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Special Article

Surgical management for ankle arthropathy in patients with hemophilia and other congenital coagulation disorders

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Abstract

Objective: Compare the surgical treatment options available in our institution and the postoperative outcomes during follow-up. Additionally, assess patient's perception of their condition and its progression.

Methods: This descriptive observational study is a case series with a narrative literature review. All patients who met the inclusion and exclusion criteria and received surgical management for ankle arthropathy due to ankle hemarthrosis between 1999 and 2022 at Hospital San José in Bogotá were included. A perception survey was conducted via teleconsultation to evaluate pain control, functional impact, and capacity for daily activities.

Results: Fifteen patients were included in the study, 13 male (86.7%). The mean age at the time of surgical intervention was 33 years (range 25–68). Among the patients, eight (53.3%) were diagnosed with Hemophilia A, four (26.7%) with Hemophilia B, two with Von Willebrand disease (13.3%), and one (6.7%) with Factor VII deficiency. The most common surgical intervention was ankle arthroscopy, with nine cases (50%). No infectious or intraoperative complications were documented, but one case of Hemophilic Pseudotumor developed late. The mean follow-up time was 87.7 months (IQR 60–105, SD 56.17). All patients reported improved pain and resumed their daily activities after the surgical intervention.

Conclusion: Surgical management, regardless of the technique used (joint preservation or sacrifice), had a positive impact on patients by reducing pain after conservative management failure and allowing them to regain their daily activities, improving their quality of life.

Level of Evidence IV; Therapeutic studies - investigating the results of treatment; Case series.

Keywords: Hemophilia; Hemarthrosis; Ankle; Arthropathy; Arthrodesis.

Introduction

Congenital coagulation factor deficiencies constitute a group of pathologies in which the coagulation process cannot properly develop, leading to potential spontaneous bleeding[1-3]. Congenital coagulation factor deficiencies found in our patients, such as Hemophilia A and B, Von Willebrand disease, and rare coagulation defects like Factor VII deficiency, were included in our study.

Worldwide, the prevalence of Hemophilia A is 21 cases per 100,000 inhabitants, and Hemophilia B is 4 cases per 100,000 inhabitants[3]. In Colombia, there are specialized care pathways for orphan diseases, and thus far, there have been 2,262 cases of Hemophilia A, 507 cases of Hemophilia B, 1,868 cases of Von Willebrand disease, and 139 cases of Factor VII deficiency. Chronic arthropathy is the most common complication related to Hemophilia, with 37.5% in the national registry. This condition leads to limited mobility of the limbs, making it the leading cause of disability in patients with hemophilic arthropathy, accounting for 45.28%[4].

The tibiotalar joint is one of the most affected by these pathologies from an early age, and its dysfunction

Study performed at the Fundación Universitaria de Ciencias de la Salud - Hospital de San José, Bogotá, Colombia.

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significantly impacts gait biomechanics[5] and the quality of life of patients. However, surgical interventions to address joint-related clinical manifestations are rare in our country, considering the high cost of the procedure and the limited availability of specialized centers that can offer comprehensive management.

Considering that Hospital San José in Bogotá currently operates under the European Foundation for Quality Management (EFQM) model as a High-Performance Clinical Unit (UCAD) in the management of Hemophilia and other congenital coagulation factor deficiencies, the hospital is recognized as a national reference center for complex medical and surgical management of these patients[6]. It has a multidisciplinary team, coagulation factors, and other hemostatic agents that contribute to the success of surgical interventions and subsequent rehabilitation.

This study shows our experience in the surgical management of ankle arthropathy due to hemarthrosis, collecting institutional information from the past 24 years and comparing it with the current literature worldwide.

A narrative review of the available literature is conducted to compare the surgical treatment options available in our institution and the postoperative outcomes during follow-up. Additionally, a survey was administered to assess the patient's perception of their condition and its progression.

Methods

This descriptive observational study is a case series with a narrative literature review. All patients with congenital coagulation deficiencies such as Hemophilia A and B, Von Willebrand disease, and rare coagulation defects, submitted to surgical management for ankle hemarthrosis-related arthropathy and traumatic causes in patients with a history of coagulation factor deficiencies between 1999 and 2022 at Hospital San Jose in Bogotá were included. Information regarding the patient's demographic characteristics and outcomes was obtained from the review of medical records.

A perception survey was used to assess the current patient status and indirectly evaluate the surgical treatment outcome measured by functionality and pain control (Table 1). The questions were previously reviewed and endorsed by three experts, consisting of two orthopedists and one hematologist.

Selection criteria

Inclusion

- Patients diagnosed with Hemophilia A and B or other congenital coagulation deficiencies who received surgical management for ankle hemarthrosis-related arthropathy.
- Patients treated since 1999 with available follow-up medical records.

Exclusion

- Loss of follow-up.
- Patients under 18 years old.

Due to the nature of the study, a descriptive analysis of the patient's information was performed. For quantitative variables, measures of central tendency (mean, median), dispersion (standard deviation), and position (percentiles) were calculated. Frequency measures and tables with percentage distribution were generated for qualitative variables, including the data collected from the perception survey. The information was processed and analyzed using the statistical software STATA version 17 (FUCS license).

