

CURRENT CONCEPTS REVIEW

The Current Role of Ankle Arthrodesis in Hemophilic Patients

E. Carlos Rodriguez-Merchan, MD, PhD¹*Research performed at Department of Orthopedic Surgery, "La Paz" University Hospital-IdiPaz, Madrid, Spain**Received: 14 March 2020**Accepted: 10 June 2020***Abstract**

There are several manners to take care of the hemophilic ankle in the initial phases of degeneration of the articular cartilage, in the event that hematologic prophylaxis is unsuccessful in accomplishing no bleeds. Some of these are nonoperative, with which management must start. These are Physical and Rehabilitation Medicine protocols and the utilization of orthoses (patellar tendon bearing). When these are unsuccessful, more aggressive types of treatment can be utilized, such as radiosynovectomy and some surgical operations (open or arthroscopic removal of anterior osteophyte of the distal part of the tibia, arthroscopic ankle debridement). Nonetheless, in the late phases of degeneration of the articular cartilage (advanced arthropathy), the solely options are surgical: ankle fusion or total ankle arthroplasty. The review of the literature has shown that the percentage of consolidation is between 90% and 100%, and that the percentage of postoperative infection is between 0% and 10%. When the Ilizarov external fixator is utilized for ankle fusion, the percentage of pin tract infection is around 14%. Ankle fusion is a secure surgical technique that meliorates articular pain and improves the quality of life of hemophilic patients.

Level of evidence: III**Keywords:** Ankle, Arthrodesis, Hemophilia indications, Results**Introduction**

In hemophilic patients, the ankle frequently suffers repetitive hemarthroses subsequent to a defect in one of the clotting factors: factor VIII (FVIII) in hemophilia A, or factor IX (FIX) in hemophilia B. There are a few methods to treat a hemophilic ankle in the initial phases of arthropathy (articular cartilage degeneration) when hematological prophylaxis is unsuccessful (1–9). Some of these are nonoperative, with which management should start: Physical and Rehabilitation Medicine protocols and the utilization of orthoses.

When the aforementioned treatments are unsuccessful, various aggressive types of management are possible, such as radiosynovectomy and some surgical interventions (open or arthroscopic excision of the anterior osteophyte of the distal tibia and arthroscopic debridement of the ankle). Nevertheless, in the last phases of cartilage degeneration (severe arthropathy)

the last resort is surgery, for which there are 2 options available: arthrodesis of the ankle or total ankle replacement [Figures 1; 2] (1–9).

In this article, the literature on ankle arthrodesis in patients with hemophilia will be reviewed.

Indications

In the initial phases of hemophilic arthropathy (articular cartilage degeneration) of the ankle, when hematological prophylaxis fails to prevent repetitive hemarthroses, chronic synovitis, and the onset of articular cartilage degeneration, other therapeutic measures need to be implemented. It is advisable to start with nonsurgical treatments, which include Physical and Rehabilitation Medicine and the utilization of orthoses (patellar tendon bearing). If these also are unsuccessful, a surgical procedure will be required. The first advisable procedure

Corresponding Author: E. Carlos Rodriguez-Merchan, Department of Orthopaedic Surgery, La Paz University Hospital-IdiPaz, Paseo de la Castellana 261, 28046-Madrid, Spain
Email: ecrmerchan@hotmail.com



