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Arthrodesis with the Ilizarov ring fixator for severe ankle arthritis

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Abstract

Introduction End-stage ankle arthritis is a very painful and disabling pathology, associated with deformity. Infection, poor skin condition, chronic smoking, Charcot arthropathy may not only affect selection of treatment method but also union, leading to unfortunate amputation. Ankle arthrodesis is indicated in advanced ankle arthritis. A variety of fixation methods are available for arthrodesis ranging from internal to external fixation. The Ilizarov ring fixator is a dynamic versatile fixation method. It is a biomechanically stable and minimally invasive method which promotes bone union and has advantage of initiating early weight-bearing and simultaneous deformity correction. We describe our experience in Ilizarov ring fixator application for ankle arthrodesis in 5 patients with severe ankle arthritis and their functional outcome. **Materials and Methods** This retrospective study was conducted in 5 ankle arthrodesis cases using the Ilizarov ring fixator application from July 2021 to October 2022 in the department of orthopaedics, Jaipur national university, India. Average age of patient was 52 years (range, 40-65). Among included patients one patient had chronic osteomyelitis of the distal tibia and severe arthrosis of the ankle joint with a non-healing ulcer, two patients had post-traumatic arthrosis following talus and distal tibia plafond fracture, Charcot ankle arthropathy and tuberculosis of the ankle joint was detected in two patients respectively. Postoperative pain relief, deformity correction and radiological union at the fusion site were defined as success. **Results** Fusion was achieved in all patients (100%). Early post-operative ambulation and full weight-bearing was initiated in every case. Pin-tract infection was the commonest complication. Shortening due to arthrodesis was less than 2.5 cm so limb lengthening was not done. Frame removal time was 12 to 14 weeks (average time, 13 weeks). Visual analogue scale was used in all cases. It was in the range of 2 to 3 points preoperatively and 7 to 9 post-operatively after arthrodesis. Average follow-up period was 6 months and it is still underway. AOFAS score was used for functional assessment. **Conclusion** Ilizarov ring fixator application can be considered as versatile, biomechanically stable, minimally invasive method for ankle arthrodesis in severe ankle arthritis associated with poor soft tissue condition, post-traumatic arthritis, infection, deformity, bone loss, Charcot arthropathy.

Keywords: Ilizarov ring fixator, ankle, arthritis, arthrodesis, Charcot arthropathy

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Научная статья

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Артродез с помощью аппарата Илизарова при тяжелом артрозе голеностопного сустава

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Аннотация

Введение. Терминальная стадия артроза голеностопного сустава является болезненной и инвалидизирующей патологией, связанной с деформацией. Инфекция, плохое состояние кожи, хроническое курение, артропатия Шарко могут не только повлиять на выбор метода лечения, но и привести к несращению и, к сожалению, к ампутации. Артродез показан при прогрессирующем артрозе голеностопного сустава. Для формирования артродеза возможно использовать различные методы фиксации – от внутренней до внешней. Кольцевой фиксатор Илизарова является динамическим универсальным устройством фиксации. Это биомеханически стабильный и минимально инвазивный метод, который обеспечивает сращение костей и имеет преимущество в плане возможности осуществления ранней нагрузки и одновременной коррекции деформации. В работе описан опыт применения аппарата Илизарова для формирования артродеза у 5 пациентов с тяжелым артрозом голеностопного сустава и функциональный исход. **Материалы и методы**. Ретроспективное исследование проведено в 5 случаях артродеза голеностопного сустава с использованием аппарата Илизарова с июля 2021 г. по октябрь 2022 г. в отделении ортопедии Джайпурского национального университета, Индия. Средний возраст пациентов составил 52 года (диапазон от 40 до 65 лет). Среди включенных в исследование пациентов у одного был хронический остеомиелит дистального отдела большеберцовой кости и тяжелый артроз голеностопного сустава с незаживающей язвой, у двух пациентов был посттравматический артроз после перелома таранной кости и дистального отдела большеберцовой кости. Артропатия голеностопного сустава Шарко и туберкулез голеностопного сустава был выявлен у двух пациентов. Послеоперационное исчезновение боли, коррекция деформации и рентгенологическое сращение в зоне артродеза расценивались как успех. **Результаты**. Сращение достигнуто у всех пациентов (100%). В каждом случае инициировалась ранняя послеоперационная ходьба и полная нагрузка. Наиболее частым осложнением была инфекция спицевого хода. Укорочение за счет артродеза составило менее 2,5 см, поэтому удлинение конечности не проводилось. Срок снятия аппарата составил от 12 до 14 недель (в среднем 13 недель). Во всех случаях для оценки использовалась визуальная аналоговая шкала. Ее значения были в пределах от 2 до 3 баллов до операции и от 7 до 9 баллов после операции артродеза. Период наблюдения в среднем составил 6 месяцев и продолжается до сих пор. Шкала AOFAS использовалась для функциональной оценки. **Заключение**. Метод Илизарова можно рассматривать как универсальный, биомеханически стабильный, малоинвазивный вариант формирования артродеза при тяжелом артрозе голеностопного сустава, связанном с неудовлетворительным состоянием мягких тканей, посттравматическими изменениями в суставе, инфекцией, деформацией, остеопорозом, артропатией Шарко.