Furthermore, a narrative literature review was conducted in May 2023 on PubMed and Cochrane databases to find literature reporting surgical management outcomes for ankle hemarthrosis-related arthropathy. The following descriptors and Mesh terms were used: "ankle," "coagulopathy," "hemophilia," "von Willebrand," and "surgery," combined in the following search equations: ("Ankle" AND "Hemophilia" AND "von Willebrand" AND "surgery") (("Hemophilia A" OR "Hemophilia B") OR "von Willebrand Diseases" AND "Ankle" AND "Surgery"). Studies published up to that date were selected based on their title and abstract, documenting the performance of surgical management and its results measured in intraoperative bleeding, length of hospital stay, pain control, and patient satisfaction.

The strategy search resulted in 217 articles. In the first filter by abstract, 48 articles were selected for full-text review. Additionally, the references of interest were reviewed to find additional articles (3 articles), resulting in 51 articles included in the narrative review (Figure 1).

Systematic reviews, case series, cohort studies, or case reports that reported the abovementioned variables were considered. To facilitate evaluation, they were subdivided into categories depending on the evaluated surgical procedure (total ankle replacement, arthroscopy, arthrodesis, and joint distraction).

Results

Fifteen patients met the inclusion criteria, and the information was obtained from the medical records. Of

Table 1. Follow-up survey

Question	Answer Choices
Did you perceive improvement in pain with surgical treatment?	Got worse, Stayed the same, Improved
Do you need external support?	Yes, No
Do you require prescribed footwear or orthotic insoles?	Yes, No
Do you have difficulty walking on uneven ground?	Yes, No
Do you limp while walking?	Yes, No
Have you been able to resume your daily activities?	Yes, No
After your surgery, did you return to your previous work activity?	Yes, No
Are you able to exercise or participate in sports activities?	Yes, No

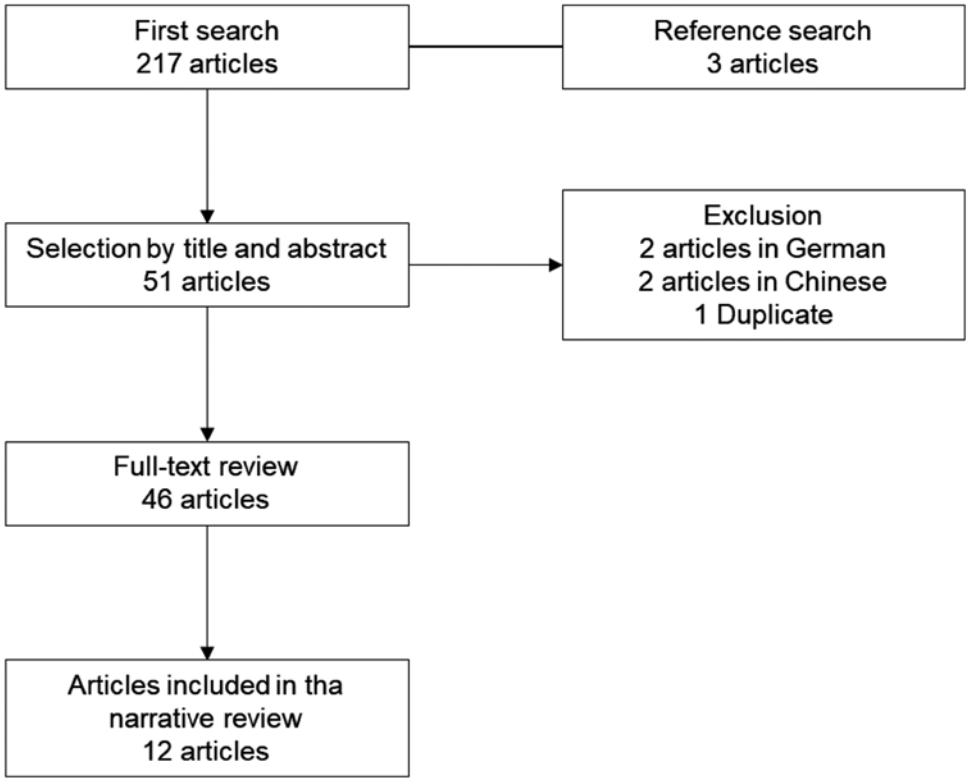

Figure 1. Flowchart of article selection.

these patients, two were women (13.3%), with a mean age at the time of surgical intervention of 33 years (range 25–68). Sociodemographic data are described in Table 1.

Among the patients, eight (53.3%) were diagnosed with Hemophilia A, four (26.7%) with Hemophilia B, two with Von Willebrand disease (13.3%), and one (6.7%) with Factor VII deficiency. Regarding the severity of Hemophilia, patients with severe Hemophilia accounted for 66.7% (n = 8), followed by moderate 16.7% (n = 2), and mild 16.7% (n = 2). Inhibitors in the preoperative were documented in three patients (27.27%): two with a low response and one with high-response inhibitors who required an immunotolerance management protocol with successful elimination of the inhibitor before the surgical intervention (Table 2).

The associated comorbidities were divided into four groups: 1) infectious, such as treated Hepatitis C; 2) one patient with cardiovascular disease (hypertension); 3) obesity, which was not recorded in any patient at the time of surgical procedure; and 4) other comorbidities included all active diseases being treated unrelated to increased risk during the perioperative period, such as kidney stones, benign prostatic hyperplasia, fatty liver, or gallstones (Table 2).