THE ONLINE VERSION OF THIS ARTICLE
ABJS.MUMS.AC.IR

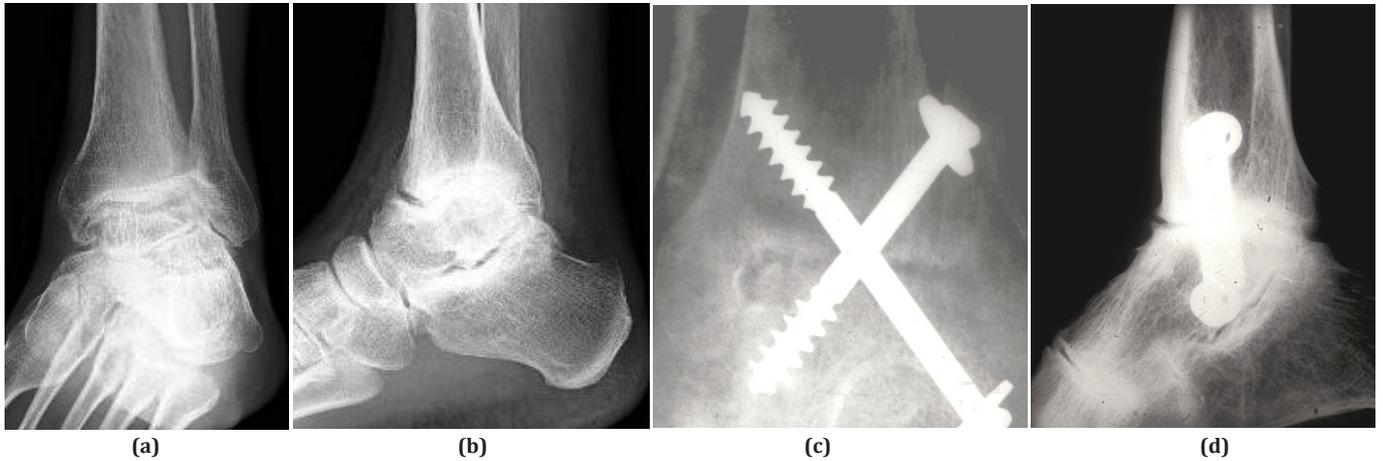


Figure 1 a-d. Tibiotalar arthrodesis performed with 2 crossed screws in very painful joint degeneration of the left ankle in an adult hemophilic patient. The result was satisfactory: (a) preoperative anteroposterior radiograph; (b) preoperative lateral image; (c) anteroposterior radiograph 3 months after arthrodesis; (d) lateral image 3 months after surgery.

is radiosynovectomy. Later, if radiosynovectomy also fails, we must use some surgical technique, such as open or arthroscopic removal of the osteophyte of the anterior part of the distal tibia or arthroscopic ankle debridement. However, in severe phases of cartilage degeneration (advanced arthropathy) the only alternatives with a chance of success are ankle arthrodesis or total ankle replacement [Figures 1, 2] (1-9).

When noninvasive treatment fails and minimally invasive procedures, such as radiosynovectomy, open or arthroscopic removal of osteophyte located in the anterior part of the distal tibia, and arthroscopic ankle debridement also are unsuccessful, ankle arthrodesis should be indicated.

The cases that can benefit from an ankle arthrodesis are those patients with intolerable pain and great functional

impairment despite having undergone all the previously mentioned noninvasive and minimally invasive treatments. The cases that may not benefit from an ankle arthrodesis are those with tolerable pain and mild to moderate functional impairment who can be controlled with noninvasive or minimally invasive treatments.

Hematological prophylaxis should be continued for life as a fundamental aspect of the management of hemophilic patients.

Main series published

In 1978, Houghton et al studied 7 hemophilic patients who experienced ankle arthrodesis over a 10-year period (1966-1976) (10). Follow-up was from 9 months to 8 years. The arthrodeses were stabilized by means of internal fixation. The surgical technique was not

