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Case Report

Simultaneous Surgical Correction for Severe Hallux Valgus Deformity Secondary to Lessor Brachymetatarsia

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Abstract: Progression to severe hallux valgus following the second and third brachymetatarsia is a rare deformity. This condition is a challenging problem because the entire correction of hallux valgus deformity and metatarsal length discrepancy is necessary to prevent a recurrence of deformity. Metatarsal length discrepancy between the first and second ray in early adolescent patient can be aggravated with the course of time and result in a failed hallux valgus correction. Because there are few references in the literature on the operative procedures for this type of combined deformity, we report a case of 11-year-old boy treated with lesser metatarsals lengthening and the first metatarsal corrective osteotomy.

Keywords: Hallux Valgus, Brachymetatarsia, Metatarsal Length Discrepancy, Surgical Correction

1. Introduction

Symptomatic hallux valgus in adolescent male is relatively uncommon with a predominance in female. Although most patients with juvenile hallux valgus are asymptomatic and treated conservatively, the associated structural deformity such as a brachymetatarsia of adjacent metatarsals which causes the progression of hallux valgus deformity can be an indication for the surgical treatment. A relatively long first metatarsal is a risk factor for recurrence of hallux valgus deformity [1], because brachymetatarsia of the second and third metatarsals can not act as a physical barrier to prevent the valgus deviation of the big toe. This condition is a challenging problem because the entire correction of hallux valgus deformity and metatarsal length discrepancy is necessary to prevent a recurrence of deformity.

Congenital brachymetatarsia is also a deformity with a low incidence (range, 0.02-0.05%). It shows a clear female preponderance of 25: 1, and commonly affects the fourth metatarsus [2, 3]. The discrepancy between metatarsal lengths has been treated by various surgical methods such as the one-stage intercalary bone grafting [4], the gradual lengthening via distraction osteogenesis [3], the combined shortening and lengthening procedure [5]. Operative procedure is commonly decided according to the extent of lengthening to be needed, and it is still not clear which method is superior [2].

With the rarity of a progressive hallux valgus deformity secondary to lessor brachymetatarsia in adolescent male, we could find no clinical report describing simultaneous surgical correction of the hallux valgus deformity and metatarsal length discrepancy. Because there is few reference in the literature on the operative procedures for this type of combined deformity, we report a case treated with lesser metatarsals lengthening and the first metatarsal corrective osteotomy.

2. Case Report

A 11-year-old boy with congenital shortening of the right second and third toes presented with bunion pain and esthetic distress including hallux valgus deformity. He also complained the impaired gait function with bunion pain and difficulty in sport activities. He had been diagnosed to the congenital brachymetatarsia at the age of 3, not taken any treatments with no specific symptom. He showed severe

hallux valgus deformity combined with the second crossover toe (Figure 1). On physical examination, there were a painful callus under the first metatarsal head without lesser metatarsalgia, severe nonflexible limitation of motion in the first metatarsophalangeal (MTP) joint (Figure 2). He had tried bunion pad without the improvement of synptoms for 6 months. We thought that correction of length discrepancy between metatarsal bones was certainly necessary to prevent a recurrence of the hallux valgus deformity. Before operation, ideal lengths of each metatarsus were estimated in comparison with the contralateral metatarsal parabola. Standing radiograph of both feet revealed a length deficiency of 14 mm on the left second metatarsus and 13 mm on the third metatarsus. These measurements represented 30.3% and 28.5% shortening of affected rays, respectively. Hallux valgus angle (HVA), intermetatarsal angle (IMA), distal metatarsal articular angle (DMAA) were measured 42°, 13°, 18° respectively (Figure 3). With consideration for a bone block obtained from the first metatarsus, we had planned an one-stage intercalary bone grafting into the second and third metatarsals. Simultaneously, shortening chevron segment osteotomy [6] had been planned to correct a hallux valgus deformity. A medial longitudinal skin incision was made over the first metatarsus and MTP joint. The first metatarsus was osteotomized in two chevron manner with 1 cm interval at the midshaft region (Figure 4). After a removal of chevron segment, the first metatarsus was shortened. Thereafter, osteotomy site was fixed with three k-wires, with maintaining the correction of IMA and DMAA. Distal soft tissue procedures consisted of the transarticular lateral capsular release, adductor hallucis tenotomy, and medial capsular plication. A dorsal small incision was placed over the second web space to enable access to both the second and third metatarsus. Each metatarsals were osteotomized horizontally and distracted to make a gap for bone graft. Bone block removed from the first metatarsus was divided into two fragments, then placed as grafts to lengthen the second and third metatarsals. Intercalary bone grafting was secured by a intramedullary k-wire under fluoroscopic guide (Figure 5). Heel weight-bearing ambulation with hard-sole shoe was recommended for the first 6 weeks. After k-wires were removed 6 weeks postoperatively, he was encouraged the motion exercises of toes with common shoe wearing. He was able to walk without discomfort after 8 weeks postoperatively. Two years after surgery, he showed good clinical results with the American Orthopaedic Foot and Ankle Society (AOFAS) scores of 98 points, without a recurrence of the hallux valgus deformity. He did not complain of bunion pain or difficulty in sport activities. Though final extent of lengthening was decreased due to soft tissue tension as compared with that of immediately postoperative period, he was satisfied with the gross appearance of feet. Plane radiographs demonstrated a favorable congruity of the first MTP joint, despite insufficient restoration of the lessor metatarsal lengths (Figure 6). When compared with preoperative measurements, HVA, IMA, DMAA were improved to 13°, 9°, 10° respectively.

