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Isolated proximal fibula hypertrophic non-union: a case Report

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Abstract

We report on a 59-year-old woman with an isolated, hypertrophic non-union of the proximal fibula. To our knowledge, there has been no previous literature documenting a symptomatic, isolated hypertrophic non-union of the proximal fibula. This injury may pose significant difficulty in surgical fixation due to the proximity of the peroneal nerve. In treating these patients, it is critical to consider the underlying factors that may contribute to its pathology, and to recognize alternative approaches that may lead to improved outcomes for the patient.

Keywords: Proximal Fibula, Peroneal Nerve, Hypertension, Rheumatoid Arthritis, Serum, Vitamin D.

Introduction

Proximal fibular fractures are common, but usually present with simultaneous disruption to the distal tibiofibular syndesmosis. Furthermore, isolated fractures of the fibula are relatively unusual as they present with a concurrent fracture of the tibia 75-85% of the time [1]. Most fractures of the fibula heal without any complication with 0.3-5.4% failure and eventual progression to non-union [1]. Proximal fibular non-unions are well documented in the setting of concurrent tibial fractures, but to our knowledge, no current literature exists describing an isolated proximal fibula non-union. In this report, we present the case of a 59-year-old female who presented with a symptomatic, isolated proximal fibula non-union.

The patient was informed that data concerning her case would be submitted for publication, and she provided consent.

Case Presentation

A 59-year-old woman presented to clinic with a chief complaint of tenderness in the lower left leg and difficulty with ambulation. The patient suffered an isolated proximal left fibular fracture from blunt trauma to the left leg 20-months prior and sought treatment from an outside provider consisting of anti-inflammatories and bone stimulation. Her medical history was positive for hypertension, rheumatoid arthritis, pulmonary empyema, and tobacco use. At presentation, the patient self-reported occasional knee instability but denied any clicking or popping. Prior to injury, she occasionally walked for exercise but had not been able to do so recently due to pain.

On physical examination, she had an antalgic gait and non-radiating tenderness to palpation over her left proximal fibula. Her left knee demonstrated a full range of motion with no tenderness. Radiographs taken during clinic visit show an oblique fracture over the left proximal fibular shaft with evidence of callous formation indicative of a hypertrophic non-union (Figure 1).

Figure 1: Anterior view of the left proximal fibula demonstrating a hypertrophic non-union.

Laboratory analysis of serum 1, 25 Vitamin D level, transferrin, albumin, and basic blood chemistry was ordered to investigate possible nutritional deficit with the intent of treating conservatively due to the high risk of common peroneal nerve injury. However, the laboratory results returned within normal limits. The case was presented at the departmental fracture conference where consensus was reached to proceed with intramedullary screw fixation, biopsy, and tibial metaphyseal bone grafting versus bone graft substitute. Risks, benefits, and alternative treatments were discussed with the patient, and they agreed upon surgical fixation.

The patient underwent standard pre-operative procedure for our facility including marking of the operative extremity, pre-operative antibiotics, non-sterile tourniquet use, and sterile draping. Due to concern for peroneal nerve entrapment and injury, percutaneous intramedullary fixation was first attempted. Unfortunately, an appropriate angle and path was not achievable, necessitating an open approach. Careful blunt dissection was used through subcutaneous tissues and several branches of the peroneal nerve were encountered and retracted. Once visualized, the nonunion site was debrided of abundant fibrous tissue and bridged with moldable putty bone substitute (Zimmer-Biomet Gamma-BSM). Internal fixation with compression plating was judged to be of too high risk for nerve injury given that several branches were already exposed, and extending the incision with further dissection would both endanger the common peroneal nerve and its blood supply. Fluoroscopic evaluation demonstrated appropriate position of putty, and the wound was closed and dressed after thorough irrigation. Due to the proximity of several branches of the peroneal nerve encountered during the dissection, a short leg split was applied with the foot in maximum dorsiflexion to avoid possible equinus contracture if a temporary palsy developed.

Postoperatively, the patient was told to remain non-weightbearing to the left lower extremity, and was discharged after recovery from anesthesia. At 2-week follow-up, the patient progressed to weight bearing as tolerated and radiography demonstrated satisfactory alignment with callous formation present (Figure 2). X-rays 4-weeks post-surgery showed similar results (Figure 3) with interval bony healing.

Figure 2: L. proximal fibula 2 weeks post surgery.

Figure 3: Fronterolateral L. Proximal fibula 3 weeks post surgery.

Discussion

Non-unions are categorized as the permanent failure of a bone to heal without further intervention. Most commonly, non-unions result as a complication due to improper immobilization, poor blood supply, or infection [2]. They are further categorized based upon radiographic parameters and causes. Septic non-unions will typically demonstrate osteolysis and are due to infection. Hypertrophic non-unions demonstrate callus formation without bony bridging which may be due to lack of proper stability but with adequate blood flow. Atrophic non-unions are marked by evidence of bone resorption without callus formation, caused by inadequate stabilization and inadequate blood supply. Oligotrophic demonstrate neither resorption or callus formation, and are thought to be due to inadequate reduction with continued fracture displacement [17]. The incidence of fibular non-unions has been well documented by Bhadra et. al, but the majority of these occurred in the setting of concurrent tibial or ankle fractures [3]. To our knowledge, there are no current reports on proximal, isolated non-unions of the fibula.