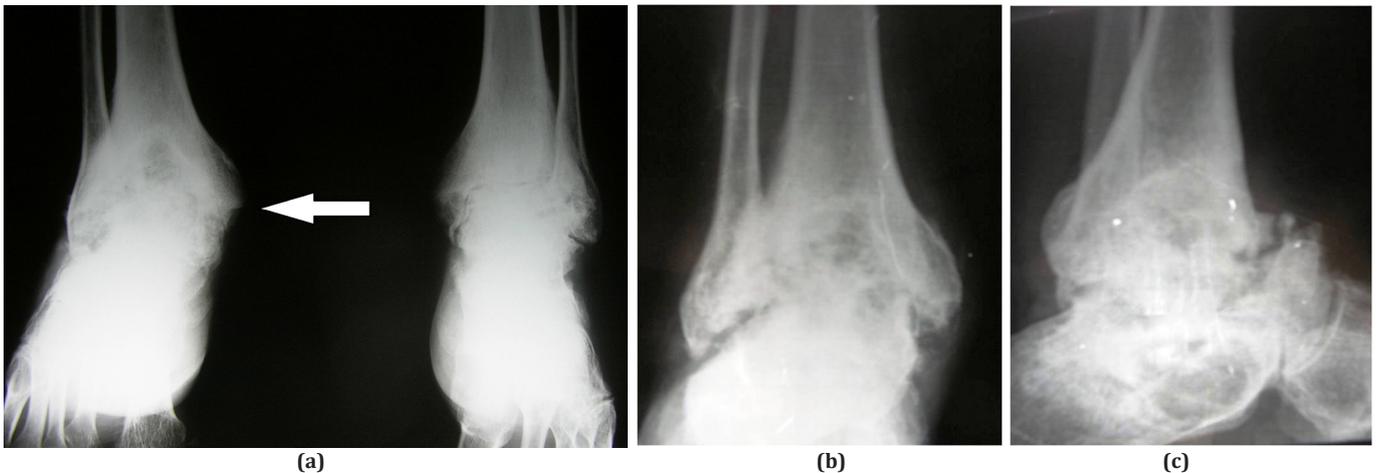


Figure 2 a-c. Tibiotalar arthrodesis performed using a closed retrograde locked intramedullary nail in an adult patient with hemophilia with inhibitor. The indication was the presence of severe pain and recurrent hemorrhage. The result was satisfactory: (a) preoperative anteroposterior radiograph of both ankles, showing advanced bilateral arthropathy, more intense on the right side (arrow); (b) preoperative anteroposterior image centered on the right ankle; (c) preoperative lateral radiograph of the right ankle.

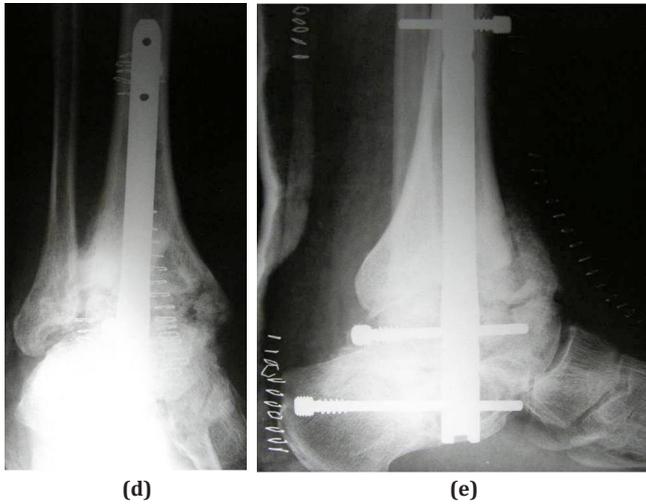


Figure 2 d, e. (d) immediate anteroposterior postoperative image; (e) immediate postoperative lateral radiograph.

free of complications, albeit satisfactory fusion was accomplished in all cases without the need for further surgery.

In 1991, Gamble et al studied 25 patients with hemophilia with ankle arthropathy. Their age was 22 years and 7 months on average (11). A history of recurring ankle hemorrhages, chronic synovitis, and overgrowth of the epiphysis of the distal tibia was related to the early beginning of arthropathy. In these series, ankle fusion was valuable in eliminating pain, repetitive bleeding, and equinus deformity.

In 1992, de Waal Malefijt et al reported 3 patients with hemophilia who effectively underwent arthroscopic ankle arthrodesis (+little postoperative pain) (12). In terms of infection, nonunion, and bone healing time, the results of arthroscopic arthrodesis were similar to that of open arthrodesis.

In 1995, Bonnin et al analyzed 10 arthroscopic ankle arthrodeses performed on patients with hemophilia (13). The follow-up was 12 months on average. In all patients, the fusion attained was in neutral ankle position. Besides, all could stroll in normal shoes. The time for fusion was 14.5 weeks on average. No local adverse events were encountered. Arthroscopic fusion was advised in cases with small or moderate deformities.

In 2009, Mann et al reported a new surgical technique for ankle arthrodesis. This technique included a medial ankle surgical approach, a medial malleolar osteotomy, bone grafting, and stapled compression (14). Excellent pain relief and ameliorated function, as well as fusion, were achieved in all patients. There was relevant amelioration according to Mazur's ankle scale following arthrodesis.

