

Arthrodesis of the ankle joint in septic osteoarthritis: six years long term outcomes in authors' personal experience

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Abstract. – **OBJECTIVE:** Our goal was to evaluate the long-term clinical outcome of ankle arthrodesis, obtained by an extramedullary internal fixation with or without bone-grafting in the treatment of ankle' septic arthritis.

PATIENTS AND METHODS: All patients treated with arthrodesis by extramedullary internal fixation for septic arthritis of the ankle joint between January 2011 and December 2016 in the same hospital were included in our retrospective study.

Patients were followed-up for a minimum of two years. To evaluate the quality of life, each patient filled in a short form of the physical and mental health summary scale and a visual analogue scale for pain. For the functional evaluation, the American Orthopaedic Foot and Ankle Society Score was used. Demographics and clinical data, including perioperative and postoperative complications, were evaluated.

RESULTS: From January 2011 to December 2016, we performed 57 arthrodeses of the ankle joint with cannulated screws in 52 patients. Mean age was 52 years old. 48 patients (92%) had post-traumatic septic arthritis. The most frequently isolated pathogens were *Staphylococcus aureus* and *Pseudomonas aeruginosa*. 48% of patients reported a postoperative complication after three months; the most commonly reported complications were weight bearing ankle-foot pain (27%) and surgical wound dehiscence (12.25%). Nonunion was reported only in 8.75% of cases.

CONCLUSIONS: Ankle arthrodesis could allow painless gait, improving patients life quality, even after long-term follow-up, and is, therefore, a solution to be considered in patients affected by septic arthritis.

Key Words

Arthrodesis, Ankle Joint, Septic Arthritis, Osteomyelitis.

Introduction

Septic arthritis of the ankle joint (tibiotalar joint) often leads to irreversible damage of the articular surface with pain and dysfunction (Figure 1A).

In many cases, Ankle Joint (A-J) arthrodesis is the treatment of choice once the infectious process has been eradicated. In such arthritic, weary joints, which are usually malaligned, it quickly and safely restores stability and painless weight-bearing. Residual symptoms are rare and usually only occur when marked degenerative alterations appear in the nearby joints, especially when A-J arthrodesis is delayed. Even when the infectious process is still active, it can be considered a good therapeutic option and sometimes represents the last chance to save the limb from amputation^{3,4,9,13}.

From the literature, we know that Septic Arthritis (S.A.) (Figure 1A) cannot be cured effectively without at least a first surgical phase in which the infected tissues and the possible bone bundles are debrided, carefully controlling the residual space, combined with an appropriate systemic antibiotic therapy (Figure 1B)^{1,5-10}.

Therefore, in case of an active infection, a “two-staged” surgical approach is also recommended at A-J level, by using an antibiotic-loaded spacer (Figure 1b) and an appropriately targeted antibiotic therapy for at least 6 weeks¹¹.

Only when the infective process is eradicated, it will be possible to perform the arthrodesis, which can be obtained by various techniques of synthesis and bone-grafting (Figure 1C).

Unfortunately, in the ankle, there are some adverse factors that make the treatment more difficult: trauma and ischemia are frequent; soft

tissues are thinner and less vascularized than other body regions; finally, during debridement, it is difficult to distinguish between healthy bone and infected bone due to the abundant presence of cancellous bone. For all these reasons, S.A. of A-J is often recurrent¹².

In the literature, various techniques for obtaining A-J arthrodesis are described as the use of external axial fixators, external circular fixators, internal fixation with retrograde intramedullary nails, extramedullary internal fixation with cannulated screws, *etc.*^{5,6,8-11,13-19}. In association with each of these procedures, autologous or homologous bone-grafting can be used^{9,11,15,16}.

This study presents the cases of A-J arthrodeses obtained by an extramedullary internal fixation, with or without bone-grafting, at our Institute (Figure 1C).

In the literature, regardless of the technique used, the success rate of arthrodesis on aseptic ankles is around 94%. There seems to be no difference between intramedullary and extramedullary techniques^{3,5-7,20}.

Unfortunately, there are not enough studies that indicate the success rates of arthrodesis after septic arthritis of the ankle. The S.A. remains one of the most important problems faced by an orthopedic surgeon, above all because there are no



Figure 1. Post-Traumatic Septic Osteo-Arthritis of the Ankle Joint, Clinical and X-Rays (A). Dead Space Control with an Antibiotic-Loaded Spacer and his removal after the accurate Debridement (B). Ankle Joint Arthrodesis with two Screws + Homologous Bone-graft and X-Rays at the end of Follow-Up (C).

complete and shared guidelines. At the moment, the conservative treatment can be considered the “gold standard” for this pathology.

Obtaining a stable arthrodesis in patients with arthritis of the A-J is, therefore, a challenge for both the surgeon and the patient and, unfortunately, sometimes amputation cannot be avoided^{8,18}, especially when ankle vascularization is poor or soft tissues are damaged²¹. The aim of this study was to evaluate the long-term outcome of A-J instrumental arthrodesis, obtained by an extramedullary internal fixation with or without bone-grafting, in septic ankle arthritis. We evaluated both clinical and functional effects, with particular regard to the quality of life of our patients.

