



# Brachymetatarsia and Single-Stage Lengthening: A Case Report

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## Abstract

Brachymetatarsia is a rare deformity of uncertain etiology. It is defined as shortening of a metatarsal bone proximal to the parabolic arch. Different presentations and metatarsal involvements have been described. Many surgical techniques can be performed; however, single-stage lengthening is favored nowadays. We present a unique clinical picture of Brachymetatarsia. Our case has a symptomatic complain along with cosmetic concerns. Radiographs confirmed the diagnosis and surgical management planned accordingly. We describe our successful experience using single-stage lengthening of the third metatarsal bone. After following the patient for 3 months, we did not encounter any complications. We recommend using the single-stage lengthening to avoid risk of infection and better patient's satisfaction.

**Keywords:** Brachymetatarsia; Metatarsal shortening; Single-stage lengthening; Distraction osteogenesis

## Introduction

Brachymetatarsia is an acquired or congenital condition that is characterized by 5 mm shortening proximal to the parabolic arch of one or more metatarsals [1]. It has been recognized that Brachymetatarsia is 25 times more common in females, and presents as metatarsalgia [2]. However, in a recent systematic review published in 2015, Jones et al. reported a female to male ratio of 13.7:1 [3]. Brachymetatarsia presents in any metatarsal bones, but it is frequently observed in the fourth metatarsal. The incidence of Brachymetatarsia estimated to be 2-5:10000 in a Japanese population [4]. Various etiologies have been documented including, congenital, traumatic, idiopathic and secondary association with malignancies and syndromes. Premature closure of the physis can predispose the development of Brachymetatarsia [5]. In one study, they concluded that Brachymetatarsia can be symptomatic when a new increase in strenuous activities is initiated; however, they had limitations in excluding stress fracture. Patients with Brachymetatarsia complain of unfavorable appearance of the forefoot, irritation with the foot-wear, pain and callosities. Various surgical techniques have been described to correct the shortening deformity including single-stage lengthening, distraction osteogenesis and combination of both. Single-stage lengthening with bone graft carries potential results and complications. It provides a better compliance and decreased recovery time. However, it carries a high risk of neurovascular injury and limited lengthening outcomes. In comparison to single-stage lengthening, distraction osteogenesis allows superior lengthening results and fewer concerns to damage the neurovascular tissues. Nevertheless, presence of pins increases the risk of superficial skin infection. Moreover, metacarpophalangeal joint stiffness has been documented for both of the modalities. Jones et al. concluded, single-stage bone lengthening procedures carry the lowest rate of complications. The mean of Lengthening and healing time were found to be 13.2 mm and 9.32 weeks.

## Case Presentation

We present a 33-year-old overweight male complains of chronic pressure symptoms, discomfort and shortening of the third toe of right foot (Figure 1). He has ongoing difficulties in wearing shoes in addition to pressure discomfort and occasional pain since adulthood. He was also unpleasant regarding the cosmetic appearance of his foot. He denied any associated numbness or difficulty walking. He is not a professional athlete and he exercises few times a week. He has no history of trauma, change in body weight, consanguinity or family history of similar condition.

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Figure 1: Preoperative standing X-ray.



Figure 2: Day 1 Postoperative X-ray.



Figure 3: 6 Weeks Postoperative X-ray.

On examination of his foot, there was an apparent shortening of his third toe in comparison to other toes with evidence of cock-up deformity. There was no metatarsophalangeal dislocation, malalignment or tenderness over the affected toe. Standing radiographic evaluation of the foot confirmed the presence of Brachymetatarsia evident by a disruption of the parabolic arc. Intraoperatively, iliac crest bone graft was harvested from the ipsilateral side. Sharp dissection through direct dorsal approach and capsular release of metacarpophalangeal joint were carefully executed. Under the image intensifier, 10 mm shortening was calculated. Osteotomy was carried in the mid shaft of the metatarsal bone. A lamina spreader was used to gradually distract the osteotomy site over a period of 15 min to 20 min with extreme caution to avoid neurovascular damage. A 7 mm lengthening was achieved and confirmed under the image intensifier. A double ended K-wire was introduced from the distal end of the osteotomy and exiting through the toe. The graft then was adjusted to fit the 7 mm distraction site. Advancement of the K-wire