Figure 1. *Preoperative photograph shows a severe hallux valgus deformity combined with the second crossover toe in the left foot.*

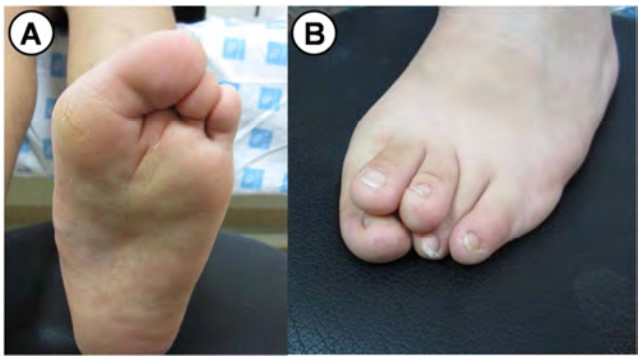

Figure 2. *Preoperative photographs show (A) a painful callus under the first metatarsal head and (B) breakage of the entire forefoot alignment by valgus deviation of the big toe.*

Figure 3. *Preoperative radiograph demonstrates a hallux valgus deformity with large distal metatarsal articular angle (DMAA), the metatarsal length discrepancy by the second and third brachymetatarsia, and metatarsus adductus in the left foot.*

Figure 4. *Drawings on preoperative radiograph describes a surgical plan which consists of the one-stage intercalary bone grafting into the second and third metatarsal bone, and the shortening chevron osteotomy (curved arrow: bone graft from the first metatarsus).*

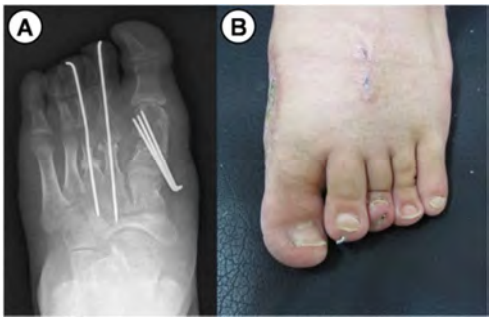

Figure 5. *(A) Postoperative radiograph shows the simultaneous surgical correction of hallux valgus deformity and metatarsal length discrepancy. (B) Postoperative photograph shows a favorable restoration of the forefoot alignment.*

Figure 6. *(A) Follow-up photograph at 2 years postoperatively shows an acceptable gross appearance. (B) Follow-up radiograph at 2 years postoperatively shows a favorable congruity of the first MTP joint, despite insufficient restoration of the lessor metatarsal lengths.*

3. Discussion

The structural abnormalities presenting in patients with juvenile hallux valgus have been reported to be a rounded metatarsal head, the loss of the sesamoid crest, the increased DMAA, a long first metatarsus, the high HVA, and the low IMA [7-9]. Barouk et al [8] reported that these structural abnormalities were observed in almost all hallux valgus cases occurring before the age of 12. The patient in this study showed the second and third brachymetatarsia in addition to these characteristics of juvenile hallux valgus. We thought that progression to severe hallux valgus deformity resulted from adjacent lessor brachymetatarsia.