Regarding the surgical procedures, 19 surgeries in 15 patients were performed; three patients were submitted to bilateral surgery, and one patient initially submitted to ankle arthroscopy with synovectomy and osteophyte resection, but due to persistent pain, the patient ultimately was submitted to tibiotalocalcaneal (TTC) fusion. The most frequent surgical intervention was ankle arthroscopy with synovectomy and osteophyte resection in nine cases (47.37%), followed by ankle fusion in five cases (26.31%), all being TTC. The least performed procedures were ankle joint replacement in two cases (10.52%). The remaining were Achilles tendon lengthening in one case (5.26%), supramalleolar osteotomy in the context of tibiotalar ankylosis with angular deformity in one case (5.26%), lateral ligament reconstruction in one case (5.26%) (Figure 2). Pain management was the most frequent indication for surgery, accounting for 84.21% (n = 16) (Figure 3). One patient underwent surgical management due to chronic lateral instability secondary to trauma, and the main indication for surgery was instability control rather than hemarthrosis or intra-articular bleeding-related arthropathy. Also, it was observed if patients were submitted to surgeries in other joints due to the same arthropathy, four patients (26.67%) were operated on in other joints, all with severe Hemophilia. Figures 4, 5, and 6 show radiographs of the procedures performed.

Intraoperative bleeding was measured using surgical and anesthesiologist records. The mean bleeding for all procedures was 65 ml (median 50 ml, IQR 50–75 ml), and no cases required blood transfusion (Table 3).

Table 2. Demographic characteristics

Characteristics n = 15	
Mean age at the time of surgery	33 (25–68)
Sex, n (%)	
Men	13 (86.7%)
Women	2 (3.3%)
City of residence, n (%)	
Bogotá	8 (53.3%)
Facatativá	1 (6.67%)
Combita	1 (6.67%)
Manizales	1 (6.67%)
Cajamarca	1 (6.67%)
Santa Marta	1 (6.67%)
Turbaco	1 (6.67%)
Ciudad de México	1 (6.67%)
Socioeconomic stratum, n (%)	
1	1 (6.67%)
2	5 (33.33%)
3	5 (33.33%)
4	4 (26.67%)
5	0 (0.0)
6	0 (0.0)
Educational level, n (%)	
Elementary	1 (6.67%)
High School	6 (40%)
Technical	2 (13.33%)
University	4 (26.67%)
Postgraduate	2 (13.33%)
Occupation, n (%)	
Employee	7 (46.67%)
Student	2 (13.33%)
Unemployed	2 (13.33%)
Retire	4 (26.67%)
Type of coagulopathy, n (%)	
Hemophilia A	8 (53.3%)
Hemophilia B	4 (26.6%)
Von Willebrand type 1	1 (6.67%)
Von Willebrand type 3	1 (6.67%)
Factor VII deficiency	1 (6.67%)
Severity of hemophilia, n (%)	
Mild	2 (16.67%)
Moderate	2 (16.67%)
Severe	8 (66.67%)
Presurgical inhibitors, n (%)	
Yes	3 (25%)
No	9 (75%)
Comorbidities, n (%)	
Infectious	3 (20%)
Obesity	0 (0.0%)
Cardiovascular	1 (6.67%)
Other	5 (3.33%)
None	9 (60%)

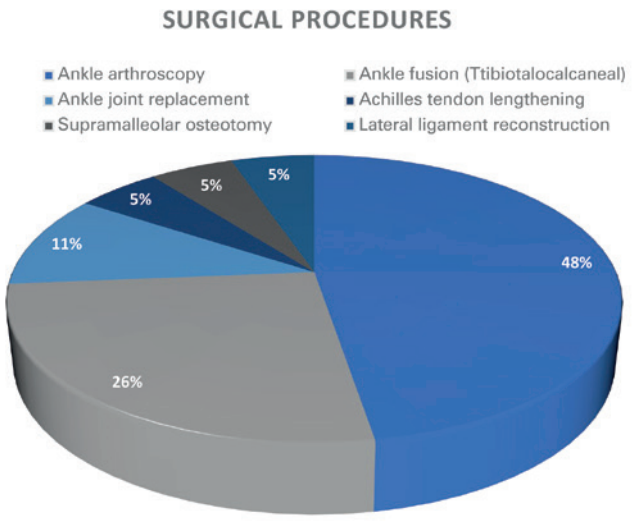

Figure 2. Surgical Procedures.

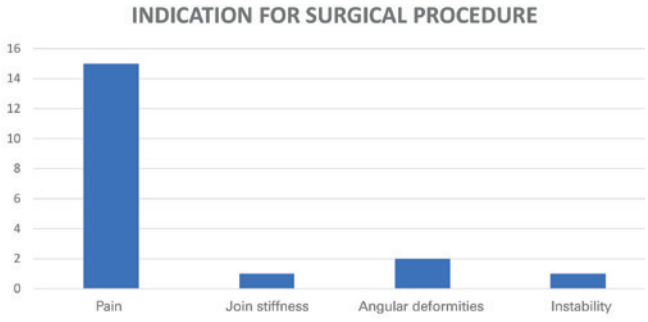

Figure 3. Indication for surgical procedure.

