

Case Report

Hallux Valgus Deformity Correction using Proximal Transverse Derotational Metatarsal Osteotomy: A Report of 3 Cases

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Abstract: To date, numerous operative techniques for hallux valgus correction have been introduced by several authors. The past decades have seen a surge in minimally invasive techniques partly because of the increasing demand for cosmetic surgery. Undoubtedly, the 2nd generation minimally invasive procedure introduced by Bösch et al. largely has an advantage of minimizing scars; but the result can vary in the hands of different surgeons. More recently, the 3rd generation Chevron-Akin procedure has demonstrated good results for mild to moderate deformity correction, however, a special equipment such as Shannon burr is required to perform this procedure. In this study, we report the operative outcome of proximal transverse derotational metatarsal osteotomy followed by cannulated screws or Kirschner's wires fixation across the osteotomy for three patients with moderate hallux valgus. Satisfactory to excellent correction was achieved by lateral translation and suspension of the distal fragment for all three cases.

Keywords: Forefoot; Hallux valgus; Axial rotation; Proximal transverse metatarsal osteotomy; Derotation

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1. Introduction

To date, more than 120 operative techniques have been developed for the correction of hallux valgus deformity. The purpose of the operations is to reduce bunion pain by correcting varus deformity of 1st metatarsal bone and valgus deformity of 1st proximal phalanx. For moderate to severe hallux valgus deformity, a pronation of the 1st metatarsal is accompanied in most cases, however, traditional osteotomy techniques such as chevron or scarf osteotomy are not primarily for correction of pronation. This limitation has led to several authors proposing and publishing a legion of techniques to achieve a desired 3-dimensional correction.

The other side of hallux valgus correction is the unsightly scar that is sometimes left with these procedures. Gradually there has been a global drive towards, minimally invasive hallux valgus corrections to address the cosmetic concerns and demands of our time. Currently, the 3rd generation minimally invasive procedure has been introduced. Among the previous procedures, the 2nd generation minimally invasive technique introduced by Bösch et al.[1] was performed with an incision less than 1cm on the medial aspect of the 1st metatarsal neck, followed by a transverse osteotomy concomitant with the fixation of an intra-medullary longitudinal Kirschner's wire (K-wire). It is technically not demanding but has shown varied operative outcomes by different authors.[2,3] The 3rd generation minimally invasive distal Chevron-Akin procedure has demonstrated good results for mild to moderate deformity correction, however, a special equipment such as Shannon burr is required to perform the procedure.[4,5] Moreover, it is still questionable whether moderate to severe deformity would be successfully corrected with distal chevron

metatarsal osteotomy.[6] It is generally believed that the osteotomy at the metatarsal shaft or proximal level is more effective to correct moderate to severe hallux valgus deformity.

In this study, we report the operative result of proximal transverse derotational metatarsal osteotomy followed by screws or K-wires fixation across the osteotomy site for three patients with moderate hallux valgus deformity. A deformity correction was achieved mainly by lateral translation and supination of the distal fragment. The ethical review committee of our institution approved this study.

2. Case reports

2.1. Case 1

A 63-year female patient visited the out-patient clinic with right bunion pain and plantar keratosis under the 2nd metatarsal head, which has not been amenable to conservative treatment. An initial weight-bearing foot anteroposterior radiograph, showed hallux valgus angle (HVA) of 28°, 1st to 2nd intermetatarsal angle (IMA) of 11.5° and distal metatarsal articular angle (DMAA) of 10° (Figure 1a). After initial work up, she was scheduled for a corrective surgery. The operation was performed in the supine position under the combined sciatic and femoral nerve block. First, a 1.6-mm K-wire (guide wire) was fixed perpendicularly to the 1st metatarsal, at 10mm distal to the 1st tarsometatarsal joint (Figure 2a). A 10mm longitudinal incision on the medial aspect was made with reference to the guide wire as the center. A transverse osteotomy was performed along the guide wire using the oscillating saw (Figure 2b). The osteotomy was extended to the 2nd metatarsal with fixation of another 1.6-mm K-wire at the center of medial eminence parallel to the transverse osteotomy line. Using the K-wire fixed at the medial eminence as a joystick, distal fragment was translated laterally with a simultaneous supination by firmly holding and pulling the proximal fragment medially with a towel clip. After a manual deformity correction, two 1.6-mm K-wires were fixed longitudinally across the osteotomy site (Figure 2c) followed by the additional insertion of two 3.0-mm cannulated screws. (Jeil Medical Corp., Seoul, Korea). With a compression force induced by screw fixation, a slight reduction loss was developed. Then, Akin procedure using through a 8-mm incision on the medial aspect of the proximal phalanx was performed with two 1.2-mm k wires (Figure 2d). We did not fix any hardware on the 2nd metatarsal osteotomy site to elevate the 2nd metatarsal by virtue with weight-bearing.

