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ORIGINAL ARTICLE

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Preliminary outcomes of anterior ankle arthrodesis

Resultados preliminares da artrodese do tornozelo por via anterior

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ABSTRACT

Objective: The objective of this study was to evaluate preliminary clinical and radiographic outcomes of a case series of patients with ankle osteoarthritis undergoing anterior tibiotalar arthrodesis using anterior plate and cannulated screws as a form of fixation.

Methods: We retrospectively assessed the clinical and radiographic outcomes of eight cases treated with this technique in our service between 2014 and 2017, using the American Orthopedic Foot and Ankle Score (AOFAS) questionnaire and radiographic evaluation in two orthogonal views with ankle weight bearing, evaluated at one year after surgery.

Results: We obtained AOFAS scores between 38 and 92 in the late postoperative period and a consolidation rate of 87.5% (seven cases). There was consolidation failure in one case, which resulted in plate loosening and the need for reoperation. Only one of the patients presented superficial surgical wound complication, treated only with serial dressings. There were no neurovascular complications.

Conclusion: The present study obtained adequate preliminary outcomes with the use of the demonstrated technique, indicating a possible advantage of the same in relation to conventional techniques and the possibility of using lower-cost surgical materials.

Level of Evidence IV; Therapeutic Studies; Cases Series.

Keywords: Arthrodesis; Arthropathies; Ankle.

RESUMO

Objetivo: O presente estudo tem por objetivo avaliar resultados preliminares clínicos e radiográficos em uma série de casos de pacientes portadores de osteoartrite do tornozelo, submetidos a artrodese tibiotalar por via anterior, com a utilização de placa anterior e parafusos canulados como forma de fixação.

Métodos: Avaliamos retrospectivamente, clínica e radiograficamente 8 casos tratados por esta técnica em nosso serviço no período de 2014 a 2017, por meio de questionário AOFAS e avaliação radiográfica em duas incidências ortogonais com carga do tornozelo, avaliados após 1 ano de pós-operatório.

Resultados: Obtivemos pontuações do escore AOFAS entre 38 e 92 no pós-operatório tardio após realização da técnica em estudo, e índice de consolidação de 87,5% (7) dos casos. Houve falha de consolidação em 1 dos casos, que resultou em soltura da placa e necessidade de reabordagem cirúrgica. Apenas 1 dos pacientes apresentou complicação superficial de ferida cirúrgica, tratada somente com curativos seriados. Não houve complicações neurovasculares.

Conclusão: O presente estudo obteve resultados preliminares pós-operatórios adequados com a utilização da técnica demonstrada, indicando uma possível vantagem da mesma em relação a técnicas convencionais e com a possibilidade de utilização de material cirúrgico de menor custo.

Nível de Evidência IV; Estudos Terapêuticos; Série de Casos.

Descritores: Artrodese; Artropatias; Tornozelo.

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INTRODUCTION

Ankle arthrodesis is a valid and widely used therapeutic option for the treatment of advanced degenerative ankle arthropathy (Figure 1). Joint fusion is indicated on several occasions in the presence of joint pain with or without deformity of the ankle and hindfoot secondary to degenerative arthropathy[1].

The main objective in all arthrodesis techniques is the adequate positioning of the ankle joint in relation to the leg, providing pain relief, deformity correction and reestablishment of the function of the lower limb[1].

Positive clinical outcomes are correlated with adequate preoperative planning, selection of the appropriate access route, the joint preparation technique and the mode of arthrodesis fixation. Patient assessment should be complete and based on the search for systemic morbidities such as diabetes, rheumatoid arthritis and vascular disorders[1], which may be associated with non-ideal surgical and clinical outcomes. Special attention should be given to the integrity of the adjacent joints, taking into account the possibility of joint overload in the long term due to arthrodesis, especially in the knee, midtarsal and subtalar joints[2].

Several surgical access routes to the ankle can be considered for arthrodesis, with the choice conditioned to the presented deformity, fixation technique, soft tissue condition and surgeon's experience or preference[1].

Lateral or transfibular approach is a common approach that has been historically used in the treatment of diseases of the tibiotarsal joint. In this access route, the fibula is obliquely osteotomized approximately 2 to 4 cm proximal to the level of the tibial pilon and is then removed and used as an autologous graft[1]. In addition to requiring osteotomy, which increases morbidity, this approach requires a supplemental incision over the medial malleolus to access the medial groove[3].

