

CURRENT CONCEPTS REVIEW**Joint Distraction in Advanced Osteoarthritis of the Ankle**

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Background: Ankle joint distraction (AJD) avoids the potential complications associated with ankle fusion or total ankle replacement (TAR) in patients with advanced ankle osteoarthritis (OA). AJD could be a tenable option to ankle fusion or TAR.

Methods: A review has been performed on the role of AJD in advanced OA of the ankle. The exploration machine was MedLine. The keywords utilized were: joint distraction ankle. Three hundred and eleven articles were found. Of the above-mentioned, only 14 were chosen and analyzed because they were rigorously focused on the issue and the question of this paper.

Results: The types of articles published until now have a poor level of evidence (levels III and IV). The overall number of patients managed until now by way of AJD is 249. The published mean follow-up is very variable, from 1 year to 12 years.

Conclusion: The rate of good outcomes ranged between 73% and 91%. The percentage of failure (final ankle arthrodesis or TAR) ranged between 6.2% and 44%. A minimum of 5.8 mm of distraction gap must be achieved. Ankle function after AJD deteriorates over time. Putting together ankle movement and distraction will result in an early and maintained profitable influence on outcome.

Keywords: Ankle, Failures, Joint distraction, Osteoarthritis, Results

Introduction

Osteoarthritis (OA) is a degenerative articular illness with a prevalence of about 10% of adult people. In advanced stages of OA severe disability will result. For these advanced cases of OA, no efficacious management is accessible yet (1, 2). AJD could be a viable treatment alternative for advanced ankle OA. This procedure avoids the potential complications associated with ankle arthrodesis or total ankle replacement (TAR) in patients with ankle OA (3, 4). AJD seems to be a workable option to ankle arthrodesis or TAR (5).

The objective of this paper is to revise the MedLine literature with the intention of responding the following question: What are the short-term and long-term

outcomes of AJD in advanced OA of the ankle.

Materials and Methods

A review has been carried out on the value of AJD in end-stage OA of the ankle. The exploration machine was MedLine (PubMed). The keywords utilized were: joint distraction ankle. Three hundred and eleven articles were found. Of those, only 14 were chosen and analyzed because they were rigorously focused on the issue and the question of this paper.

Results

The kinds of reports published have a low level of

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evidence (levels III and IV).

In 1978 Judet and Judet reported a hinge distraction device which permitted physiological mobility of articulations after surgical techniques such as arthrolysis or arthroplasty (6). They observed that the use of the device permitted the generation of fibrous tissue between the bony ends.

In 1995 van Valburg et al performed AJD for three months with an Ilizarov external fixator in 11 patients with ankle post-traumatic osteoarthritis to aim to retard the necessity of an arthrodesis (1). They found clinical amelioration in pain and movement for a mean of 2 years, with an increment in the ankle joint space.

In 1999 van Valburg et al published that Ilizarov joint distraction was an encouraging technique for advanced ankle OA, at least retarding the necessity of an ankle fusion (7). Taking into account the high incidence of OA and the lack of a solution for this illness, Ilizarov joint distraction as a remedy for OA may have great therapeutic, social and economical influence.

Thirty-eight patients with advanced ankle OA who were being intended for ankle fusion were treated with AJD by Marijnissen et al (8). In addition, they compared AJR with ankle debridement. The mean follow-up was 2.8 years). Meaningful clinical profit was observed in 75% of patients. The amelioration raised over time. Radiological assessment demonstrated augmented joint space width and diminished subchondral sclerosis. Besides, AJD exhibited superior results than ankle debridement.

In 2005 Ploegbaers et al reviewed twenty-two patients with advanced ankle OA managed with AJD (Ilizarov external fixator) (9). There were 27% of failures. In 73% of patients substantial clinical amelioration was observed for at least 7 years.

In 2008 Paley et al reviewed 32 patients who underwent AJD and found that 78% of patients preserved their ankle movement and had no pain to sporadic moderate pain that can be treated usually with NSAIDs (10). Only one necessitated an ankle arthrodesis, and only one required a TAR.

In 2009 Tellisi et al analyzed 23 patients who underwent AJD (11). The mean age of their series was 43 years. Follow-up was 30 months on average. Adjuvant surgical procedures were carried in 16 cases including Achilles tendon lengthening (five), ankle arthroscopy (four), open arthrotomy (one), and supramalleolar tibial and distal fibular osteotomy to correct distal tibial deformity (six). Twenty-one patients (91%) proclaimed ameliorated pain. The mean preoperative AOFAS score was 55, and the mean postoperative score was 74 (significant difference). SF-36 scores demonstrated moderate amelioration in all elements. Total ankle motion was preserved in all patients with amelioration in the range of motion in five patients who commenced with mild equinus contractures. Only two of the patients went through ankle arthrodesis following AJD.