In 2010, Tsailas and Wiedel assessed the results of ankle fusion utilizing crossed screws (15). Over a 24-year period (1983–2006), 20 arthrodeses were performed in 13 patients with severe ankle and subtalar joint arthropathy (11 ankle arthrodeses, 1 isolated subtalar

arthrodesis, and 8 combined ankle-subtalar arthrodeses). Three of the latter had a subtalar arthrodesis in a second surgery. The mean age of the patients was 38.7 years, and the follow-up was 9.4 years on average. In the majority of patients, ankle arthrodesis was accomplished with 2 crossed screws. For subtalar arthrodesis, staples were utilized or the tibiotalar screws were extended into the calcaneus. Ankle fusion was effective in all but 1 patient, for whom the technique was redone, and fusion was finally accomplished. There was also 1 case of painless nonunion of the subtalar joint, which did not need further surgery. There was no repetitive hemorrhage or deep infection. Cross-screw ankle-subtalar arthrodesis was an efficacious surgical procedure in patients with hemophilia (15).

In 2011, Tsukamoto et al published their results on arthroscopic ankle arthrodesis in hemophilic hindfoot arthropathy (16). They performed 3 arthroscopic ankle arthrodeses in 2 patients (aged 26 and 25 years). Follow-ups were between 2 years and 6 years. Consolidation was attained in the 3 ankles. Arthroscopic fusions of the ankle demonstrated halted or relevantly diminished repetitive articular hemorrhage. Pain alleviation and ameliorated walking ability were accomplished with this surgical technique. The mean score on the American Orthopedic Foot and Ankle Society (AOFAS) scale of the ankle-hindfoot was 39 points prior to surgery and 80 at the final follow-up. All patients were very satisfied, with pain alleviation and minimal adverse events. Tsukamoto et al stated that arthroscopic arthrodesis was an efficacious surgical technique for these patients (16).

In 2013, Bai et al reviewed the results of arthroscopic ankle fusion in hemophilic patients in a level IV (retrospective case series) study (17). They analyzed 10 patients (10 ankles) with advanced hemophilic ankle arthropathy who underwent arthroscopic ankle arthrodesis. Consolidation was accomplished in all patients, and the time to fusion was 10 weeks on average. In one patient, there was a superficial infection of the surgical wound. According to Morgan's classification, 8 (80%) results were good and excellent, and 2 (20%) were fair. All patients stated that they were satisfied with the result of the surgical procedure. Arthroscopic ankle fusion was an efficacious option compared with the open technique in hemophilic ankle arthropathy (17).

In 2013, Bluth et al analyzed the outcomes of 57 ankle arthrodeses carried out in 45 patients over a 40-year period (1971–2010) (18). The follow-up was 6.6 years on average. No prompt intraoperative or postoperative adverse events related to ankle arthrodesis were encountered. The nonunion percentage was 10.4% for tibiotalar arthrodesis and 8.3% for subtalar arthrodesis. These rates lowered to 3.7% and 5.6%, respectively, following the initiation of new surgical protocols in 1995. No nonunions needed revision surgery. The modified AOFAS scale showed that at an average 7.2 years following surgery, 75% of patients had no pain. The remaining 25% had a mean pain level of 3 (on a scale of 0-no pain to 10-maximum pain). No patient showed ankle malalignment. Patients had insignificant activity restrictions or gait anomalies, and could stroll long

Table 1. Main data from the review of the literature on ankle arthrodesis in hemophilic patients