Length of hospital stay was measured in days from admission to postoperative discharge; the mean stay for all procedures was 13.25 days (median 11 days, IQR 9.5–14.5). One patient required a 31-day hospital stay due to ankle fusion and knee joint replacement performed in the same surgical procedure (Figure 7).

No surgical site infections were documented within the first 30 postoperative days for the 19 surgical procedures. However, a Hemophilic pseudotumor related to the arthroscopy portal was discovered four years after the intervention.

A perception survey was conducted with 15 patients, with a mean follow-up time of 87.7 months (IQR 60–105, SD 56.17). All patients reported improvement in pain after surgery. Only two patients (13.33%) needed orthotic devices or external support, and six (40%) reported difficulty walking on uneven surfaces or limping during walking. All patients resumed their daily activities, but three (20%) were unable to return to their previous work activity or engage in sports.

Regarding the narrative review, the search was conducted on PubMed and Cochrane databases, resulting in 217 articles. After an initial filter by title, abstract, and cross-references,

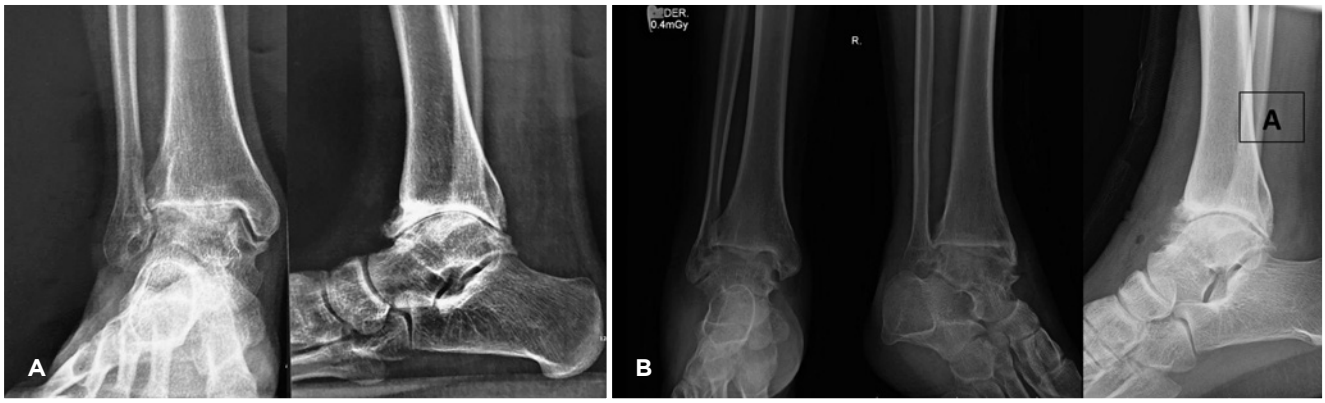

Figure 4. Right ankle arthroscopy (A) Preoperative AP and lateral radiographs of patients with Von Willebrand type 3 (B) Postoperative AP, oblique, and lateral radiograph.

