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Case Presentation
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Lateral Ankle Ligament Reconstruction Following Wide Distal Fibula Resection: A Novel Technique

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Abstract

Distal fibular tumors are rare. Following neoadjuvant treatment, a local disease control could be achieved by a wide local resection. However, it remains challenging to stabilize the joint and preserve motion. This is a case report of a young athlete treated with wide distal fibular resection for Ewing Sarcoma. We herein, describe a novel lateral ankle reconstruction technique using a gracilis tendon autograft that achieved a stable ankle joint and allowed patient to return to sports.

Keywords: Distal fibula excision; Lateral ankle ligament reconstruction; Tendon autograft; Ewing sarcoma

Introduction

Complete or partial bone resection is commonly performed for local tumor control and excision. Limb salvage procedures are preferred over amputation and became common practice specifically for growing children [1]. Distal fibular resection with preservation of the ankle joint function remains challenging. Multiple lateral ankle ligament reconstruction techniques have been described, aiming to restore a functional and stable ankle joint. These techniques include reverse transfer of the proximal vascularized fibula to reconstruct the lateral malleolus [2], tibialis posterior to peroneus brevis tendon transfer [3], reconstruction using thick fasciocutaneous island flap without fibular reconstruction [4], reconstruction using peroneus brevis tenodesis to the tibia [5]. Amidst lack of universally accepted reconstruction procedure, the choice of a specific technique relies on the surgeon's preference and experience.

We herein, describe a novel lateral ankle reconstructive procedure using a gracilis ten-don autograft to stabilize the ankle joint.

Case Presentation

Preoperative history

A 12-year-old male soccer player patient presented to the clinic with a 3-week history of right ankle swelling. Following history and physical exam, a standard radiographic assessment followed by Magnetic Resonance Imaging (MRI) of the right ankle were obtained. It showed a destructive bone lesion involving the distal fibula with soft tissue component suggestive of an Ewing sarcoma. A subsequent tissue biopsy confirmed the diagnosis.

The patient received a standard neoadjuvant chemotherapy protocol (alternating cycles consisting of Vincristine/Doxorubicin/Cyclophosphamide and Ifosfamide/Etoposide). A follow up MRI at 2.5 months showed significant shrinkage in the size of the tumor with near-complete resolution of its soft tissue component. The patient was, next, admitted for a surgical distal fibula resection.

Surgical technique

The surgery was performed, under general anesthesia, with the patient in supine position. The gracilis tendon was harvested from the ipsilateral knee, then looped upon itself. Krakow sutures were placed at both ends then the graft was tensioned. An extended lateral ankle approach was used for an en-bloc resection of the distal fibula (distal 24 cm) and its surrounding soft tissue (the peronei, the interosseous membrane and the lateral ligaments). The intraoperative frozen specimen of the tumor bed margins was negative for malignancy.

The gracilis tendon was inserted from the distal tibia to the calcaneus. Based on the tendon

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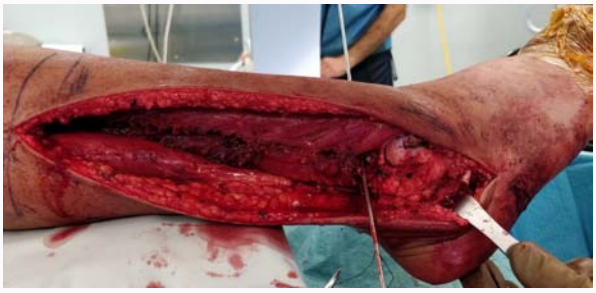

Figure 1: The distal fibula resection was completed. A guide pin was placed under fluoroscopic guidance parallel to the ankle joint from lateral to medial in the distal tibia. The peroneal tubercle is identified on the calcaneus.

Figure 2: A Guide pin was placed just distal to the peroneal tubercule in the calcaneus followed by drilling and over reaming. The gracilis tendon autograft (black star) is seen well fixed to the calcaneus.

Figure 3: The sutures at the graft end were passed from lateral to medial in the distal tibia tunnel to pull tension on the graft.

Figure 4: Ankle was positioned in neutral dorsiflexion with 5 degrees of subtalar eversion, tension was mentioned on the graft then an interference screw was inserted in the tibial tunnel.

Figure 5: The graft is shown well fixed and stable under varus stress.

Figure 6: Radiographic imaging of the right ankle 6 months post-operatively revealing a uniform space in the superior tarsal joint: a) antero-posterior view and b) lateral view.

Figure 7: A sagittal MRI view of the right ankle showing the bone tunnels in the tibia and calcaneus for the graft reconstruction with a stable ankle joint at 2 years follow up.

diameter, the calcaneal and distal tibia insertion sites were drilled and over reamed to fit the tendon autograft and a bio interference screw of 5.5 mm diameter (Arthrex®) in each tunnel (Figure 1). The calcaneal tunnel was placed just distal to the peroneal tubercle then the graft was inserted into the tunnel followed by the bio-interference screw (Figure 2). The tibial tunnel was made, under fluoroscopy, parallel to the ankle joint. The sutures at the graft end were shuttled through the tibia from lateral to medial to allow adequate tensioning. The ankle joint was maintained in neutral dorsiflexion and the subtalar joint in 5 degrees of eversion and external rotation, tension was pulled on

the graft, then a bio interference screw of 5.5 mm diameter (Arthrex®) was inserted to fix the graft into the tibia (Figure 3). A varus stress was applied to the ankle joint. Adequate clinical and radiographic stability was obtained (Figure 4, 5). The wound was closed in layers then a well-padded short leg cast was applied.