A combination of anteromedial and anterolateral longitudinal approaches is also used. The anteromedial incision is created medial to the tibialis anterior tendon and to the medial malleolus, and the anterolateral incision is created lateral to the peroneal tendon[1]. However, this approach may pose a risk to the intermediate portion of skin and possible necrosis between the two incisions[1,3].

The posterior approach presents greater technical complexity. It is performed by an incision in the posterior aspect of the leg, parallel to the Achilles tendon, with attention to avoid injury to the sural nerve[3]. It is indicated for patients

Figure 1. Radiographic image demonstrating post-traumatic degenerative arthropathy of the ankle.
Source: Author's personal archive.

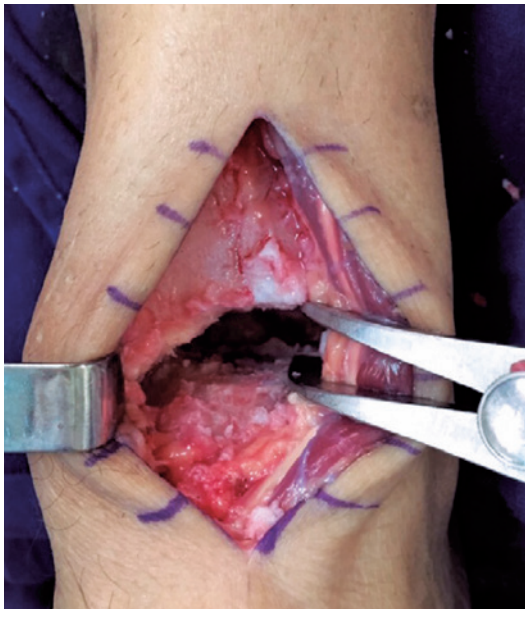

Figure 2. Anterior access route and joint distraction to facilitate surface preparation.
Source: Author's personal archive

who are at risk of skin complications on the anterior surface of the ankle due to skin lesions such as fracture sequelae or burns.

Furthermore, arthroscopic tibiotarsal arthrodesis may be classically indicated for degenerative arthropathies without deformities (<10 degrees). This technique presents advantages in relation to the open techniques, including lower postoperative pain and lower incidence of soft tissue complications. As disadvantages, it demands a longer time for bone consolidation and requires surgeon experience due to the long learning curve[4].

Among the access techniques described, single-incision anterior arthrodesis has been frequently used for tibiotarsal joint fusion. It is performed along the lateral border of the extensor hallucis longus tendon, in the central region between the malleoli. This approach requires caution to avoid injury to local neurovascular structures (superficial peroneal nerve in the first window and deep peroneal nerve with anterior tibial artery in its deep part) and for the maintenance of a viable skin flap. Through this incision, the ankle joint is inserted between the extensor digitorum longus and extensor hallucis longus tendons. This surgical access route allows good exposure of the anterior region of the ankle, providing the surgeon with an extremely wide view of the joint, with the possibility for distal or proximal extension (Figure 2). This access route also offers advantages over other techniques with regard to the work field and visualization, as well as the possibility of the correction of severe deformities. In addition, it offers the possibility of rigid fixation of the system through an anterior neutralization plate and percutaneous compression screws. Its disadvantages are the non-exposure of posterior structures, difficulty in approaching malleoli and tendinous adhesions, paraesthesia, swelling and increased postoperative vascular impairment[1,3,5].

In general terms, an important point in the arthrodesis process is the preparation of the joint for fusion, with the simplest one described being direct joint curettage. Other techniques described include joint resection, subtotal cartilage resection and local graft[1,3]. Regardless of the technique employed, the principles described for successful joint fusion should be respected, including complete removal of the articular tissue, accurate apposition of the surfaces and ideal positioning of the limb and rigid maintenance of this position until consolidation[5].

There are a range of devices used for local fixation, such as fasteners, rods, plates, screws and a combination of these[1,3]. There is disagreement in the literature regarding the best method. However, clinical and biomechanical studies show that rigid internal fixation increases the rates of consolidation in a shorter time, with a lower infection rate, less discomfort to the patient and faster mobilization compared with other techniques[6].