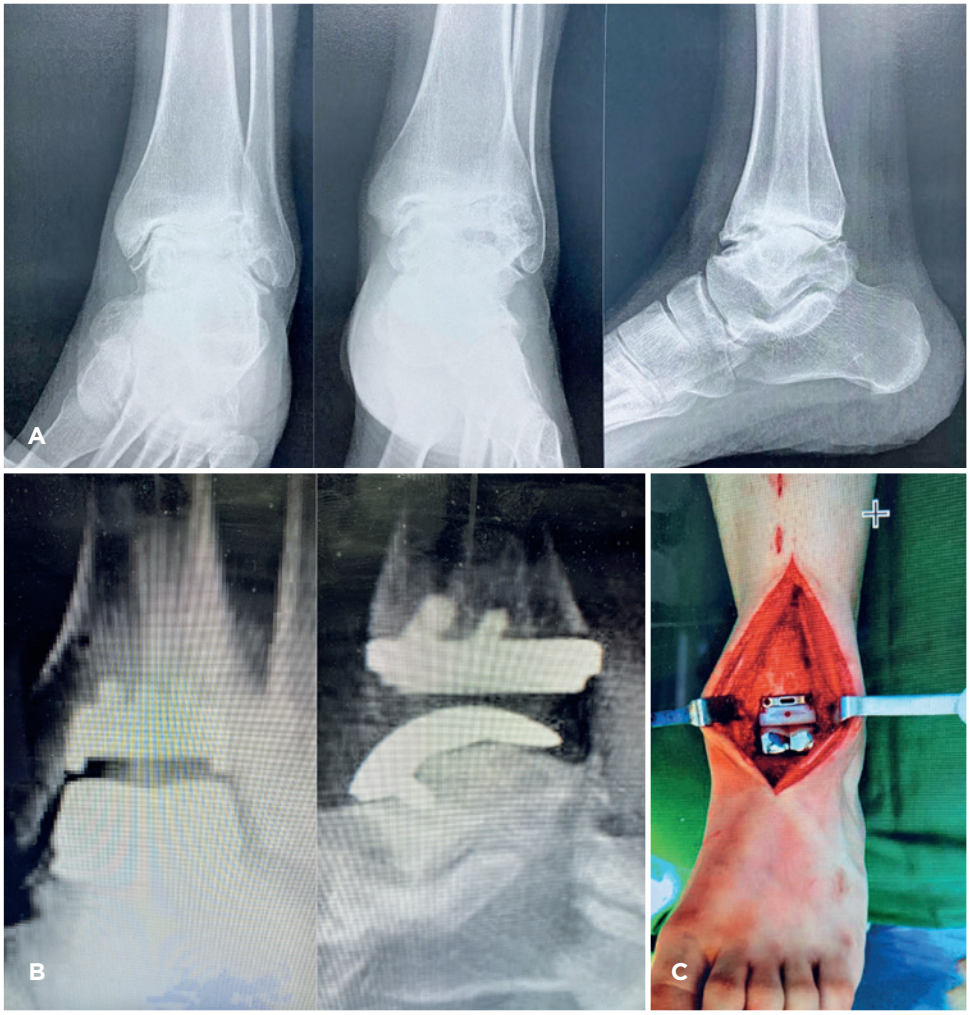

Figure 5. Right ankle arthroplasty in a patient with severe Hemophilia B. (A) Preoperative AP, oblique, and lateral radiographs. (B) Postoperative radiograph. (C) Intraoperative image.

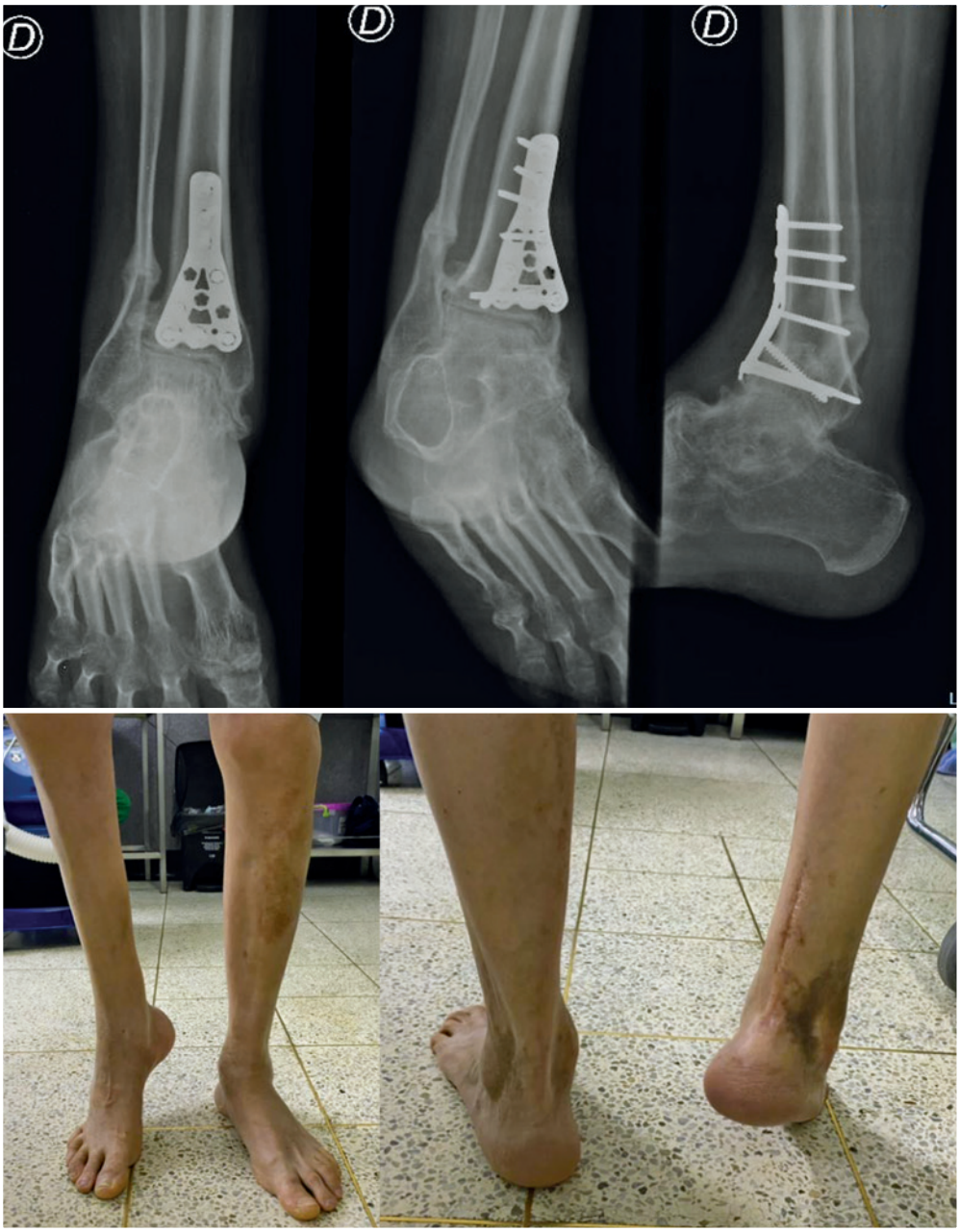

Figure 6. Left supramalleolar osteotomy in a patient with severe Hemophilia A with ankle ankylosis and proximal recurvatum deformity.