An immediate postoperative radiograph showed satisfactory correction (Figure 1b). Weight-bearing on the forefoot was prohibited for 4 weeks. The foot was protected in a specially-designed postoperative shoe with a hard outer sole. Radiographs done at three months showed the complete union of the osteotomy sites, warranting the removal of all the hardware. At 18 months postoperatively, the pre-existing bunion pain and plantar keratosis under the 2nd metatarsal head had disappeared completely without any specific complication. The radiograph showed the improved HVA, IMA, and DMAA to 3.8°, 8.2°, 6° respectively (Figure 1c). A comparative analysis of the pre and post-operative axial sesamoid radiographs, the position of the intersesamoid ridge on the plantar side of the 1st metatarsal was successfully supinated while the medial sesamoid was still laterally deviated (Figure 3). In summary, our procedure induced a small correction for IMA due to the absence of distal fragment valgus angulation, however successful postoperative derotation of the 1st metatarsal head could be obtained.

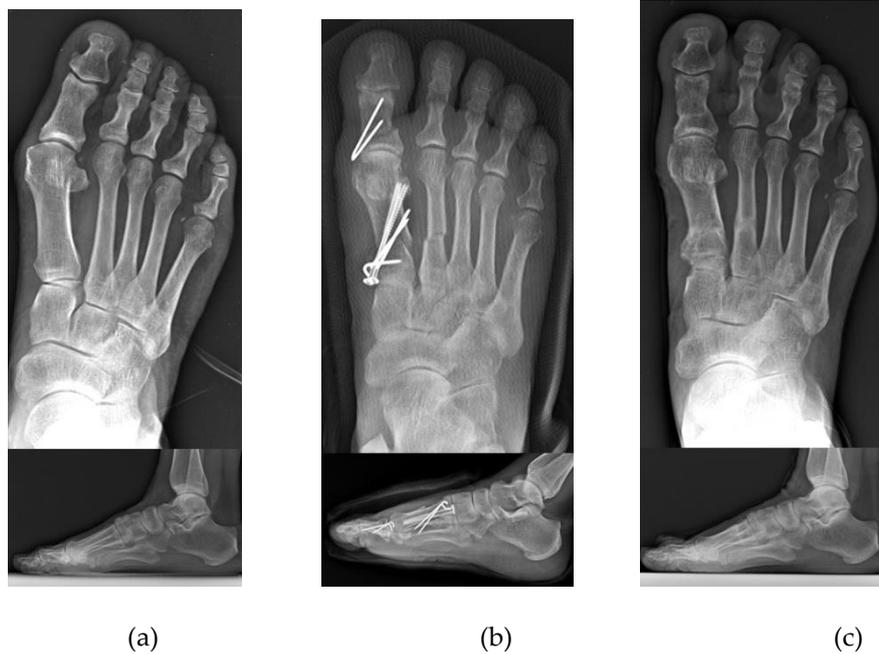


Figure 1. Radiographs of preoperative (a), immediate postoperative (b), and at postoperative 18 months (c) taken from 63-years female patient with moderate hallux valgus deformity.