There are currently specifically moulded and locking plates on the market to perform arthrodesis by the anterior access route, but their cost for patients and health care providers is high. In our series, we used common small non-locking plates as a neutralization device, as well as common cannulated screws. Thus, we want to determine the possibility of performing the technique with a lower economic cost.

The aim of the present study was to evaluate the preliminary clinical and radiographic outcomes of anterior tibiotalar arthrodesis in a small retrospective case series by means of a postoperative evaluation only.

METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number: 87121618.8.0000.5505.

We retrospectively evaluated cases of patients with degenerative ankle arthropathy who underwent anterior tibiotarsal arthrodesis with a single incision in our service between 2014 and 2017.

Patients in the late postoperative period (one year after the surgery) who had undergone the single-incision anterior access technique were included in the study.

Surgical technique

The access route is established in the central region between the malleoli. After incising the skin, anterior access to the ankle is used along the lateral border of the extensor hallucis longus tendon. This approach requires caution to avoid injury to local neurovascular structures (superficial peroneal nerve in the first window and deep peroneal nerve with anterior tibial artery in its deep part) and for the maintenance of a viable skin flap. After careful dissection, the ankle joint is inserted between the extensor digitorum longus and extensor hallucis longus tendons. Careful handling and separation of tissues is important at this time, as well as superficial dissection, to avoid soft tissue complications. After identification of the joint, debridement and decortication and preparation with perforations in the subchondral bone are performed to obtain bleeding bone and good joint apposition and positioning. Next, fixation with two 7.0-mm cannulated partially threaded screws is performed by introducing the screws from the posterola-

teral direction in the tibia to the anteromedial direction in the talus and from the posteromedial direction in the tibia to the centrolateral direction in the talus to obtain compression stability. We then added a distal radius T-shaped 3.5-mm anterior plate, locking or non-locking (easily found in small plates boxes), shaped it for accommodation on the talar neck followed by fixation with all plate screws, to avoid weak areas in the construct (Figures 3 and 4). Finally, we cleaned the wound and carefully sutured it by planes, followed by the placement of a sterile dressing and a splint. Our postoperative protocol allows partial protected weight bearing starting in the 4th week and total protected weight bearing when bone consolidation is achieved, with progressive weaning of the orthosis according to the neuromuscular condition.

Patients were asked to come to our service, and after signing the informed consent form, they were interviewed, and epidemiological data were collected. We used additional questionnaires to obtain data such as wound complications, need for antibiotic therapy, pseudarthrosis or delayed consolidation and surgical revision.

Eight cases treated with anterior ankle arthrodesis were evaluated. The mean age of the patients was 48.5 years (SD=9.8); six were male, and two were female. Five of the patients required surgery due to post-traumatic arthrosis secondary to ankle fracture, one due to post-traumatic arthrosis patient secondary to talar fracture, one patient due to degenerative arthropathy secondary to fixed ankle varus and one for revision of a failed tibiotarsal arthrodesis. All procedures were unilateral, with four on the left side and four on the right.

We then applied the American Orthopedic Foot and Ankle Society (AOFAS) – Ankle and Hindfoot score validated for the Portuguese language[7], which evaluates functional outcomes via nine items to be filled out by the evaluator, covering three categories: pain (40 points), functioning (50 points) and alignment (10 points). The score is obtained by summing the items and ranges from 0 to 100 points, where zero corresponds to the greatest disability and 100 to the best clinical condition.

Finally, we radiographically evaluated the bone consolidation from radiographs with ankle weight bearing in two orthogonal views (anteroposterior and profile). We defined as consolidation the visualization of bone continuity in follow-up radiographs present in at least three cortices in the anteroposterior and profile views.

We do not have preoperative questionnaire data for comparison.

RESULTS

After applying the AOFAS questionnaire, we obtained scores between 38 and 92 points. Six patients obtained satisfactory scores, while two obtained poor scores, having lost points in the pain category. The patient who presented the worst score (58) presented mobility at the arthrodesis site (non-consolidation), with loss of alignment and severe functional deficit. The remaining patients were asymptomatic (Table 1).

