

Case Report
Brachymetatarsia of 4th metatarsal treated with distraction osteogenesis:
A case report

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ABSTRACT

Brachymetatarsia is a deformity of one or more metatarsal bones in which the bone length is abnormally reduced. It usually occurs bilaterally and has a female preponderance. The condition can be asymptomatic, or may cause symptoms such as pain and skin irritation. We reported a rare case of a 17-year-old male with unilateral brachymetatarsia of the fourth metatarsal. Distraction osteogenesis with the use of mini rail fixator had been performed to the patient. Satisfactory results were obtained both in cosmetic and functional outcomes. Distraction osteogenesis could be recommended as one of alternative procedures to treat brachymetatarsia. Several possible complications need to be considered during the procedure.

Keywords: Metatarsal; Brachymetatarsia; Distraction osteogenesis; Rail fixator
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INTRODUCTION

Brachymetatarsia is a deformity of one or more metatarsal bones in which the bone length is abnormally reduced. The cause of this condition is early closure of the physal-plate, which could be acquired or congenital. It is primarily idiopathic, but sometimes associated with syndromic events such as Trisomy 21, monosomy-X, pseudohypoparathyroidism, Albright syndrome, and diastrophic dysplasia.¹ The prevalence is female dominant (25:1), usually occurs bilaterally, and primarily affects the fourth metatarsal followed by the third metatarsal.² The normal length of metatarsal explained by Lelievre: the first and second metatarsals should be equal, and the other metatarsals gradually decrease in length.³ Problems in brachymetatarsia could be cosmetic due to the involvement of several rays or clinical due to abnormal plantar pressure distribution which may cause discomfort, pain, and skin irritation.^{2,3}

The management of brachymetatarsia can be operative and non-operative treatment. In most cases, the symptoms can be addressed by a non-operative approach.^{2,3} The non-operative treatment aims to reduce pressure on plantar prominence by adding a metatarsal pad to support the metatarsal head level and excavation of the insert beneath the metatarsal. Surgical treatments for brachymetatarsia include osteotomy followed by acute distraction and bone grafting, or gradual distraction (distraction osteogenesis).^{3,4} Distraction osteogenesis is one of alternative procedures to treat a shortened bone.⁵ In the recent case, we performed distraction osteogenesis with the use of mini rail fixator to treat brachymetatarsia of the fourth metatarsal. Informed consent was obtained from the patient prior to this publication.

Case presentation

We report a case of a male, 17 years old, who came to our clinic with a chief complaint of a shortened fourth toe of his right foot. The patient stated that the shortened toe happened since he was born and denied any history of trauma. The patient didn't feel any pain or discomfort. The physical examination revealed the 4th toe of the right foot was shorter than the other toes (Figure 1A). A plain radiograph was done, and it showed a shortening of the fourth metatarsal, while the rest of the phalangeal, metatarsal, and tarsal bones were normal in shape and number (Figure 1B). Preoperative screening from general physical examination to laboratory tests did not

reveal any abnormal findings. We treated the patient with distraction osteogenesis procedure with the use of mini rail fixator.

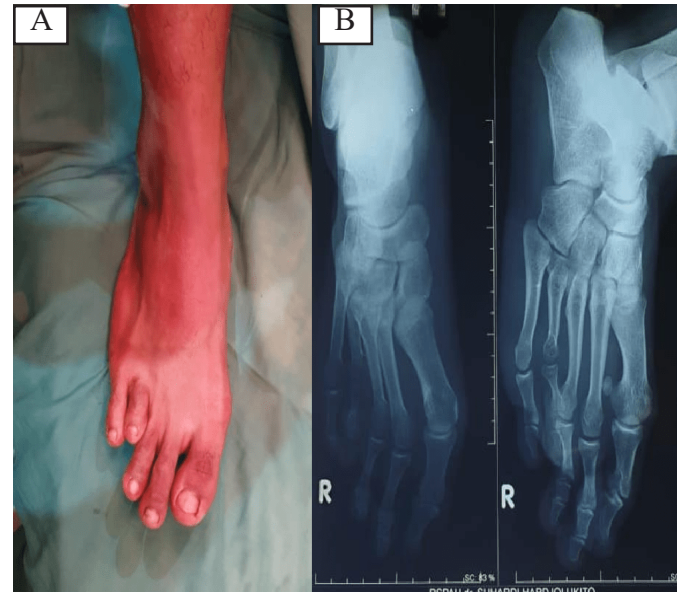


Figure 1. Pre-operative clinical (A) and radiologic pictures (B) of the right foot

Surgical procedure

Surgery was performed by one of the authors (AS). Under spinal anesthesia, the surgery was performed in supine position with knee flexion of 90°. Prior to skin incision, the 70 mm mini rail fixator (® *B-fix, Aike, Shanghai Medical Instrument, China*) was pre-assembled following the length of the fourth metatarsal length. The site for pin insertion and osteotomy were determined under fluoroscopy control. Dorsal incision was performed over the fourth metatarsal. Three pins (2mm in diameter) were inserted at the proximal metaphysis followed by two pins at distal metaphysis (Figure 2). Osteotomy was then performed between the pin insertion sites. Z-lengthening was performed to the extensor tendon of the fourth toe. Intramedullary temporary fixation was performed to the fourth metatarsophalangeal (MTP) joint with the use of 1.6 mm Kirschner-wire. The distraction was done distally and started at the 5th day after the surgery. Fixator was lengthened approximately 0.5 mm in a day.