Table 3. Intraoperative bleeding (ml)

Surgical Procedures	Mean	SD	Median	IQR
Ankle arthroscopy	52.7	8.33	50	50–50
Ankle arthrodesis	87	24.39	100	75–100
Total ankle replacement	75	35.35	75	50–100
Lateral ligament reconstruction	75	-	75	75–75
Achilles tendon lengthening	50	-	50	50–50
Total	65.83	22.32	50	50–75

IQR: Interquartile range.

51 articles were obtained. In a second filter, four articles were excluded due to the language of publication (2 German, 2 Chinese) and one duplicate article, leaving 46 articles for full-text review. Finally, 12 articles that met the selection criteria were selected and used in this review.

In the literature, there are different case series with small cohorts for various surgical procedures, with ankle arthroplasty generating the most interest in functional outcomes (Table 4). Barg et al.[7] reported improvement in

Figure 7. Length of hospital stay by surgical procedure.

Table 4. Functional outcomes of each study

Author (year)	# Patient (# Surgeries)	Surgery	VAS pre and post	Surgical site infections	Hemostatic complications
Barg (2010)	8 (10)	Arthroplasty	7.1–0.8 (p < 0.001)	0	-
Kotela (2015)	3 (3)	Artrhoplasty	7.1–0.8	-	-
Barg (2015)	34 (36)	Arthroplasty	8.2–0.9 (p < 0.001)	-	-
Preis (2017)	14 (14)	Arthroplasty	8.5–1.3 (p < 0.001)	0	-
Bluth (2013)	45 (45)	Arthrodesis	-	1	-
Wang (2020)	14 (14)	Arthrodesis	7.0–1.4 (p < 0.001)	2	-
Ahn (2020)	29 (16 Arthroplasty – 13 Arthrodesis)	Arthroplasty vs. Arthrodesis	5.5–0.9 (p < 0.001)	-	2 (Intra-articular hematoma)
Mussawy (2021)	19 (10 Arthroplasty – 9 Arthrodesis)	Artrhoplasty vs Arthrodesis	Arthroplasty 7.6–2.5 Artrodesis 7.4–0.7	2 (Arthroplasty)	-
Rodriguez-Merchan (2014)	23 (24)	Arthroscopy	6.6–2.3	0	2 (Intra-articular hematoma)
Yasui (2017)	8 (8)	Arthroscopy	5.7–2.2	0	0
Pulles (2015)	3 (3)	Articular distraction	6.5–1.2	2	-
Wallny (2006)	23 (23)	Achilles tendon lengthening	-	-	-

VAS: Visual analog scale.

preoperative pain from 7.1 (range 4–9) to 0.8 (range 0–3) ($p < 0.001$) in eight patients (10 ankles) with a previous diagnosis of Hemophilia A, all satisfied with the surgical procedure, and no surgical site infections were reported. Kotela et al.[8], with a cohort series of three cases submitted to ankle joint replacement, reported a mean preoperative pain score of 7.1, which improved to 0.8 postoperatively. Once again, Barg et al.[9] included 34 patients (36 ankles), 20 patients with Von Willebrand disease, all patients were submitted to joint replacement. The mean preoperative pain score was 8.2 (range 7–10), which decreased to 0.9 (range 0–4) ($p < 0.001$) postoperatively. In 2017, Preis et al.[10] presented a series of 14 cases, including five patients submitted to conversion from arthrodesis to total ankle arthroplasty. They reported improvement in preoperative pain from 8.5 (range 8–10) to 1.3 postoperatively (range 0–6) ($p < 0.001$) and did not report deep infections.

Tibiotalocalcaneal or rearfoot fusion has been considered the gold standard treatment due to predictable long-term outcomes. Bluth et al.[11] included 45 patients over 39 years (1971–2010). All patients underwent surgical management with tibiotalar and/or subtalar fusion, with good results. Complete resolution of pain was achieved in 75% of patients, while the remaining experienced mild pain. Complications included deep infection (osteomyelitis) in one patient and non-union in 18.7% of cases. Another series reported by Wang et al.[12] included 14 patients, 12 with Hemophilia A and two with Hemophilia B, with a mean age of 40.7 years. The patients were submitted to ankle fusion with an Ilizarov external fixator. Preoperatively, the mean pain score was 7.0 (range 6–8), improving to 1.4 (range 0–3) ($p < 0.001$) postoperatively. Two cases experienced superficial infection at the pin insertion sites, but no deep infections were reported.

Comparisons have been made between ankle fusion and arthroplasty in patients with hemophilia, such as the case series reported by Ahn et al.[13] with 29 patients, where 16 were submitted to total ankle replacement and 13 fusion. In the replacement group, the mean preoperative pain score was 6.2 (range 3–10), with a postoperative improvement to 0.8 (range 0–5) ($p = 0.002$). For the fusion group, the preoperative mean pain score was 4.5 (range 2–10), improving to 0.7 (range 0–3) ($p = 0.005$) postoperatively. There were no statistically significant differences between the groups, as both improved pain in the postoperative outcome. For the management of end-stage joint disease, Mussawy et al.[14] presented nine patients submitted to fusion with a mean age of 35.7 years and ten patients submitted to total ankle arthroplasty with a mean age of 49.4 years. In the fusion group, pain decreased from 7.4 in the preoperative to 0.7 postoperatively ($p < 0.001$), and for the arthroplasty group, it was 7.6 in the preoperative to 2.5 postoperatively ($p < 0.001$); despite a statistically significant difference in favor of ankle arthrodesis ($p = 0.013$), clinically all patients expressed satisfaction with the results and proposed both therapeutic options. However, more complications were reported, such as deep infection, in the total ankle arthroplasty group ($n = 2$). For our cohort, in general, there was a decrease from 5.5 (range 2–10) in the preoperative to 0.9 (range 0–5) ($p < 0.001$) postoperatively.