AUTHORS	YEAR	N° OF PATIENTS	TYPE OF FIXATION	INFECTION RATE	UNION RATE	COMMENTS FROM ORIGINAL AUTHORS
Houghton et al (10)	1978	7 (adults)	NA	NA	100%	The surgical technique was not free of complications. No need for further surgery
Gamble et al (11)	1991	25 (adults)	NA	NA	NA	The surgical procedure was valuable in eliminating pain, repetitive bleeding, and equinus deformity
de Waal Malefijt et al (12)	1992	3 (adults)	Arthroscopic procedure	Similar to open arthrodesis	Similar to open arthrodesis	In terms of infection, nonunion, and bone healing time, the results of arthroscopic arthrodesis were similar to that of open arthrodesis.
Bonnin et al (13)	1995	10 (adults)	NA	NA	NA	No local adverse events were encountered. Arthroscopic fusion was advised in cases with small or moderate deformities.
Mann et al (14)	2009	NA (adults)	Stapled compression	NA	NA	Excellent pain relief and ameliorated function, as well as fusion, were achieved in all patients.
Tsailas and Wiedel (15)	2010	13 adults (20 fusions)	Two crossed screws (staples for subtalar fusion)	0%	90%	Cross-screw ankle-subtalar arthrodesis was an efficacious surgical procedure in patients with hemophilia
Tsukamoto et al (16)	2011	3	Arthroscopic procedure	0%	100%	Arthroscopic arthrodesis was an efficacious surgical technique for hemophilic ankle arthropathy
Bai et al (17)	2013	10 adults (10 ankles)	Arthroscopic procedure	10%	100%	Arthroscopic ankle arthrodesis was an efficacious option compared with the open technique in hemophilic ankle arthropathy
Bluth et al (18)	2013	45 adults (57 ankles)	NA	0%	89.6% for tibiotalar fusion 91.7% for subtalar fusion	Ankle arthrodesis was an adequate treatment for advanced hemophilic ankle arthropathy
Baker et al (19)	2014	4 (adults)	Arthroscopic procedure (two partially threaded cannulated differential pitch screws or 6.5-mm compression screws)	NA	NA	Success was accomplished by arthroscopic ankle arthrodesis
Lane et al (20)	2014	68 (adults)	NA	NA	NA	On a self-reported activity scale, 11.8% ameliorated, 8.8% worsened, and 79.4% were unchanged.
Brkljac et al (21)	2016	28 adults (41 fusions)	34 tibiotalar fusions were performed (7 by arthroscopy, 6 by minimally invasive surgery, and 21 by open surgery). Two isolated subtalar fusions and 3 combined tibiotalar and subtalar fusions were performed	2.4%	90.3% (the rate of reoperation for nonunion was 4.8%)	All nonunions occurred in tibiotalar arthrodeses.
de l'Escalopier et al (22)	2017	17 children (22 ankles)	Méary's technique	NA	100%	Two patients experienced secondary subtalar osteoarthritis, which was treated by subtalar arthrodesis 6 years following the initial ankle arthrodesis.
Eichler et al (23)	2017	9 adults (12 ankles)	NA	0%	100%	In patients with advanced hemophilic arthropathy, ankle arthrodesis improved patients' function and quality of life.
Wang et al (24)	2020	14 (adults)	Ilizarov technique	14%	100%	All patients were satisfied with the surgery.

NA = Nonavailable

Table 2. Dosage and duration of FEIBA (factor VIII inhibitor bypassing agent) and rFVIIa (recombinant FVII activated) for ankle arthrodesis

Bypassing agent	Preoperative	Day 1-Day 5	Day 6-Day 14
FEIBA	75-100 U/kg	75-100 U/kg q8-12h	75-100 U/kg q12h
rFVIIa	120 µgr/kg	90-120 µgr/kg q2 day 1 Q3h day 2 Q4h day 3-5	90-120 µgr/kg q6 h

distances. The conclusion was that ankle arthrodesis effectively alleviated pain and yielded good functional results and that it was an adequate treatment for advanced hemophilic ankle arthropathy (18).

In 2014, Baker et al published the results of 4 hemophilic patients with ankle arthropathy managed with arthroscopic tibiotalar fusion (19). They used 2 standard portals (anterolateral and anteromedial). Fixation was performed using 2 partially threaded cannulated differential pitch screws or 6.5-mm compression screws. The conclusion was that success was accomplished by arthroscopic ankle arthrodesis.

In 2014, Lane et al analyzed the outcomes of ankle fusion in 68 patients with hemophilic arthropathy (20). Their mean age was 36.9 years. On a self-reported activity scale, 11.8% ameliorated, 8.8% got worse, and 79.4% were unchanged.

In 2016, Brkljac et al assessed the consolidation percentage of diverse hindfoot arthrodesis procedures for the treatment of hemophilic hindfoot arthropathy in 28 patients (41 procedures) (21). Thirty-four tibiotalar arthrodeses were carried out (7 by arthroscopy, 6 by minimally invasive surgery, and 21 by open surgery). Two isolated subtalar arthrodeses and 3 combined tibiotalar and subtalar arthrodeses were performed, one of which included a talonavicular arthrodesis in the second stage. The age of the patients was 40.3 years on average (range, 18.7–65.7). The follow-up was 77 months on average (range, 7–190). The comprehensive percentage of nonunion was 9.7%. All nonunions took place in tibiotalar arthrodeses. The rate of deep infection was 2.4%, and the rate of reoperation for nonunion was 4.8%. Both revisions were efficacious (21).

