Case Study: Single-Stage Lengthening Osteotomy for Brachymetatarsia of the 4th Metatarsal

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Purpose

The purpose of this case study is to evaluate the efficacy of a single-stage lengthening metatarsal osteotomy for the treatment of symptomatic brachymetatarsia.

Literature Review

Brachymetatarsia is seen in 0.02 to 0.05% of the population and frequently affects women[1]. Most commonly, brachymetatarsia is caused by a congenital defect leading to premature closure of the growth plates, but can also be caused by trauma and other associated conditions such as pseudo-hypothyroidism, Down syndrome, Turner syndrome or Albright syndrome[3].

Brachymetatarsia can involve all metatarsals, but frequently involves the fourth. The involved short metatarsal bears no weight and leads to an unstable floating digit which causes substantial overloading of the adjacent metatarsals[4]. Patients, therefore, often complain of metatarsalgia and plantar hyperkeratosis of the adjacent metatarsals[3].

Surgical correction is indicated in cases of symptomatic brachymetatarsia. Common surgical treatments include callus distraction and lengthening osteotomies with or without the use of bone grafts. Single-stage lengthening metatarsal osteotomies appear to have a decreased complication rate and healing time versus a callus distraction approach[2].

Case-study

A 29 year-old male presented to the clinic with complaints of pain beneath the right 1st, 2nd and 3rd MPJs when ambulating. The patient stated that his 4th toe had been short and elevated since birth. He expressed mild emotional distress due to bullying because of the physical appearance of his right foot. He was an avid runner, but had limited his physical activity due to pain. He had tried conservative treatments such as shoe gear

Case-study continued

modification, NSAIDS and metatarsal pads. The patient wished to undergo surgical correction of his right 4th toe. On physical examination of the right foot, the 4th toe was in a hammered, dorsiflexed position, floating above the weight-bearing surface. There was pain with palpation and hyperkeratosis to the plantar aspect of the 1st, 2nd and 3rd MPJs. A deep sulcus was noted under the 4th toe. Radiographically, the 4th metatarsal was short and underdeveloped with an osteopenic head (Figure 1). At this time, the patient was diagnosed with brachymetatarsia of the right 4th metatarsal. Surgical options were discussed and the patient opted for a single-stage lengthening osteotomy.

A long Z-cut osteotomy of the right 4th metatarsal was performed. The osteotomy was distracted 12mm and fixated using a non-locking plate and four 2.7mm cortical screws (Figure 2).

Post-operative management for the patient included 6 weeks full weight-bearing in a forefoot offloading shoe. Radiographic confirmation of consolidation of the osteotomy occurred at 6 weeks post- op. The patient then transitioned from the offloading shoe to a running shoe. The patient returned to his normal physical activities at 8 weeks post-op without incident. Following surgical lengthening of the patient's right 4th metatarsal, complaints of metatarsalgia disappeared and hyperkeratosis eventually subsided. The patient did present with mild, painless 4th MPJ stiffness which led to hardware removal at 18 months post-op. After hardware removal, the patient had full painless ROM of the 4th MPJ.

Discussion

Brachymetatarsia leads to abnormal pressure distribution of the forefoot, resulting in excessive weightbearing of the adjacent metatarsals[3]. Lengthening the metatarsal is indicated and can be achieved via callus distraction, single-stage lengthening osteotomy with or without bone grafts, or a combination of both [2].

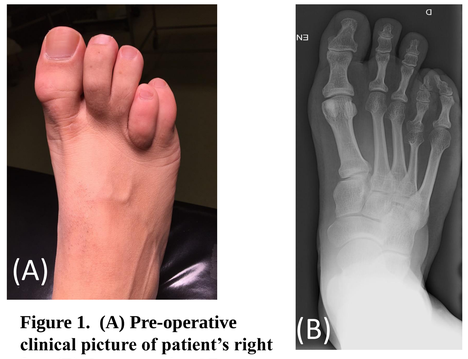

Figure 1. (A) Pre-operative clinical picture of patient's right foot (B) Pre-operative AP radiograph of patient's right foot.

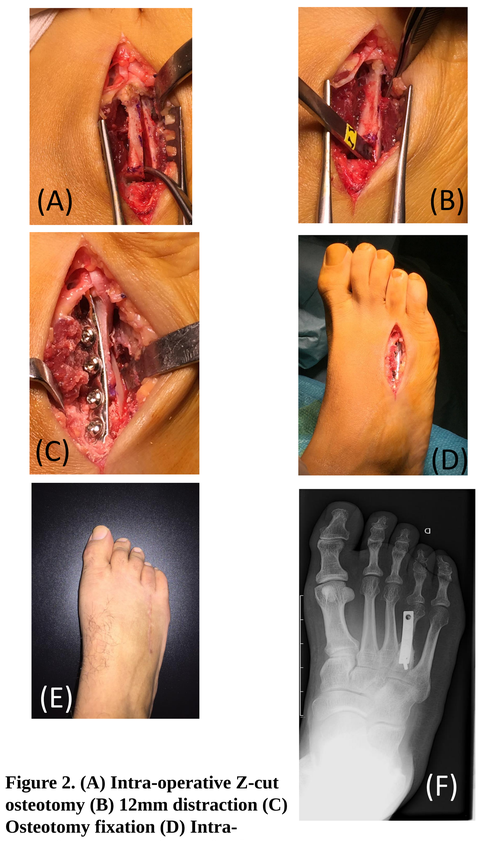

Figure 2. (A) Intra-operative Z-cut osteotomy (B) 12mm distraction (C) Osteotomy fixation (D) Intra-operative results before skin closure (E) 8 month post-operative (F) 8 month post-operative radiograph

Discussion continued

Although previous reports claim that callus distraction is the preferred choice for the treatment of brachymetatarsia, [4,5] we believe that single-stage procedures can be more beneficial for patients.

Desai et al. [1] reported that a lengthening scarf osteotomy allowed for controlled elongation of the metatarsal. The modified osteotomy permitted more secure fixation and decreased the chance of post-op shortening of the metatarsal that is often seen with a transverse osteotomy.

The Jones et al. [2] systematic review stated a 52% complication rate with callus distractions versus 19% with single-stage procedures. They explained that callus distraction allows for more lengthening, but requires twice the healing time when compared to single-stage osteotomies.

Finally, Hosny et al. [4] also reported greater metatarsal lengthening achieved with a distraction osteogenesis; however, they also noted that a single-stage procedure allows for shorter bone healing time and better patient compliance.

Compared to callus distraction, single-stage procedures permit faster healing time, earlier ambulation, and lower complication rates. This was true in our case-study; the patient healed within 6 weeks and returned to running in 8 weeks without pain. Therefore, a single-stage lengthening osteotomy is a viable option for the treatment of symptomatic brachymetatarsia.

References

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