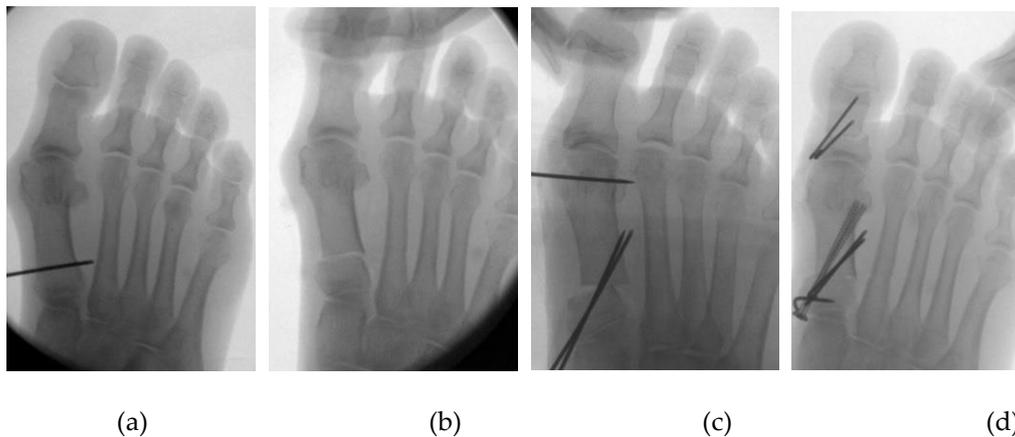


Figure 2. At first, a 1.6mm K-wire (guide wire) was fixed perpendicularly to the 1st metatarsal at 10mm distal to the 1st tarsometatarsal joint (A). A transverse osteotomy was performed along the guide wire using the oscillating saw (B). Then, another 1.6mm K-wire fixed at the center of medial eminence parallel to the transverse osteotomy line. . Using the K-wire fixed at the medial eminence as a joystick, distal fragment was translated laterally with a simultaneous supination by firmly holding and pulling the proximal fragment medially with a towel clip. Two 1.6mm K-wires were fixed longitudinally across the osteotomy site in transverse direction to the osteotomy site (C) followed by additional two 3.0mm cannulated screws fixation. After that, Akin procedure with two 1.2mm K-wire fixation was performed under another 8-mm incision on the medial aspect of the proximal phalanx (D).

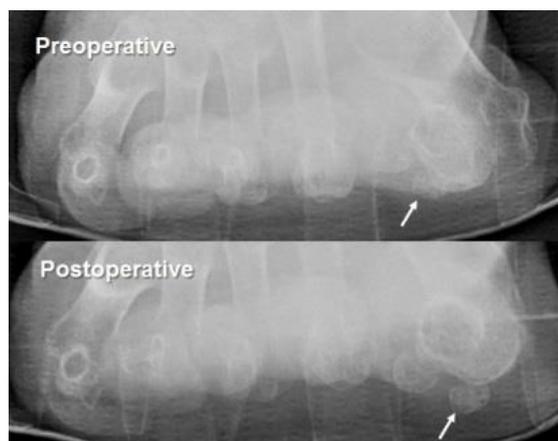


Figure 3. The comparison of pre and post-operative axial sesamoid radiographs

In the comparison of pre and post-operative axial sesamoid radiographs, the position of the intersesamoid ridge on the plantar part of the 1st metatarsal was successfully supinated while the medial sesamoid was still laterally deviated.

2.2. Case 2

A 73-years female patient visited our clinic for right bunion pain, which was not responding to conservative treatment. Preoperative HVA, IMA, and DMAA were 36.3°, 15.5°, and 36°, respectively (Figure 4a). The operation was performed in the same manner described in the first case. However in this patient, an additional 2-cm medial incision was made above the bunion after the proximal metatarsal osteotomy. Through this incision, the hypertrophied joint capsule was removed and medial eminence was resected using Rongier. To secure the osteotomy site firmly, a 3.0-mm cannulated screw and two 1.4-mm K-wires were fixed (Figure 4b). Akin procedure was performed though the premade incision above medial eminence. Similar to the first case, hardware was removed at 3 months postoperatively. HVA, IMA, and DMAA at postoperative 1 year had significantly changed to 14.9°, 8.4°, 20° respectively (Figure 4c). On the axial sesamoid radiograph, we confirmed that the position of intersesamoid ridge was largely supinated and the medial sesamoid was well reduced postoperatively. (Figure 5).

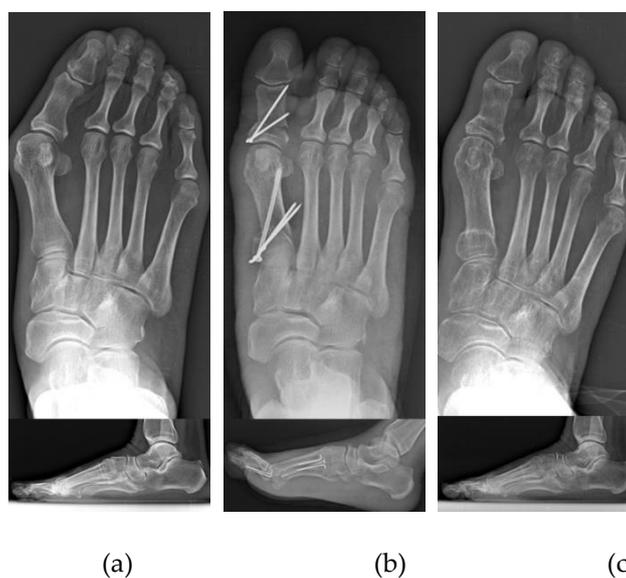


Figure 4. Radiographs of preoperative (a), immediate postoperative (b), and at postoperative 1 year (c) taken from 73-years female patient with moderate hallux valgus deformity.