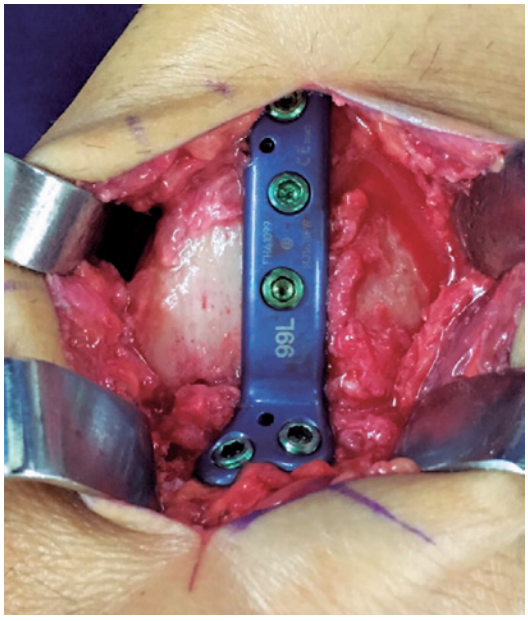

Figure 3. Positioning of the anterior plate and screws after correct joint positioning and ankle alignment.
Source: Author's personal archive.

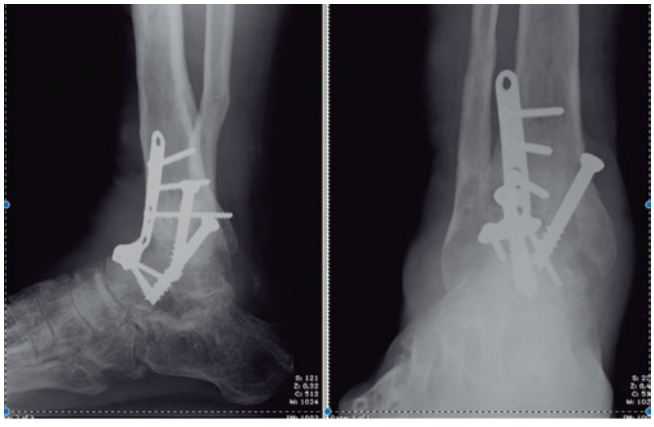

Figure 4. Radioscopic image in the anteroposterior view after fusion.
Source: Author's personal archive.

There was evidence of radiographic consolidation in seven cases (87.5%) and of loosening with material breakage in one case (12.5%), requiring surgical revision at the twelfth postoperative week. The procedure was performed by the previous route, resulting in consolidation of the case during follow-up. We found only one (12.5%) superficial surgical wound infection, which was controlled with oral antibiotic therapy and dressings. There was no description of complications such as local dehiscence, malalignment, skin discomfort due to protruding material or deep infection (Figure 5).

DISCUSSION

The present study obtained satisfactory consolidation outcomes, similar to those found in the literature. In a prospective study, Gharehdaghi et al.[8] evaluated 12 patients over a two-year period who underwent anterior arthrodesis using a combination of anterior dynamic compression plate (DCP) and screws. In their series, there was complete joint fusion in all subjects, with radiographic evidence of well-positioned consolidation over an average of 12 weeks (ranging from eight to 15 weeks). There was no case of failure of the implants[8].

Similar results were also presented by Mohamedean et al.[9] in a prospective study of 29 patients in which the anterior access route and DCPs were used with a follow-up of 36 months. In that study, 100% consolidation was achieved in an average of 12.2 weeks, with improvement in functional scores and patient quality of life.

The anterior access route, by its nature, facilitates accommodation of the plate and screws in different arrangements, providing versatility in the arthrodesis construct. In a study conducted between 2005 and 2010, Slater et al.[10] performed anterior arthrodesis with a combined plate and screw construct, demonstrating that anterior plates allow the calcaneus to be incorporated into the arthrodesis, when necessary. This technique provides a variety of screw entrances and sufficient immediate stiffness and a high rate of consolidation with few complications[10].

There is debate in the literature regarding which fixation method is the most stable, as discussed by Kakarala and Rajan[11] in a comparative series of 22 cases. The group in which anterior moulded plate and cross screws were used obtained full consolidation and in less time compared with fixation with screws alone. Of the latter, two cases progressed to pseudarthrosis and to the need for surgical revision with complementation of the synthesis with an anterior plate[11]. Rowan and Davey[12] presented the results of the use of the anterior AO plate for arthrodesis fixation with a consolidation rate of 94%. Mears et al.[13] suggested that the results with the T-plate or a two-hole anterior plate, with a consolidation rate of 100%, are comparable to those obtained with cross-screw fixation. Despite the stability, the authors used a reinforcement protocol involving cast immobilization and partial weight bearing only after six weeks, which could have affected the reported consolidation rates[12].