The role of surgical correction in children with open growth plate is limited and usually delayed until the skeleton matures. Postoperative recurrence rate is age-dependent, and there is an increased recurrence or overcorrection rates for those who are skeletally immature [10, 11]. The patient in this study presented with the impaired gait function with bunion pain worsened over several months. In addition, the irreducible stiffness of big toe motion and the esthetic distress were gradually aggravated. Despite considering immaturity of the skeleton, we concluded that delaying the surgical correction could result in progression of forefoot malalignment and dysfunction of the first MTP joint. Because isolated surgical correction of a hallux deformity without fully addressing associated abnormalities increase the risk for recurrence, we planned to correct simultaneously the hallux valgus deformity and lesser brachymetatarsia to restore a normal parabolic arch of foot. A long first metatarsal increases the bunion pain and can be a risk factor of recurrence [1], because brachymetatarsia of the second and third metatarsal can not act as a physical barrier to prevent the valgus deviation of the big toe. The discrepancy between metatarsal lengths was decreased by shortening the long first metatarsus, and by using the bone from the first metatarsus as a graft to lengthen the second and third metatarsals. We temporarily used 1.6 mm k-wires to maintain the intercalary bone grafting in the second and third metatarsals, and removed them 6 weeks postoperatively to minimize the risk for a growth plate injury. Also, the operative site for a shortening chevron osteotomy was sufficiently remote from the physis of the first metatarsal, when compared with conventional proximal metatarsal osteotomies for the juvenile hallux valgus.

Many authors reported that hallux valgus in males was more difficult to treat surgically and was associated with other deformities, such as pes planus and metatarsus adductus [7, 8, 10]. Nery et al [12] reported that hallux valgus in males is commonly hereditary (transmitted on the maternal side) in nature, and shows early onset and higher severity when compared with females. In addition, a high DMAA with congruent MTP joint was suggested to be the main intrinsic factor related with a hallux valgus deformity. Young et al [9] reported that the increased DMAA could complicate the operative correction and increase the incongruency risk after the correction. A distal soft tissue procedure and proximal metatarsal osteotomy for hallux valgus with a high degree of

DMAA can decrease the magnitude of deformity correction at the first MTP joint [13]. Many authors have reported that the scarf osteotomy for juvenile hallux valgus can be a promising technique with successful outcomes and low recurrence rates [9, 10, 14]. The scarf osteotomy can control metatarsal length and allow for shortening when the first metatarsal is excessively long, and rotation can be used to correct the DMAA. On the other hand, Chell et al [10] found that the magnitude of correction during a scarf osteotomy is limited for severe deformities with a high degree of DMAA. In addition, they concluded that scarf osteotomy may increase the risk for a growth plate injury due to the longer osteotomy cuts as compared to those of other osteotomies when the patient has an immature skeleton. In this study, we used a shortening chevron osteotomy with 1 cm interval at the midshaft region and the distal soft tissue procedures. Because the patient showed the relatively high degree (18°) of DMAA in comparison with the magnitude of IMA (13°), we focused to correct the DMAA through the manipulation and the additional shaving of osteotomy site under fluoroscopic guide.

The discrepancy between the metatarsal lengths in the brachymetarsia is treated by various surgical methods which can be decided according to the extent of lengthening to be needed. Kim et al [5] proposed that one-stage lengthening should be performed only in patients who require less than 25% lengthening of the metatarsus. Haleem et al [15] reported that distraction osteogenesis with external fixator allows for lengthening of 40% to 60% of the original metatarsal length. The combined lengthening and shortening procedure is known to be a technique which can avoid the complications such as donor site morbidity following the auto-bone graft, neurovascular injury from rapidly stretching soft tissues, and discomforts by long duration of external fixator use. The autograft from adjacent metatarsal bones are optimally shaped and require little shaping, and graft damage is minimized [7]. Several case series with brachymetatarsia have demonstrated the clinical outcomes following a combined lengthening and shortening procedure [5, 16, 17].

4. Conclusion

Simultaneous surgical correction through the lesser metatarsal lengthening and first metatarsal corrective osteotomy can be an effective treatment method for severe hallux valgus deformity secondary to lessor brachymetatarsia in adolescent male.

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