On the other hand, arthroscopy is one of the most used tools nowadays due to its less invasive and joint preservation qualities and favorable results. An example is the cohort study by Rodriguez-Merchan et al.[15], with 23 patients submitted to 24 ankle arthroscopies for debridement and synovectomy with osteophyte resection. Of these patients, 22 had Hemophilia A, and one had Hemophilia B, with a mean age of 25.3 years (range 21–36). The mean preoperative pain was 6.6 (range 6–9), decreasing to 2.3 (range 1–3) postoperatively. Good clinical results and patient satisfaction were achieved in 22 cases (91.7%), while two patients experienced postoperative hemarthrosis requiring joint aspiration, and three patients required a second procedure with ankle arthrodesis due to persistent symptoms. Another more recent case series is described by Yasui et al.[16], with eight patients submitted to arthroscopic management, with a mean age of 29 years (range 18–54 years). The mean preoperative pain was 5.7, decreasing to 2.2 postoperatively. No hematological complications or surgical site infections were reported. In our experience, most patients were submitted to arthroscopic management, including synovectomy and osteophyte resection. In one patient, arthroscopy was used as a preparation method for ankle arthroscopic fusion, making it a useful therapeutic option for joint preservation or sacrifice.

Finally, alternative treatment options used less frequently have been described, such as joint distraction using the Ilizarov external fixator, reported by Van Vulpen et al.[17], showing their experience with three patients aged 22–33 years and followed up for 12 months. They observed a decrease in preoperative pain from 6.5 to a mean value of 1.2 at the end of the postoperative follow-up. Two patients experienced superficial infections successfully resolved with oral antibiotic therapy. Another procedure is Achilles tendon lengthening for the management of equinus deformities; Wallny et al.[18] presented 23 patients with a mean follow-up of 13 years (range 1–24), where 12 patients showed improvement in range of motion, ten remained unchanged, and one worsened. Therefore, they recommend reserving lengthening as a standalone procedure for equinus deformities less than 30°.

No postoperative hemorrhagic complications were documented, unlike some cohorts where postoperative intraarticular hemorrhages were reported. These results highlight the importance of joint management by hematology during the pre-and immediate postoperative period, multidisciplinary care, and the systematic use of a tourniquet during surgery. No surgical site infections were recorded in any patient.

The collected data from the selected articles are summarized in Figure 1.

Discussion

Congenital coagulation deficiencies such as Hemophilia A and B, Von Willebrand disease, and other rare coagulation defects like factor VII deficiency are uncommon pathologies

that, in severe cases, can lead to joint degeneration and functional limitation, primarily affecting the hip, knee, elbow, and ankle[19]. Numerous publications are on managing hip and knee arthropathy, but literature on the tibiotalar joint is scarce.

The number of available patients to evaluate the surgical management of ankle arthropathy due to hemarthrosis is limited. In our study, 15 patients were included, including patients with Hemophilia A and B, Von Willebrand disease, and factor VII deficiency, whose surgical management needs were determined over time based on radiological findings related to tibiotalar degenerative changes and clinical assessment, which involves not only pain qualities but also a range of motion and angular deformities. Therefore, one of the three available surgical management options (arthroscopy, arthrodesis, and arthroplasty) was chosen alone or combined with other procedures (ligament reconstruction, periarticular osteotomies, or Achilles tendon lengthening).

In our case series, those with severe pathologies may require surgical interventions in more than one joint, consistent with what has been described in the literature[19,20].

Despite the small number of patients, an improvement in pain and a return to daily activities were evident, similar to what has been reported in different cohorts found in the literature review, thus impacting the quality of life of a vulnerable population.

Conclusion

Regardless of the technique used, surgical management has a good clinical response, decreasing pain in patients after conservative management failure, translating into patient satisfaction. The most frequent surgical procedure was arthroscopy with synovectomy and osteophyte resection, in line with a trend towards joint preservation techniques, differing from more aggressive procedures such as joint replacement and arthrodesis for older patients. However, there is no consensus on the first-choice therapeutic option for each patient. Therefore, in young patients with a preserved range of motion and Takakura 0-I-II degenerative changes, the arthroscopic option would be considered after medical management failure, with osteophyte resection and synovectomy, possibly requiring additional soft tissue management and realignment osteotomies. But in cases where it is not possible to consider a conservative approach, we can consider arthrodesis in patients with Takakura III-IV tibiotalar arthritis with angular deformity of the hindfoot and loss of range of motion, while arthroplasty is considered in patients who preserve some tibiotalar mobility, in addition to maintaining alignment.

The main limitation of our study is the small sample, which makes it difficult to gather a more homogeneous group to determine if a certain surgical procedure is superior to others.

Further studies are also needed to objectively assess the impact of surgical intervention using pre-and postoperative functional scales.

More studies are necessary to reflect the impact of implementing public health policies, increased access and coverage of services, and primary prophylaxis, and whether these measures reduce sequelae in the adult population.