Ключевые слова: аппарат Илизарова, голеностопный сустав, артрит, артродез, артропатия Шарко

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INTRODUCTION

Ankle arthrodesis is indicated in advanced ankle arthritis [1, 2, 3]. It could be due to post-traumatic, congenital or neuromuscular disorders, infection, avascular necrosis of the talus, Charcot arthropathy, bone tumours [4, 5, 6, 7]. It is a salvage procedure and an alternative to below-knee amputation in patients with end-stage ankle arthritis [5, 6, 8]. End-stage ankle arthritis is a very painful and disabling pathology, associated with deformity [1, 9]. The procedure is successful

in relieving pain, correcting mal-alignment, and provides functional independence [8, 10]. Arthrodesis is also very useful following failed ankle arthroplasty [10, 11]. It is very important to understand the contributing factors like smoking, diabetes, and chronic osteomyelitis as they would likely influence the decision regarding whether to do limb salvage or opt for an amputation [7, 12, 13, 14, 15] as reconstruction efforts in these circumstances are associated with a high risk of failure [2, 12, 16].

Sir John Charnley introduced compression arthrodesis of the ankle in 1951 [17]; since then many modifications have been described, having variable success rates [4, 5, 18]. There are various methods to achieve ankle arthrodesis from internal fixation with the help of screws, plates, intramedullary nails to external fixation [18, 19]. There is no gold standard method. Controversy exists with respect to the optimal technique for ankle arthrodesis to acquire stable rigid fixation, which does not allow interfragmentary motion and permits full weight-bearing [1, 18, 19, 20].

Internal fixation for ankle arthrodesis is sufficient in most cases but situation becomes difficult in the presence of poor skin condition, active infection, bone loss, deformities around the joint, limb shortening [21]. Solid fusion is difficult to obtain in these conditions. Failure of arthrodesis with infection often ends up in disappointing amputation [5, 22]

In the last few years, the Ilizarov ring fixator has revolutionized the treatment of arthritis. In the conditions with poor skin, infection, bone loss, deformity, the Ilizarov fixator has advantage of being minimally invasive, versatile and dynamic device, which provides circumferential rigid fixation permitting axial loading. Weight-bearing promotes high union rates and improves functional capacities of patients [3, 5, 7, 13, 17, 23, 24].

MATERIAL AND METHODS

This study was conducted at the department of orthopaedics of Jaipur national university medical college from July 2021 to October 2022. Five cases (4 males, 1 female) of advanced ankle joint arthritis were retrospectively analysed. Patients whose records were missing and lost to follow-up were excluded from the study. Average age of patient was 52 years (range, 40-65). All patients were subjected to ankle arthrodesis with the Ilizarov external fixator.

The data collected were demographic profile of patients, mechanism, side of injury, method of fixation if any, skin condition, history of previous illness like diabetes, tuberculosis, history of steroid consumption, history of chronic smoking, indication for ankle arthrodesis, limb length discrepancy, need for bone grafting, revision surgery required, mean hospital stay.