In 2017, de l'Escalopier et al evaluated the long-run outcomes of 17 children with hemophilia who experienced ankle arthrodesis (22 ankles) over a period of 27 years (1980–2006), with a minimum follow-up of 10 years (22). The age of the patients was 15.5 on average (6–23) years. Méary's technique was used, given the patients had closed growth plates. The follow-up was 19.7 years on average. Neither intraoperative nor perioperative adverse events related to ankle arthrodesis were encountered. Good bone consolidation of the arthrodesis was accomplished in all patients, without axial deformations. Two patients experienced secondary

subtalar osteoarthritis, which was managed by subtalar fusion 6 years following the initial ankle fusion. In this study, tibiotalar fusion in young patients with hemophilia gave good long-run functional outcomes, with a low percentage of adverse events (22).

In 2017, Eichler et al published an analysis (grade IV evidence) in which they analyzed the results obtained in 12 ankle arthrodeses (9 patients with hemophilia) carried out over a 12-year period (2000–2013) (23). The age of the patients was 39 years on average (range, 19–58), and the follow-up was 8 years on average (range, 2–16). The pain amelioration was relevant, and there was no bruising or infection at the surgical site. Consolidation was accomplished in all cases after 3.5 months on average (range, 3–4 months). In patients with severe hemophilic arthropathy, ankle arthrodesis ameliorated function and quality of life of hemophilic patients.

In 2020, Wang et al evaluated the outcomes of ankle arthrodesis in 14 hemophilic patients with advanced arthropathy using the Ilizarov technique (24). Bone fusion was accomplished in all patients. The time to fusion was 12.9 weeks on average (range, 10–17 weeks). Two patients had superficial pin tract infection, and one patient developed subtalar osteoarthritis. The operation was satisfactory for all patients. Ankle fusion with the Ilizarov method appeared to be a viable alternative for advanced hemophilic ankle arthropathy.

Table 1 summarizes the main information found in the literature on ankle arthrodesis in patients with hemophilia. Considering all the previously mentioned series, there were 271 ankle arthrodeses in the literature. The percentage of consolidation was between 90% and 100%. The percentage of postoperative infection was 2.5%. When the Ilizarov external fixator was utilized, the percentage of pin tract infection was 14%.

In patients with hemophilia, ankle arthrodesis is a safe surgical procedure, even in those with inhibitors or who are positive for human immunodeficiency virus and hepatitis C virus. Nonetheless, the risk of postoperative bleeding and infection at the surgical site is greater in patients with hemophilia than in those without hemophilia. Therefore, the risk of obtaining a poor result after ankle arthrodesis is higher in patients with hemophilia. There is no doubt that ankle arthrodesis, when well indicated (very painful and disabling advanced hemophilic arthropathy) makes ankle pain and quality of life better. However, the rate of nonunion can be between 0% and 10%, with approximately 5% of patients requiring further surgery to accomplish bone fusion. The rate of postoperative infection is 2.5%. When the Ilizarov external fixator is utilized for ankle fusion, the percentage of pin tract infection can be 14%.

E. Carlos Rodriguez-Merchan MD PhD¹

¹ Department of Orthopaedic Surgery, La Paz University Hospital-IdiPaz, Paseo de la Castellana 261, 28046-Madrid, Spain