In a biomechanical study, Tarki et al.[14] demonstrated that the anterior plate complemented the multiplanar screws

Table 1. Clinical and radiographic outcomes

Patient	Age	Laterality	Sex	Initial diagnosis	Total AOFAS	Pain/ 40	Functioning/ 50	Alignment/ 10	Follow-up time (years)	Radiographic evaluation	Complications
1	54	E	M	Ankle fracture	92	40	42	10	4	Consolidated	
2	62	E	M	Fixed ankle varus	38	20	13	5	4	Non-consolidated	Plate breakage
3	36	D	F	Ankle fracture	83	40	33	10	4	Consolidated	
4	40	E	M	Ankle fracture	83	40	33	10	3	Consolidated	
5	46	D	F	Ankle fracture	73	30	23	10	2	Consolidated	
6	39	D	M	Ankle fracture	92	40	42	10	2	Consolidated	Superficial infection
7	51	E	M	Ankle fracture	85	40	35	10	2	Consolidated	
8	60	D	M	Tibiotarsal arthrodesis failure	80	40	30	10	1	Consolidated	

Source: Prepared by the author based on the results of the study.

Figure 5. Healed surgical wound 10 weeks after surgery.
Source: Author's personal archive.

and provided increased rigidity compared with fixation with screws alone[14]. With the addition of the anterior plate, the increase in rigidity of the construct was 3.5 in the sagittal plane, 1.9 in the axial plane and 1.4 in the coronal plane. Biomechanically, the anterior plate acts as a tension band device when it resists plantar flexion and dorsiflexion, as well as a neutralization plate when it resists shear forces[14]. The presence of micro motions in the synthesis with only screws can be deleterious in the evolution of the local fusion. Since there is increased stability with plate synthesis, the construct can be made with fewer cross screws, which would allow the maintenance of a larger surface for bone consolidation.

We found a low incidence of complications, which included a superficial surgical wound infection that was controlled with a 14-day antibiotic cycle and one case of implant rupture. The results were similar to those of other studies, with reported infection rates ranging from 6 to 8%[8,9], showing improvement without compromising the final outcome. Other adverse events include surgical wound dehiscence, screw penetration in the subtalar joint and correction loss[12,15]. In larger segments, tibial stress fracture, malalignment, the development of secondary arthritis or progression to subtalar arthritis have been reported[15].

The presented results reinforce the idea that the anterior technique and fixation by a combination of plate and screws can be satisfactory and useful in ankle arthrodesis, even in developing countries that use different implant qualities according to the available budget. The principles of compression between structures, local stability, maintenance of a wide surface for bone formation and synthesis stiffness are still important in the search for consolidation.

CONCLUSION

This study describes a technique that can be performed in services with poor access to high-cost materials, with the use of a single 3.5-mm non-locking plate and conventional 7.0-mm cannulated screws, with good functional outcomes and postoperative consolidation rates.

The present study has some limitations, including the small number of cases, retrospective design of non-homogeneous cases and absence of preoperative data for comparison. The short follow-up time of the patients is justified by the objective of reporting only the preliminary outcomes of the technique.

Authors' contribution: Each author contributed individually and significantly to the development of this article: JDXS *(https://orcid.org/0000-0003-4807-7990) conceived and planned the study activities that led to the study, wrote the article, interpreted the study results, participated in the review process and approved the final version; VFP *(https://orcid.org/0000-0002-1005-6089) conceived and planned the study activities that led to the study, wrote the article, interpreted the study results, participated in the review process and approved the final version; VYM *(https://orcid.org/0000-0002-4676-2954) participated in the review process and approved the final version; RMA *(https://orcid.org/0000-0001-9229-8008) conceived and planned the study activities that led to the study, interpreted the study results, participated in the review process and approved the final version; NSBM *(https://orcid.org/0000-0003-1067-727X) conceived and planned the study activities that led to the study, wrote the article, interpreted the study results, participated in the review process and approved the final version. *ORCID (Open Researcher and Contributor ID).

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