In 2011 Intema et al reported twenty-six patients with severe post-traumatic ankle osteoarthritis who had been treated with AJD for 3 months (Ilizarov external fixator)

(12). Subchondral sclerosis with local cysts was observed in baseline scans. At 1 and 2 years of follow-up, a general lessening in bone density (-23% and -21%, respectively) was encountered. AJD resulted in a reduction in pain and functional deficiency. Ameliorations in clinical results were best connected with dissolution of low-density (cystic) zones.

Thirty-six patients were randomized by Saltzman et al to surgical management with either immovable AJD or AJD with motion (13). The series was followed for 24 months after removing the external fixator (EF). The Ankle Osteoarthritis Scale (AOS) was recorded. Two years after EF removal, patients in both groups showed substantial amelioration compared with the status prior to AJD. Patients treated with motion-distraction showed substantially better AOS scores than patients treated with fixed-distraction at 26, 52, and 104 weeks follow-up. At 104 weeks, the motion-distraction patients had a general mean amelioration of 56.6% in the AOS score, while the fixed-distraction patients had a mean amelioration of 22.9%.

In 2014, Marijnissen et al performed a survival analysis of 25 patients with 12 years of follow-up (14). Regression analyses were utilized to prognosticate failures and clinical profit at 2 years after AJD. Survival analysis demonstrated that 44% of the patients failed, 17% in 2 years and 37% in 5 years following AJD. Survival analysis in subgroups demonstrated that the failure rate was only distinct in female gender (30% at 2 years) versus male gender (after 11 years still no 30% failure). Female gender was preindicative of failure 2 years following AJD (multivariate analyses). Gender and functional limitation at baseline anticipated more pain. Functional limitation and pain at baseline were correlated with more functional limitation. AJD showed a long-term clinical favorable result. However, the percentage of failure was substantial over the years. Women had a greater possibility of failure during follow-up.

In 2015 Nguyen et al analyzed 29 patients (minimum follow-up of 5 years, mean 8.3 years) (15). Sixteen (55%) of the 29 patients still had the natural ankle articulation while 13 patients (45%) had went through either ankle fusion or TAR. Positive predictors of ankle survival were the following: a better Ankle Osteoarthritis Scale (AOS) score at 2 years, older age at the time of surgery, and immovable distraction. Radiological examination and advanced imaging demonstrated worsening of ankle OA at the time of final follow-up. Table 1 summarizes main characteristics and outcomes of the literature.

Regarding the amount of distraction required in AJD, the results reported by Fragomen et al in a cadaver study suggested that if the radiological articular space of on a standing X-ray of an ankle going through AJD exhibits a minimum of 5.8 mm of distraction gap, then there will be no contact between articular surfaces throughout full weight-bearing (16). Therefore, 5 mm of radiological articular space, as proposed historically, could not be appropriate to preclude contact of the articular surfaces throughout weight-bearing.

Table 1. Main data and results in the literature on ankle joint distraction (AJD) for advanced ankle osteoarthritis (OA)