References

1. Rodriguez-Merchan EC. The haemophilic ankle. *Haemophilia*. 2006; 12(4):337-44.
2. Rodriguez-Merchan EC. Ankle surgery in haemophilia with special emphasis on arthroscopic debridement. *Haemophilia*. 2008; 14(5):913-9.
3. Pasta G, Forsyth A, Merchan CR, Mortazavi SM, Silva M, Mulder K, et al. Orthopaedic management of haemophilia arthropathy of the ankle. *Haemophilia*. 2008; 14:170-6.
4. Rodriguez-Merchan EC. Orthopaedic problems about the ankle in hemophilia. *J Foot Ankle Surg*. 2012; 51(6):772-6.
5. Rodriguez-Merchan EC. Management of hemophilic arthropathy of the ankle. *Cardiovasc Haematol Disord Drug Targets* 2017; 17(2):111-8.
6. Rodriguez-Merchan EC. Risks and patient outcomes of surgical intervention for hemophilic arthropathy. *Expert Rev Hematol*. 2019; 12(5):325-33.
7. Rodriguez-Merchan EC. Total ankle replacement or ankle fusion in painful advanced hemophilic arthropathy of the ankle. *Expert Rev Hematol*. 2015; 8(6):727-31.
8. Mortazavi SM, Asadollahi S, Farzan M, Shahriaran S, Aghili M, Izadyar S, Lak M. 32P colloid radiosynovectomy in treatment of chronic haemophilic synovitis: Iran experience. *Haemophilia*. 2007; 13(2):182-8.
9. Pasta G, Mancuso ME, Perfetto OS, Solimero LP. Radiosynoviorthesis in children with haemophilia. *Hämostaseologie*. 2009; 29(Suppl. 1):S62-4.
10. Houghton GR, Dickson RA. Lower limb arthrodeses in haemophilia. *J Bone Joint Surg Br* 1978; 60(3):387-9.
11. Gamble JG, Bellah JA, Rinsky LA, Glader B. Arthropathy of the ankle in hemophilia. *J Bone Joint Surg Am* 1991; 73(7):1008-15.
12. de Waal Malefijt MC, Van Kampen A. Arthroscopic ankle arthrodesis: a new technique. *Ned Tijdschr Geneesk* 1992; 136(52):2585-8.
13. Bonnin M, Carret JP. Arthrodesis of the ankle under arthroscopy. Apropos of 10 cases reviewed after a year. *Rev Chir Orthop Reparatrice Appar Mot* 1995; 81(2):128-35.
14. Mann HA, Biring GS, Choudhury MZ, Lee CA, Goddard NJ. Ankle arthropathy in the haemophilic patient: a description of a novel ankle arthrodesis technique. *Haemophilia*. 2009; 15(2):458-63.
15. Tsailas PG, Wiedel JD. Arthrodesis of the ankle and subtalar joints in patients with haemophilic arthropathy. *Haemophilia*. 2010; 16(5):822-31.
16. Tsukamoto S, Tanaka Y, Matsuda T, Shinohara Y, Taniguchi A, Kumai T, et al. Arthroscopic ankle arthrodesis for hemophilic arthropathy: two cases report. *Foot (Edinb)*. 2011; 21(2):103-5.
17. Bai Z, Zhang E, He Y, Yan X, Sun H, Zhang M. Arthroscopic ankle arthrodesis in hemophilic arthropathy. *Foot Ankle Int*. 2013; 34(8):1147-51.
18. Bluth BE, Fong YJ, Houman JJ, Silva M, Luck Jr JV. Ankle fusion in patients with haemophilia. *Haemophilia*. 2013; 19(3):432-7.
19. Baker JF, Maleki F, Broderick JM, McKenna J. Arthroscopic ankle arthrodesis for end-stage haemophilic arthropathy of the ankle. *Haemophilia*. 2013; 1(20):e97-9.
20. Lane H, Siddiqi AE, Ingram-Rich R, Tobase P, Scott Ward R, Universal Data Collection Joint Outcome Working Group, Hemophilia Treatment Center Network Study Investigators. Functional outcomes following ankle arthrodesis in males with haemophilia: analyses using the CDC's Universal Data Collection surveillance project. *Haemophilia*. 2014; 20(5):709-15.
21. Brkljac M, Shah S, Hay C, Rodriguez-Merchan EC. Hindfoot fusion in haemophilic arthropathy: 6-year mean follow-up of 41 procedures performed in 28 adult patients. *Haemophilia*. 2016; 22(2):e87-98.
22. de l'Escalopier N, Badina A, Padovani JP, Harroche A, Frenzel L, Wicart P, et al. Long-term results of ankle arthrodesis in children and adolescents with haemophilia. *Int Orthop*. 2017; 41(8):1579-84.
23. Eichler D, Ehlinger M, D'Ambrosio A, Desprez D, Bierry G, Adam P, et al. Ankle fusion in hemophilic patients. *Orthop Traumatol Surg Res*. 2017; 103(8):1205-9.
24. 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*. 2020:1-7.