The rare incidence of this injury sequelae requires the careful review of the patient's underlying biological and environmental factors prior to surgical intervention. At the time of initial injury, patient history was positive for cigarette smoking, which is well-documented to increase the risk of non-unions and lead to delayed fracture healing [4]. Delay or failure to heal caused by smoking is attributed to an alteration of osteoblast and osteoclast activity and vasoconstriction caused by nicotine [5]. While tobacco consumption may have a contributory role in the pathology of this patient, it is likely not the main cause of the non-union as the proximal fibula is an area of abundant vascularity [3,6]. The abundant callus formation in Fig. 1, non-significant nutritional tests, and able ambulation of the patient without immobilization suggests against the environment as a causative factor.

Instability at the fracture site has been shown to be the principle mechanical factor leading to aseptic non-unions [6]. In the case of hypertrophic non-unions of the fibula, many of these have been shown to occur at its distal end or in conjunction with unstable tibial fixation [3,7]. Non-union occurs in this area due to inadequate mechanical stability resulting in motion which stimulates fibroblasts instead of osteoblasts. Fibroblast stimulation leads to fibrocartilage formation, collagen deposition, and subsequent non-union [8]. Importantly, abundant fibrotic tissue was noted in our patient during surgical intervention. This fibrous tissue is incapable of withstanding the stresses of normal weight bearing and caused pain with ambulation [8]. Therefore the goal of intervention is to mechanically stabilize the fracture allowing calcification of fibrous cartilage, penetration by new vasculature, bone bridging and remodeling [6].

The patient's positive history of Rheumatoid Arthritis may be relevant to both the initial fracture presentation as well as the occurrence of the non-union. The inflammatory nature of RA is known to cause delayed non-union of fractures and has been shown to contribute to the pathology of rare non-unions such as those of the radial neck [9]. Additionally, the patient was undergoing therapy with the disease modifying anti-rheumatic drug (DMARD) Leflunomide which has been shown to significantly decrease osteoblast proliferation [10].

Treatments for fibular non-unions range from observational to surgical intervention. Our patient had previously been treated with electrical stimulation by another provider, with initial symptom improvement. A literature search, however, yielded little information regarding the overall efficacy of electrical stimulation in the context of fibula non-unions. In the setting of concurrent tibial and fibular fractures, several studies show eventual union of approximately half of fibular non-unions without intervention. However, these fractures may undergo a several year course of healing before union [11]. Prolonged observation was not an option in our patient as they were symptomatic and favored surgical intervention. Additionally, this patient met many of the indications cited by previous literature for surgical intervention including fracture site tenderness, antalgic gait, and radiographic/CT evidence of non-union [3].

The case of hypertrophic non-union of the fibula traditionally requires compression plating, but the proximal fracture location in this patient raised concern for damage to the common peroneal nerve [3]. The concern for peroneal nerve damage further inhibited our multiple attempts at fixation via insertion of pins. Due to this, a bone graft was exclusively used to treat the fracture site. Ebraheim et al. previously treated 3 cases of fibular non-unions with concurrent tibial fractures using bone graft only and reported boney union at 19 and 28 months in two patients, with the third being lost to follow-up [7]. For this fracture, γGamma-bsm® Moldable Putty Bone Substitute Material was selected for the graft material. This graft was chosen due of its properties as an osteoconductive scaffold, and its ability to guide a structural framework for bone growth [12]. This synthetic, self-setting putty contains a low crystalline, calcium deficient carbonated apatite similar to the composition of natural bone [13]. Additionally, this was much more easily obtained than alternative graft options such as iliac crest or proximal tibial autograft, and avoided any subsequent donor site morbidity [12]. The primary complaint leading to failure in rigid scaffolds such as the one chosen surrounds its brittleness. However, there has been no clear evidence that suggests a superior graft material in this regard [14].

An argument could be made for an alternative surgical approach utilizing fibular excision or segmental resection, but each comes with significant associated risks. Segmental resection has been shown to alleviate symptoms that interfere with normal activity in those with a hypertrophic non-union. However, the resection site is along the diaphysis, generally no closer than five to six centimeters from either end of the fibula and is therefore not applicable to our patient [15]. An abundance of research discusses the excision of the proximal fibula in the context of bone tumors, but there seems to be a significant risk of knee instability and peroneal palsy that would likely pose too great of a risk and outweigh the benefits in our patient [16]. This option may be sought if the patient fails current fixation and returns to previous symptoms, but would be regarded as secondary option in this case. Further clinical and radiographic follow up is planned to observe for union.

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