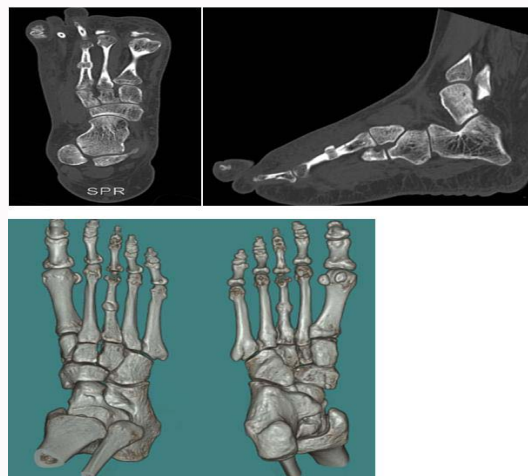


Figure 4: CT post op 12 weeks showing good callus formation, successful lengthening.

proximally passing through the graft and the proximal site of the osteotomy. Screw fixation was attempted but failed as the K-wire is passing through (Figure 2). After fixation, tourniquet was released and signs of perfusion were present distally. Z-lengthening of the extensor tendon was performed prior to the closure. He was shifted to the surgical ward, underwent serial neurovascular examination and discharged the following day without complications. We followed the patient in our clinic after 2 and 6 weeks. During his follow up, progressive signs of healing and bony union were observed. At the sixth week, K-wire was removed, and partial weight bearing initiated until full weight bearing achieved gradually. We did not encounter any neurovascular compromise throughout the follow up period (Figure 3).

## Discussion

Brachymetatarsia has been described as a congenital or acquired condition that commonly affects females. Recent reported statistics showed an incidence of 0.02% to 0.05% with a female to male ratio reaching up to 25:1 [6]. Various etiologies have been described linking Brachymetatarsia to syndromic, traumatic and congenital causes. One can hypothesize that premature closure of the physis at this anatomical region can be related to an abnormal biomechanical load to the metatarsal. As previously described in the literature, a case of premature closure of the thumb physis in a pianist due to assumption of the repetitive loading trauma or overuse injury [7]. Our reported case is a rare condition with an uncommon presentation. There is a paucity of male presentation with such condition in the literature. In addition to the rarity of third metatarsal involvement. Our diagnosis was made based on clinical and radiological examination. Brachymetatarsia can be treated for cosmetic reason and to improve patient pain. As in our case, the pain Visual Analogue Score rated 4/10 pre-operatively. In comparison to post lengthening, the score was brought down to zero. We have achieved a better pain score, and improved cosmeses as a long-term outcome.

Different surgical techniques have been proposed in the literature. Better outcomes and fewer complication rates were reported with single stage distraction osteogenesis. Lengthening can be achieved by acute distraction and bone graft augmentation. The advantageous side of this technique presents faster results and better patient's satisfaction. On other hand, it compromises the

neurovascular structure and carries higher risk of injury. Therefore, giving time during the distraction intra-operatively allows decrease in the soft tissue tension. Hence, gradual spreading while performing the distraction is paramount. Staged distraction using external fixator has a lower risk for soft tissue damage, but requires more time to reach the distraction target, in addition to, potential risk of infection. Using this technique was successful in treating our patient with high satisfaction rate postoperatively with regard to pain on VAS and appearance. In comparison to other reported complications in the literature, we did not encounter any vascular compromise or union complications. Full weight bearing was achieved as soon as callus formed. Follow up CT scan showed good healing and a satisfactory lengthening was achieved (Figure 4).

## Conclusion

Brachymetatarsalgia and cosmetic concerns mandate operative intervention in patients with brachymetatarsia. Surgical treatment of Brachymetatarsia can be achieved uneventfully without the use of external-fixation device. Minimizing the risk of infection and external-fixation discomfort can be explicit by using single-stage lengthening. At 3 months of follow up, graft was taken and union was established.

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