Authors' contributions: Each author contributed individually and significantly to the development of this article: RRC *(https://orcid.org/0000-002-3817-0609) Conceived and planned the activities that led to the study; CCD *(https://orcid.org/0000-0002-8049-3903) Interpreted the results of the study, participated in the review process and approved the final version; MHST *(https://orcid.org/0000-0001-8752-7080) Conceived and planned the activities that led to the study; DODF *Interpreted the results of the study, participated in the review process and approved the final version. All authors read and approved the final manuscript.*ORCID (Open Researcher and Contributor ID).

References

1. Rodríguez Ciodaro R, Pardo Laverde CE, Guerrero Forero Álvaro S, Solano Trujillo MH, Caicedo Donoso C, Hernández Arango N. Hemophilic pseudotumor of the ankle: a case report. J Foot Ankle. 2021;15(3):278-8.
2. Brown DL. Congenital bleeding disorders. Curr Probl Pediatr Adolesc Health Care. 2005;35(2):38-62.
3. Hemophilia [Internet]. eLearning Platform. [citado 25 de mayo de 2023]. Disponible from: https://elearning.wfh.org/elearning-centres/hemophilia/
4. Fondo colombiano de enfermedades de alto costo, Cuenta de alto costo (CAC). Situación de la hemofilia y otras coagulopatias en Colombia 2021; Bogotá D.C. 2022.
5. Lobet S, Detrembleur C, Francq B, Hermans C. Natural progression of blood-induced joint damage in patients with haemophilia: clinical relevance and reproducibility of three-dimensional gait analysis. Haemophilia. 2010;16(5):813-21.
6. Peña Castellanos ÁM, Solano Trujillo MH, Villamizar Gómez L. Medical management of patients with hemophilia a, b and von Willebrand disease who underwent surgery a sixteen year experience at Hospital de San José, Bogotá. Repert Med Cir. 2011;20(4):233-9.
7. Barg A, Elsner A, Hefti D, Hintermann B. Haemophilic arthropathy of the ankle treated by total ankle replacement: a case series. Haemophilia 2010;16(4):647-55.
8. Kotela A, Lorkowski J, Żbikowski P, Ambroziak P, Kucharzewski M, Kotela I. Total ankle arthroplasty in patients with inherited bleeding disorders. Haemophilia. 2015;21(3):e257-e9.
9. Barg A, Barg K, Wiewiorski M, Schneider SW, Wimmer MD, Wirtz

DC, et al. Total ankle replacement in patients with bleeding disorders. Orthopade. 2015;44(8):623-38.

10. Preis M, Bailey T, Jacxsens M, Barg A. Total ankle replacement in patients with haemophilic arthropathy: primary arthroplasty and conversion of painful ankle arthrodesis to arthroplasty. Haemophilia. 2017;23(4):e301-e9.
11. Bluth BE, Fong YJ, Houman JJ, Silva M, Luck JV Jr. Ankle fusion in patients with haemophilia. Haemophilia. 2013;19(3):432-7.
12. Wang S, Li Q, Zhang Z, Wang W, Li J, Liu L. Ankle arthrodesis for end-stage haemophilic ankle arthropathy using a Ilizarov method. Int Orthop. 2020;44(5):995-1001.
13. Ahn J, Yoo MC, Seo J, Park M, Jeong BO. Comparison of Total Ankle Arthroplasty and Ankle Arthrodesis in End-Stage Hemophilic Arthropathy. Foot Ankle Int. 2020;41(8):937-44.
14. Mussawy H, Kehrer M, Strahl A, Rolvien T, Hubert J, Beil FT, et al. Clinical and patient reported outcome in total ankle replacement compared to ankle fusion in end-stage haemophilic arthropathy. Haemophilia. 2021;27(6):e739-e46.
15. Rodriguez-Merchan EC, Gomez-Cardero P, Martinez-Lloreda Á, De La Corte-Rodriguez H, Jimenez-Yuste V. Arthroscopic debridement for ankle haemophilic arthropathy. Blood Coagul Fibrinolysis. 2015;26(3):279-81.
16. Yasui T, Hirose J, Ono K, Takedani H. Arthroscopic debridement for advanced haemophilic ankle arthropathy. Haemophilia. 2017;23(5):e479-e81.
17. van Vulpen L, Vogely HC, Roosendaal G, de Kleijn P, van Roermund P, Schutgens R, et al. SAT0548 First Prospective Results of Joint Distraction in Haemophilic Ankle Arthropathy. Ann Rheum Dis. 2015;74(Suppl 2):858-9.
18. Wallny T, Brackmann H, Kraft C, Nicolay C, Pennekamp P. Achilles tendon lengthening for ankle equinus deformity in hemophiliacs: 23 patients followed for 1-24 years. Acta Orthop. 2006;77(1):164-8.
19. Rodriguez-Merchan EC. Musculo-skeletal manifestations of haemophilia. Blood Rev. 2016;30(5):401-9.
20. Pulles AE, van Vulpen LFD, Lafeber FPJ. Artropatía hemofílica. In: Firestein GS, Budd RC, Gabriel SE, Koretzky GA, McInnes IB, O'Dell JR. Firestein y Kelley. Tratado de reumatología.11th ed. Barcelona, Espanha: Elsevier; 2021. p. 2115-26.