Patients and methods

We retrospectively included all patients diagnosed with S.A. of the A-J and treated with A-J arthrodesis by extramedullary internal fixation with or without bone-grafting between January 2011 and December 2016 in one centre.

Exclusion criteria were: patients undergoing A-J arthrodesis for reasons other than septic osteoarthritis (S.O.A.), death unrelated to S.O.A. before follow-up evaluation, and finally, patients treated with techniques other than extramedullary internal fixation.

Surgical Technique

Goals of arthrodesis were obtaining absence of pain, a stable and dynamic synthesis lasting over time and, as pointed out by Charnley many years ago, referring to the knee joint, interfragmentary compression by instrumental synthesis and/or bone-grafting²².

Arthrodesis was carried out as soon as possible to protect the nearby joints from improper loads²³. The plantar flexion contracture of degenerated ankle joints that was present in most cases was corrected, obtaining a foot in a neutral position (0° of flexion) in women and in slight dorsiflexion (10°-15°) in men.

The foot was dorsally displaced relative to the tibiofibular mortise to abbreviate the forefoot lever and extend the back-foot to correct the forward displacement of the foothold determined by arthrodesis.

Finally, arthrodesis was performed in 10°-15° of pronation, to protect the sub-talar joint from supine overload²⁴.

Patient Management

All patients received preoperative and postoperative antibiotic treatment, targeted at the infecting microorganism whenever possible, for at least 6 weeks. Personal documentation of patients (bone scan, MRI, previous biopsies) was recorded at hospital admission. All patients underwent a “two-stage” surgical treatment: the first stage was an accurate debridement and control of the residual space until normalization of the infection markers, followed by A-J arthrodesis.

The postoperative protocol was: two weeks immobilization in a long leg plaster; after two weeks, the plaster was removed, and a Walker boot was positioned; ambulation was allowed with partial weight bearing; the allowed weight bearing was gradually increased according to the clinic and the radiographic improvements, and the full weight bearing was achieved after an average period of 6 to 8 weeks; after 8-12 weeks, the Walker boot was removed and an elastic brace was prescribed; ambulation without crutches was allowed. Once fusion was reached, customized orthopedic shoes were prescribed²⁵. To evaluate our results, long-term controls were performed for a minimum of two-years follow-up. In the hospital, venue of the study, every admitted patient compiled a Short Form of the Physical and Mental Health Summary Scale (SF-12 scale) and a Visual Analogue Scale for pain (VAS scale) to evaluate the patient quality of life. For the functional evaluation, the American Orthopaedic Foot and Ankle Society Score (AOFAS score) was used. All ankle and foot pathologies received this evaluation preoperatively. Demographics and clinical data were recorded: Body Mass Index (BMI), mean age, sex, comorbidities, inflammation markers, microbiological tests results, days of hospitalization, peri-operative complications, postoperative complications within three months after surgery. In addition, findings of inflammatory processes in bone scan, MRI, and bone biopsies were recorded.

Results

From January 2011 to December 2016, we performed 57 A-J arthrodeses with cannulated screws with or without bone-grafting in 52 patients, 38 men and 14 women, mean age 52 years old. 48 patients (92%) had post-traumatic septic arthritis, 4 (8%) iatrogenic septic arthritis. None had hematogenous forms.

Table I. Sex, etiology, pathogens.

No. of patients 52 – Mean age 52 yrs.		
Male	38	73%
Female	14	27%
Post-traumatic S.O.A.	48	92%
Iatrogenic S.O.A.	4	8%
<i>Staphylococcus aureus</i>	24	46%
<i>Pseudomonas aeruginosa</i>	3	6%
S. aureus + P. aeruginosa	5	10%
Others pathogens	8	15%
No pathogens	12	23%

No.: Number; yrs.: years; S.O.A: septic osteo-arthritis; *S. aureus*: *Staphylococcus aureus*; *P. aeruginosa*: *Pseudomonas aeruginosa*.

The most frequently isolated pathogens were *Staphylococcus aureus* and *Pseudomonas aeruginosa*; the first was isolated in 24 patients (46%), the latter in 3 patients (6%) and both coexisted in 5 patients (10%). In 23% of patients, no pathogen was isolated, the other patients (15%) had other pathogens (Table I).

The possible positivity of the bone scan, MRI, and the positivity of any bone biopsy was evaluated. 46 patients were positive (88.5%).

The mean BMI was 29.66, most of the patients were overweight, and 22 of them (42.3%) were obese. 29 patients (55.8%) were smokers, 27 (51.9%) had hypertension, 9 had diabetes (17.3%), and 7 (13.4%) had cerebrovascular problems. Based on these results, it was decided to evaluate the risk of death within one year from the operation using the Charlson Comorbidity Index (CCI), which was equal to 3.13. The average hospital stay was 9.4 days.

