delacqua G, Delacqua F, Kirby J, Duda SN; Consortium on behalf of the REDCap. The REDCap consortium: building an international community of software platform partners. J Biomed Inform 2019;95:103208.
25. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42:377–381.
26. AOFAS. Position statement: the use of venous thromboembolic disease prophylaxis in foot and ankle surgery [Internet]., 2020.
27. Felcher AH, Mularski RA, Mosen DM, Kimes TM, DeLoughery TG, Laxson SE. Incidence and risk factors for venous thromboembolic disease in podiatric surgery. Chest 2009;135:917–922.
28. Blanco JA, Slater G, Mangwani J. A prospective cohort study of symptomatic venous thromboembolic events in foot and ankle trauma: the need for stratification in thromboprophylaxis? J Foot Ankle Surg 2018;57:484–488.
29. Hanslow SS, Grujic L, Slater HK, Chen D. Thromboembolic disease after foot and ankle surgery. Foot Ankle Int 2006;27:693–695.
30. Krauss ES, Segal A, Cronin M, Dengler N, Lesser ML, Ahn S, Caprini JA. Implementation and validation of the 2013 Caprini score for risk stratification of arthroplasty patients in the prevention of venous thrombosis. Clin Appl Thromb Hemost 2019;25:1076029619838066.
31. Nemeth B, Douillet D, le Cessie S, Penaloza A, Moumneh T, Roy P-M, Cannegieter S. Clinical risk assessment model to predict venous thromboembolism risk after immobilization for lower-limb trauma. EClinicalMedicine 2020;20:100270.
32. Delegates* TI-VG. Recommendations from the ICM-VTE: general. J Bone Joint Surg Am 2022;104(suppl 1):4–162.
33. Barbar S, Noventa F, Rossetto V, Ferrari A, Brandolin B, Perlati M, Bon ED, Tormene D, Pagnan A, Prandoni P. A risk assessment model for the identification of hospitalized medical patients at risk for venous thromboembolism: the Padua prediction score. J Thromb Haemost 2010;8:2450–2457.
34. Caprini JA. Thrombosis risk assessment as a guide to quality patient care. Dis Mon 2005;51:70–78.
35. Spyropoulos AC, Anderson FA, Fitzgerald G, Decousus H, Pini M, Chong BH, Zotz RB, Bergmann J-F, Tapson V, Froehlich JB, Monreal M, Merli GJ, Pavanello R, Turpie AGG, Nakamura M, Piovella F, Kakkar AK, Spencer FA; Improve Investigators. Predictive and associative models to identify hospitalized medical patients at risk for VTE. Chest 2011;140:706–714.
36. Dashe J, Parisien RL, Pina M, Giacomo AFD, Tornetta P III. Is the Caprini score predictive of venothromboembolism events in orthopaedic fracture patients? J Orthop Trauma 2019;33:269–275.
37. Schiff RL, Kahn SR, Shrier I, Strulovitch C, Hammouda W, Cohen E, Zukor D. Identifying orthopedic patients at high risk for venous thromboembolism despite thromboprophylaxis. Chest 2005;128:3364–3371.
38. Jameson SS, Rankin KS, Desira NL, James P, Muller SD, Reed MR, Rangan A. Pulmonary embolism following ankle fractures treated without an operation – an analysis using National Health Service data. Injury 2014;45:1256–1261.
39. Jørgensen PS, Warming T, Hansen K, Paltved C, Berg HV, Jensen R, Kirchhoff-Jensen R, Kjaer L, Kerbouche N, Leth-Espensen P, Narvestad E, Rasmussen SW, Sloth C, Tørholm C, Wille-Jørgensen P. Low molecular weight heparin (Innohep) as thromboprophylaxis in outpatients with a plaster cast: a venografic controlled study. Thromb Res 2002;105:477–480.
40. Kock HJ, Schmit-Neuerburg KP, Hanke J, Rudofsky G, Hirche H. Thromboprophylaxis with low-molecular-weight heparin in outpatients with plaster-cast immobilisation of the leg. Lancet (London, England) 1995;346:459–461.
41. Lapidus LJ, Ponzer S, Elvin A, Levander C, Lärfars G, Rosfors S, Bri ED. Prolonged thromboprophylaxis with Dalteparin during immobilization after ankle fracture surgery: a randomized placebo-controlled, double-blind study. Acta Orthop 2007;78:528–535.
42. Lassen MR, Ageno W, Borris LC, Lieberman JR, Rosencher N, Bandel TJ, Misselwitz F, Turpie AGG; for the RECORD3 Investigators. Rivaroxaban versus enoxaparin for thromboprophylaxis after total knee arthroplasty. N Engl J Med 2008;358:2776–2786.
43. Pelet S, Roger M-E, Belzile EL, Bouchard M. The incidence of thromboembolic events in surgically treated ankle fracture. J Bone Joint Surg Am 2012;94:502–506.