Routine blood tests and standard radiographic images of the ankle capturing the foot in AP, lateral and oblique views were done preoperatively. Magnetic resonance imaging (MRI) was used in case of chronic osteomyelitis with severe ankle arthritis to determine the extent of infection in bone and soft tissues.

All patients were operated by the principal author. Descriptive statistics means were calculated for quantitative variables like age of the patients, length of hospital stay.

VAS was calculated both pre- and postoperatively to assess pain. AOFAS score was calculated to determine functional recovery.

Aim of this study was to assess the results of Ilizarov ring fixator application for ankle fusion in adults and also to study complications of this method.

Operative procedure

The surgical intervention was performed under spinal anaesthesia in supine position. The ankle joint was approached through the anterolateral approach. Any ulcer over the lateral aspect was excised. Dense fibrous tissues and synovium were excised; aggressive surgical debridement was done in infected cases. The articular surfaces of the distal tibia and the dome of the talus were excised with a 5-mm osteotome which facilitated good opposition between the distal tibia and the talus. The talus was aligned at 90 degrees to the tibia and was opposed to the distal tibia by temporary Kirschner wires inserted from the plantar aspect of the calcaneus to the tibia.

In the Ilizarov frame, 1.8-mm bayonet and olive wires were used, which were fixed with 160 degree (here degree of ring mention is very important) full ring for the distal tibia, half-ring for the calcaneus, and the midfoot half-ring. The midfoot half-ring was used for equines prevention. The connections between the rings were threaded rods and hinges. Compression between the tibia and talus was done with the help of the threaded rod. The cancellous bone of the lateral malleolus was excised, fragmented into small pieces then placed between the distal tibia and the talus. The midfoot half-ring was connected to the tibial ring. Limb discrepancy following surgery was less than 2.5 cm and limb lengthening was not needed. The foot was kept in 5 degree external rotation. Compression was given at fusion site at the rate of 1 mm per day from post-op day 5 and continued for the next 8 days.

Classification of patients was made as per new classification of ankle arthrodesis with ring fixator, 4 patients were type 1 and one was type 2 [29].

Prophylactic antibiotics were given for 5 days. Regular dressings were done at frequent intervals. Antitubercular drugs were started in cases whose histopathology report was suggestive of tuberculosis. As per pain tolerance, weight-bearing with a walker was permitted from postoperative day two or three.

Average hospital stay was 3 weeks; however in the case with infected ulcer it was prolonged for 4 weeks. The patients were followed-up at monthly interval for 6 months and some continue follow-ups.

Wound healing, neurovascular status of the limb, evidence of pin-tract infection, postoperative ambulation status, need for walking aid, union time and eradication of infection assessed by blood investigations were evaluated at follow-ups. VAS and AOFAS score assessment was done in all cases

X-rays were taken for assessment of bone healing and alignment. Union was judged as complete cortical bridging or bony trabeculae across the ankle joint and between fusion surfaces. Clinically, fusion was assessed by absence of pain and motion on stress application over the ankle joint

RESULTS

A total of 5 cases (4 males, 1 female) of ankle joint arthritis were included. Average age of patients was 52 years (40 to 65 years). The Ilizarov ring fixator was applied in them. Among the included patients, one patient had chronic osteomyelitis of the distal tibia with severe arthrosis of the ankle joint and a non-healing ulcer (Fig. 1). The patient had undergone multiple surgeries and was a chronic smoker. Two patients had post-traumatic arthrosis following a talus fracture and a distal tibia plafond fracture. Charcot ankle arthropathy and tuberculosis of the ankle joint was pathology in another two patients.

Fig. 1. A 51-year old male with severe infected ankle osteoarthritis who was subjected to ankle fusion with the Ilizarov ring fixator: a-c – Preoperative clinical image, X-ray, and MRI scan; d-e – Postoperative X-ray and view of applied frame; f-i – Walking with frame on and wound healing in the course of treatment

Fig. 1 (continued). A 51-year old male with severe infected ankle osteoarthritis who was subjected to ankle fusion with the Ilizarov ring fixator: j-l – X-ray and view of the wound after frame removal and at 6-months follow-up; m-o – final functional results of treatment at 6-months follow-up

Ankle arthrodesis was successful in all cases. Radiological evidence of union was seen between 10 and 12 weeks, mean time to union was 10 weeks. In one case of antituberculosis therapy, union was achieved at 20 weeks. The most important indication for arthrodesis was pain and deformity, except the case of Charcot neuroarthropathy. The average hospital stay was 3 weeks. It was prolonged in case of chronic osteomyelitis with non-healing ulcer which needed regular dressings. The patient with chronic osteomyelitis was advised to completely stop smoking.