The incidence of peri-operative complications was 21%; the most common complications were anemia (10.5%) and nausea (5.25%) (Table II).

The incidence of postoperative complications within three months from operation was 21%, and the most frequently found in this case were surgical wound dehiscence (12.25%) and hemarthrosis (5.25%) (Table II).

Postoperative complications presenting after three months postoperatively had an incidence of 48%. The most commonly reported were weight-bearing ankle-foot pain (27%) and surgical wound dehiscence (12.25%). Delayed union and nonunion were reported only in 8.75% of cases. Finally, 36 (63%) operations were performed with 2 cannulated screws without the use of bone-grafts, 21 (37%) associating 2 cannulated screws and bone-grafts (Table II).

In the 36 arthrodeses performed without the insertion of bone grafts, in 10 cases weight-bearing ankle-foot pain persisted, in 3 cases delayed consolidation and subsequently nonunion occurred, in 3 cases anemia occurred, in 6 there was a dehiscence of the surgical wound, in 2 cases hemarthrosis occurred, and only one patient presented with nausea, other complications were found in 5 cases. In the remaining 6 cases, there were no complications.

In the 21 arthrodeses with bone-graft insertion, in 5 cases weight-bearing ankle-foot pain persisted, in 2 cases delayed consolidation and subsequently nonunion occurred, in 8 cases there was the dehiscence of the surgical wound, in 3 anemia occurred, in 2 cases nausea occurred, and only one patient presented with hemarthrosis.

The results of the clinical outcomes assessment are reported in Table III.

Table II. Complications after surgery in 57 patients.

	N.	(%)	Only screws 36/57 (63%)	Screws with bonegrafts 21/57 (37%)
Perioperative (systemic)	12/57	(21%)		
Anemia	6/57	(10.5%)	3	3
Nausea	3/57	(5.25%)	1	2
Others	3/57	(5.25%)	3	0
Postoperative (local within three months)	12/57	(21%)		
S.W. Dehiscence	7/57	(12.25%)	3	4
Hemarthrosis	3/57	(5.25%)	2	1
Others	2/57	(3.5%)	2	0
Postoperative, local (after three months)	27/57	(48%)		
A-F Load Pain	15/57	(27%)	10	5
S.W. Dehiscence	7/57	(12.25%)	3	4
Nonunion	5/57	(8.75%)	3	2

S.W.: surgical wound; A-F: ankle-foot.

Table III. Ankle joint arthrodesis scores.

AOFAS Score		SF-12 Scale		VAS Score	
Pre	Post	Pre	Post	Pre	Post
48/100	53/100	PCS-12: 24.2 MCS-12: 25.8	PCS-12: 36.7 MCS-12: 38.8	7.3	4.3

AOFAS, American Orthopaedic Foot and Ankle Society; SF-12, Short Form Health Survey – 12; VAS, Visual Analogue Scale, PCS; Physical Component Summary; MCS, Mental Component Summary.

Discussion

Our cases serie shows that a significant increase of this pathology has been observed in the last decade, linked to severe trauma-related osteosynthesis and that the pathogens most responsible are *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

The most frequent complications in our experience were: surgical wound dehiscence with-in and after three months postoperatively, which often resulted in the prolonged need of advanced medications, and the weight-bearing ankle-foot pain after three months from the operation, which often required further surgical treatment for the removal of the cannulated screws.

In the literature, the incidence of non-union is reported in up to 30% of cases, while in our experience it is markedly lower, less than 10%²⁶.

In our experience, the rate of complications, including nonunion, reaches 60%, fitting in the trends reported in the literature. It should be noted that none of the patients studied underwent amputation [27,28]. It would also seem that, as reported by other authors [26,29-31], the use of autologous or homologous bone-grafts reduces the incidence of nonunion and weight-bearing ankle-foot pain, compared to operations with only cannulated screws. The incidence of delay of consolidation resulted in nonunion after 36 operations with only cannulated screws was 1.08%, while after 21 interventions with the association of screws and bone-grafts it was 0.4%, with no statistical significance due to the small size of the clinical sample analyzed.

Finally, based on direct testimony provided by patients undergoing A-J arthrodesis, and evaluated by AOFAS score, SF-12 scale, and VAS scale pre- and postoperatively, it seems that the quality of life of patients improved after surgery. The clinical condition of the ankle (AOFAS score) of patients wasn't significantly worsened, but rather, although not statistically significant, it slightly improved in the postoperative period; the pre-operative and postoperative physical and mental health status of patients

(SF-12 scale) significantly improved in the postoperative period; finally, the VAS scale for pain slightly improved in the postoperative period (Table III).

Our work presents some limitations due to its retrospective nature and to the small number of patients. To reach statistical significance and confirm this result, further studies on a larger population must be done.

Conclusions

Despite arthrodesis being considered the defeat of the orthopaedic surgeon, ankle joint arthrodesis can improve the quality of life of these patients and is, therefore, a great solution. Amputation, previously much more often used, is nowadays almost completely avoided by arthrodesis.

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Conflict of Interests

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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