A series of radiograph evaluations was done to evaluate the lengthening process of the fourth metatarsal and the new bone formation. Radiograph at the fourth week after the surgery showed the bone gap resulted from the distraction process (Figure 3). The intended length of the 4th metatarsal was obtained at 6 weeks after surgery (Figure

4A). Further follow-up at 16 weeks after surgery showed that the bone had been consolidated (Figure 4B, C). Thus, the removal of external fixation was performed. We followed the patient six months after the removal of the implant. The patient didn't feel any discomfort, and was able to perform daily activities without limitation. The wound was closed, and infection at the pin site was negative.



Figure 2. Radiograph of the foot at immediate after surgery.

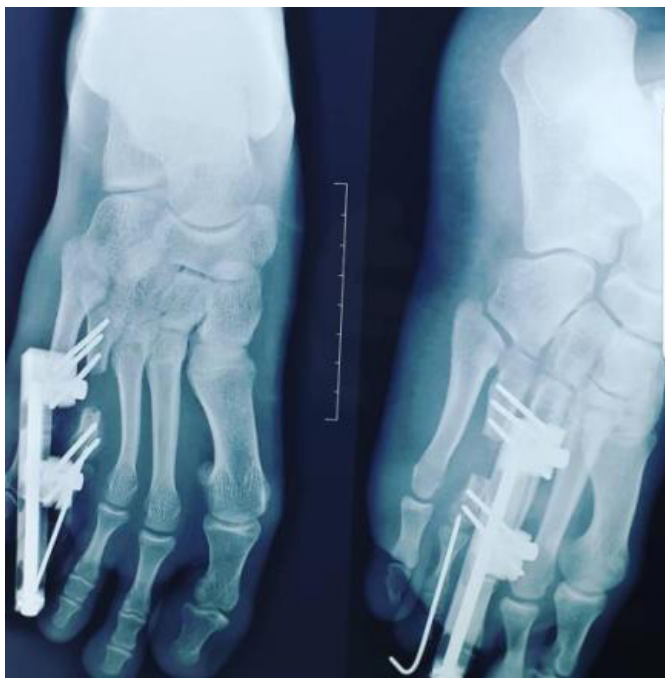


Figure 3. Radiograph of the foot at 4 weeks after surgery



Figure 4. Radiograph during follow-up. **A.** Callus formation at 6 weeks post-operative, **B.** Consolidated new bone formation at 16 weeks post-operative, **C.** Clinical picture of the fixator.



Figure 5. Final follow-up. **A.** Clinical comparison between before and after procedure. **B.** Radiograph after removal of the fixator.

DISCUSSION

Brachymetatarsia is a rare skeletal anomaly that presents in adolescence or young adulthood with cosmetic discomfort and, in some cases, with pain. Most of the cases can be treated non surgically. Few cases such as symptomatic brachymetatarsia present with pain, skin irritation, or walking difficulties need surgical intervention and results in resolved both cosmetic and pain problems.¹ In our presented case, surgery was done

for the reason of cosmetic issue as the patient wanted to join a military recruit which did not allow any congenital deformity. Furthermore, brachymetatarsia has also been reported to be one of the causes of foot pain in a military trainee.⁶

The best time for a surgical procedure for brachymetatarsia is when the growth plates of the metatarsals are closed. In our recent case, surgery was performed at the age of 17 years where all of the growth plates of the foot have been closed completely. There will be no expected complications related to growth plate injury in this patient. However, adverse events/complications related to the distraction osteogenesis procedure still need to be considered. Various complications could occur during the procedure of distraction osteogenesis.^{7,8} Specific complications related to distraction osteogenesis of metatarsal include: stiffness or subluxation of the metatarsophalangeal joint, pes cavus or plantar angulation deformity of the distal fragment, hallux valgus, malalignment (angulation), and failure of bone formation.^{8,9} In our recent case, complication of joint subluxation was prevented with the use of temporary K-wire fixation of the MTP joint which was later removed after the lengthening process completed. Furthermore, tenotomy and lengthening of the extensor tendon also performed to prevent MTP contracture. No complications related to bone formation or bone malalignment occurred in our recent case.

High degree of patient and family compliance is necessary during the procedure of distraction osteogenesis. Post-operative follow-up should be performed to the patient. The surgeon could adjust the rate of bone lengthening if the expected new bone formation was not obtained. The surgeon may delay the lengthening process or perform accordion maneuver to enhance new bone formation.¹⁰ Significant pain was another problem that could occur related to bone lengthening process. Soft tissue distraction could be the cause of pain. In our case, the patient did not complain any severe pain during the lengthening process.

CONCLUSION

Distraction osteogenesis could be recommended as one of alternative procedures to treat brachymetatarsia. Several possible complications need to be considered during the procedure.

Conflict of interest

None

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