Immediate postoperative full weight-bearing was initiated as per pain tolerance from post-op day 2 to 3. In the initial post-op month, weight-bearing with a walker was encouraged; walking without support was permitted later depending upon clinical and radiological evidence of ankle arthrodesis completeness. All wounds healed with regular dressings; no plastic surgical intervention was needed.

Pin-tract infection was the commonest complication which required antibiotics and regular dressing.

All patients tolerated the fixator well. All patients have completed their 6-month follow-up which is still underway. No patient required bone grafting, premature frame removal due to infection and pain. No case required revision to internal fixation or other treatment modality. Shortening due to arthrodesis was less than 2.5 cm, so limb lengthening was not done. Frame removal time was 12 to 14 weeks (average time 13 weeks). Limb was protected for 3 weeks following frame removal.

VAS was used in all cases. It was in between 2 and 3 points preoperatively while after arthrodesis it was between 7 and 9. AOFAS score system was used for functional assessment in all patients and will be used at the next follow-up. Average AOFAS score was 60.

DISCUSSION

Severe ankle arthritis is very painful and disabling for patients [4]. It can be treated with internal or external fixation, and even total ankle arthroplasty [1, 4, 5, 16, 19, 25]. Arthrodesis with the Ilizarov technique is a minimally invasive method which causes less damage to the periosteum and vascularity than internal fixation [5, 16]. Therefore, this method can be suitable for patients with soft tissue compromise, peripheral vascular disease, diabetes mellitus, and Charcot arthropathy [3]. In severe cases, otherwise, amputation is considered [4-6, 10, 12]

Ilizarov ring fixator application has been regarded as the last option for limb salvage in cases of severe ankle arthritis [1, 5]. Higher union rates following Ilizarov ring fixator application might be due to the stability of frame and its ability to produce desired compression at the fusion site thereby stimulating bone healing [5, 6, 15, 21, 23, 26]. The Ilizarov technique is a very stable and dynamic fixation which promotes not only bony fusion but also permits deformity correction [5, 8, 27]. One of its merits is early weight-bearing promoting functional recovery [22].

However, total ankle arthroplasty has certain theoretical advantages over ankle arthrodesis as it has less negative impact on gait and biomechanics of the adjacent joints [5, 11, 23, 28].

Charcot neuroarthropathy is one of the major indications for arthrodesis [5,9, 26]. It is joint destructive pathology leading to instability, deformity, infection with ulcers, eventually ending in amputation [3, 9]. The aim of treatment is to achieve a stable painless and plantigrade foot. This aim can be gained by other arthrodesis methods but there is high failure rate in Charcot neuroarthropathy [2, 18]. The Ilizarov method has a very good union rate in this condition as well [19, 26].

In cases with post-traumatic arthritis with bone loss, severe deformity, poor skin conditions or failed internal fixation Ilizarov ring fixator application is very useful as it not only promotes ankle fusion but also provides deformity correction and bone lengthening simultaneously [4, 6, 7, 8, 20, 27,]. Thus dynamic deformity correction is possible throughout the process of treatment [1, 2, 5, 7, 13]. In all our cases, we could achieve stable painless ankle with plantigrade foot and reasonable functional recovery as per demands of patients. But there are disadvantages associated with the method such as a heavy frame, longer treatment span, pin-tract infection, and a high learning curve for surgeons.

CONCLUSION

Thus, Ilizarov ring fixator application can be considered as versatile, biomechanically stable, minimally invasive method for ankle arthrodesis in severe ankle arthritis associated with poor soft-tissue condition, post-traumatic arthritis, infection, deformity, bone loss, Charcot arthropathy. However, to strengthen our conclusion, a larger sample size and a longer follow-up will be needed.

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