Postoperative follow-up

The patient was not allowed to bear weight on his right foot. The wound healed with no complication. At 8 weeks follow up, the patient was transitioned from a short leg cast to a walking boot for another 4 weeks. Physical therapy began with ankle range of motion and muscle strengthening. At 16 weeks follow up, the patient's ankle range of motion was near normal. Radiographs of the right ankle at 6 months follow up showed a well-balanced ankle joint (Figure 6). At the 8 months follow-up, the patient was satisfied with the outcome and his American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hind foot Rating System was 92. The patient was able to return to play with his soccer team.

At 2 years, a follow up MRI of the right ankle showed no recurrence of the tumor, no signs of arthritis and a well aligned ankle (Figure 7).

Discussion

Distal fibular resection is a rare invasive surgery that compromises the stability and function of the ankle joint. The structural and dynamic role of the distal fibula, along with the consequences of its resection, have been previously described in the literature [6-12]. Jones et al. [7] performed progressive fibular resections with the first cut created between the Calcaneofibular Ligament (CFL) and Anterior Talofibular Ligament (ATFL) insertion sites, the second cut 1 cm proximal to the first (above ATFL) and the third cut 1 cm above the second (at the syndesmosis level) [7]. The authors found that sequential distal fibular resection caused a progressive increase in talar tilt and anterior drawer at each cut level regardless of ligaments repair. Ligament repair decreased talar tilt and anterior drawer at all cut levels, however the values did not approach the control values. The ligament repair made significant improvements in talar tilt at the second and third cuts and in anterior drawer at the third cut. Distal resection without reconstruction can lead to significant loss of the three rockers of normal gait with decreased walking speed, loss of ankle range of motion, and decreased hip and knee excursion [8].

After a distal fibula resection, there is an increased incidence of ankle translational in-stability [6,7,9,10], ankle collapse into varus [11], gait abnormality affecting progression of body's center of mass [8] and joint cartilage degeneration with early onset of osteoarthritis [11]. As such, lateral ankle reconstruction, following distal fibula resection, is crucial for adequate lower limb function. The published surgical techniques included case reports and cases series.

A fasciocutaneous flaps without fibular reconstruction, was reported by Shi et al. [4], in two patients. At last, follow-up the patients showed partial loss of ankle range of motion with neutral dorsiflexion and reduced plantar flexion. A tibialis posterior to peroneus brevis tendon transfer was reported, in one patient, by Vaseenon et al. [3]. The patient was able to ambulate, with limitations in daily activities and was capable of only low-speed exertion. Monson et al. [5], in a case series of three patients, reported a satisfactory outcome following distal fibula resection. The authors tenodesed the peroneus brevis to the tibia and repaired the remnants of the calcaneofibular and anterior talofibular ligaments to the peroneus brevis tendon. Eger et al. [13], in their case report, described the use of a long portion of the iliac crest. The patient had a fluid gait and full ankle range of motion at 15 years follow up. Faure et al. [14], used a scapular apophysis to reconstruct the lateral malleolus. In their case report, the patient had a full ankle range of motion and minimal varus instability at two years follow up. Gao et al. [2] reported, at one month follow up, excellent functional results and ankle motion comparable to the contra-lateral side. The authors used a reversed vascularized proximal fibula to reconstruct the lateral ankle joint. Disadvantages of this technique included on or site morbidity, knee instability and peroneal nerve damage [15]. Morphological differences between the distal and proximal fibula could make such reconstruction challenging, with possible delayed or non-union of the fibula [2]. Jamshidi et al. [16] reported on the use of distal fibula osteoarticular allografts in four patients. At 3.2 years follow up, all ankles were stable on radiologic and clinical examinations, and all patients were able to return to daily activities with slight pain. One skeletally immature patient developed valgus deformity due to distal fibula growth arrest. The use of fresh Allografts risks an immune graft rejection or disease transmission [2]. Dieckmann et al. [11], reported on nine patients treated with tibiotalar arthrodesis using screws. Four patients had successful ankle fusion. One patient developed a super infected pseudarthrosis with talipes equinus eventually requiring amputation. The other three had non-union and required tibiotalocalcaneal arthrodesis using a retrograde nail. The authors used TESS [17] (Toronto Extremity-Salvage score) and MSTS [18] (Musculoskeletal Tumor Society score) scores for functional evaluation. They found no significant differences between the tibiotalar and tibiotalocalcaneal arthrodesis groups.

To the best of our knowledge, we described the first technique using an autograft gracilis tendon for lateral ankle ligament reconstruction following wide distal fibula resection. This technique avoids the inherit complications of a bony reconstruction, namely a non-union, bone allograft rejection, limb growth arrest, and donor-recipient sites morphological bone incompatibilities. Gracilis tendon harvesting is commonly performed for orthopedic re-constructions; it is considered a safe choice when autogenous graft is needed [19].

This study highlights the advantages and reliability of a lateral ankle ligament reconstruction, using a gracilis tendon autograft, following wide distal fibula resection. Further studies are needed to validate the findings in this cases report.

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