Author (year) (Ref)	N ^o patients	Mean age	Time of distraction	Associated motion	Mean follow-up	Clinical result	Imaging result	Rate of failure
Van Valburg (1995) (1)	11	NA	3 months	No	2 years	Clinical improvement in pain and mobility	An increase in the joint space was found	NA
Marijnissen (2002) (8)	38	NA	NA	No	2.8 years	Clinical benefit was found in 75% of the patients. The improvement increased over time.	Increased joint space width and decreased subchondral sclerosis were encountered.	NA
Ploegmakers (2005) (9)	27	NA	NA	No	NA	In 73%, improvement in all clinical parameters was maintained for at least 7 years.	NA	27%
Paley (2008) (10)	32	NA			NA	78% of patients had maintained their ankle ROM and have no pain to occasional moderate pain that can be managed generally with NSAIDs alone. Only one required an ankle fusion, and only one was converted to a TAR	NA	6.2 % (one required an ankle fusion, and one had to be converted to an ankle joint replacement.
Tellisi (2009) (11)	25	43	NA	No	30 months	91% reported improved pain. ROM was maintained in all patients with improvement in the functional arc of motion in five patients who started with mild equinus contractures. Only two of the patients in the study underwent fusion after AJD.	NA	8.6 % (two of patients underwent fusion.
Intema (2011) (12)	26	NA	3 months	No	1 and 2 years	AJD resulted in a decrease in pain and functional deficit. Improvements in clinical outcomes were best correlated with disappearance of low-density (cystic) areas ⁷	Baseline scans demonstrated subchondral sclerosis with local cysts. At 1 and 2 years of follow-up, an overall decrease in bone density (-23% and -21%, respectively) was observed. Interestingly, density in originally low-density (cystic) areas increased.	NA
Saltzman (2012) (13)	36	NA	NA	Yes	2 years	Patients were randomized to treatment with either fixed distraction or distraction with motion. Patients in both groups showed significant improvement compared with the status before treatment. The motion-distraction group had significantly better AOS scores than the fixed-distraction group at twenty-six, fifty-two, and 104 weeks after frame removal. At 104 weeks, the motion-distraction group had an overall mean improvement of 56.6% in the AOS score, whereas the fixed-distraction group had a mean improvement of 22.9%.	NA	NA
Marijnissen (2014) (14)	25	NA	NA	NA	12 years	AJD showed a long-term clinical beneficial outcome.	NA	Survival analysis showed that 44% of the patients failed, 17% within 2 years and 37% within 5 years. Female patients had a higher chance of failure during follow-up.
Nguyem (2015) (15)	29	NA	NA	NA	8.3 years	55% of patients still had the native ankle joint. Positive predictors of ankle survival included a better clinical score at two years, older age at surgery, and fixed distraction.	Radiographs and advanced imaging revealed progression of ankle OA at the time of final follow-up.	45% of patients underwent either ankle arthrodesis or TAR.

NA: Not available, ROM: Range of movement, AOS: Ankle Osteoarthritis Scale, NSAIDs: Non-steroidal anti-inflammatory drugs, TAR: Total ankle replacement

Discussion

The intention of this paper was to revise the literature with the aim of responding the following question: What are the outcomes of AJD in advanced osteoarthritis of the ankle. The quality of studies published up to now on the topic is poor (low level of evidence, levels III and IV).

The overall number of patients managed up to now with AJD is 249. The published mean follow-ups are very variable, from 1 year to 12 years (1, 8-15). The rate of good results (clinical improvement) ranged between 73% and 91% (1, 8-15). The percentage of failures (final ankle arthrodesis or TAR) ranged between 6.2% and 44% (1, 8-15). The report with the longest follow-up demonstrated that 44% of the patients failed, 17% within 2 years and 37% within 5 years (14). Women had a greater possibility of failure during follow-up.

For Nguyen et al, positive predictors of ankle survival were the following: a better AOS score at 2 years, older age at the time of surgery, and immovable distraction (15). Radiological examination and advanced imaging demonstrated worsening of ankle OA at the time of final follow-up. Adding ankle mobility to AJD demonstrated an early and maintained beneficial influence on result (13).

A minimum of 5.8 mm of distraction gap must be achieved because 5 mm of radiological articular space, as advised historically, could not be appropriate to preclude contact of the joint surfaces throughout weight-bearing (16).

In our review of the literature we have observed a broad range of amelioration rate, ranging from 22.9% to 91%. There are some possible explanations to this fact: distinct inclusion criteria, distinct indications (the surgical technique was usually advised in well-aligned and stable ankle joints in younger patients), distinct surgical procedures (some authors utilized bone marrow

aspiration injection simultaneously).

In the literature there are some concerns with respect to the level of distraction and possible nerve injury or functional results. Thus, it is a debatable topic that requires further investigation.

Ankle function after AJD appears to worsen over time. It is also real for all reconstructions including ankle fusion or TAR. However in 1999 van Valburg et al stated that best outcomes of AJD can be encountered after one year following AJD (7).

There is a polemic in the literature concerning whether AJD must be fixed or with movement. Saltzman et al have observed that motion-distraction generated substantially superior AOS scores than immovable distraction at 26, 52, and 104 weeks follow-up (13). However, Nguyen et al encountered AJD as a favorable predictor of ankle durability (15).

In conclusion, between 73% and 91% of patients with advanced OA of the ankle attained a clinical gain from AJD. A minimum of 5.8 mm of distraction gap must be achieved. Putting together ankle movement and distraction demonstrated an early and maintained beneficial effect on result. Ankle function after AJD deteriorates over time.

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