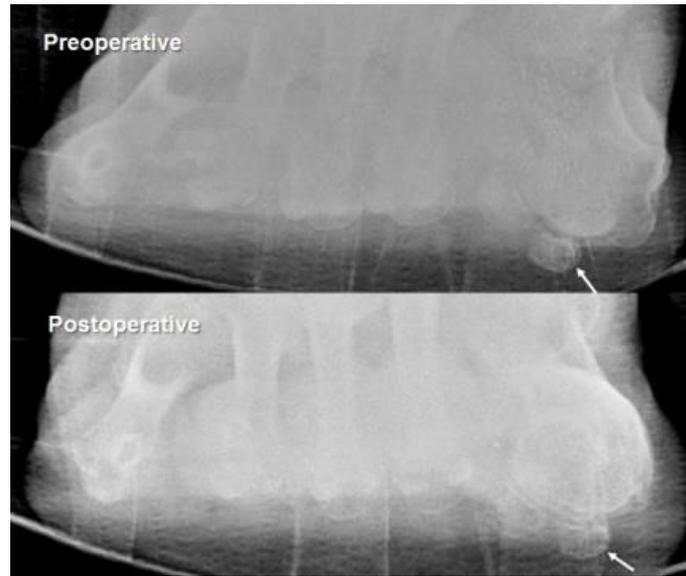


Figure 5. The comparison of pre and post-operative axial sesamoid radiographs

On the axial sesamoid radiograph, we confirmed that the position of intersesamoid ridge and the medial sesamoid were largely supinated postoperatively.

2.3. Case 3

For a 58-years female patient, the same operation was performed for left hallux valgus deformity, of which HVA, IMA, and DMAA were 34.4° , 10.4° , and 24.2° respectively (Figure 6a). Incisions and the entire operative procedure were similar to case 2. Two 3.0-mm cannulated screws and two 1.4-mm K-wires were used to secure the osteotomy site. An immediate postoperative radiograph showed satisfactory correction (Figure 6b) and the final radiograph at postoperative 1 year showed 15.1° of HVA, 5.3° of IMA, and 18° of DMAA (Figure 6c). Postoperatively, the intersesamoid ridge was supinated while the medial sesamoid was still unreduced (Figure 7).

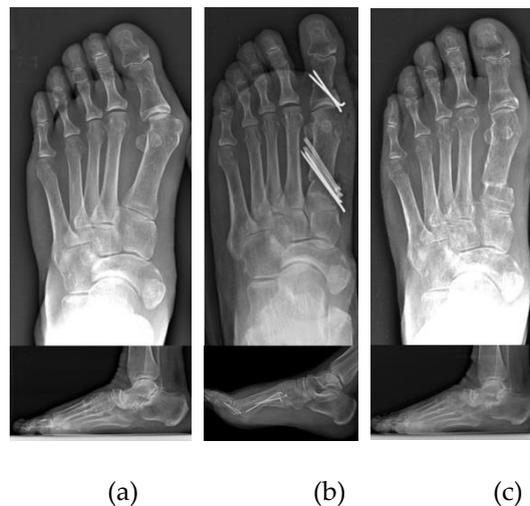


Figure 6. Radiographs of preoperative (a), immediate postoperative (b), and at postoperative 1 year (c) taken from 58-years female patient with moderate hallux valgus deformity.

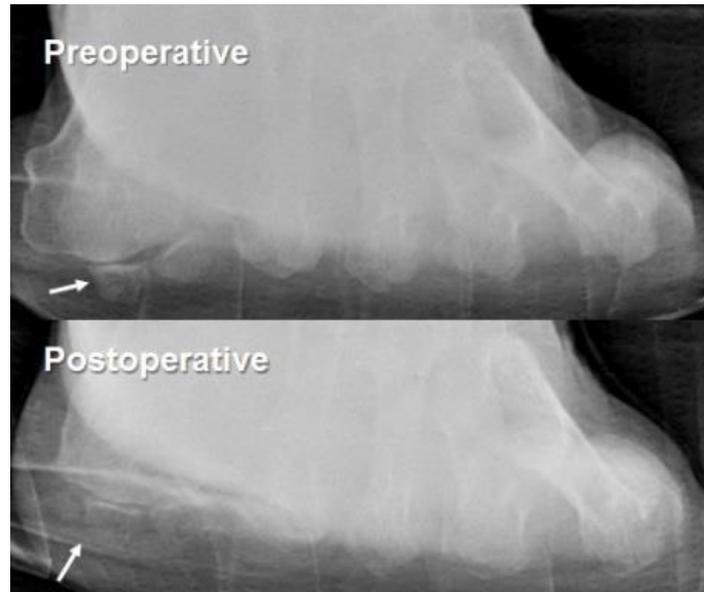


Figure 7. The comparison of pre and post-operative axial sesamoid radiographs

Postoperatively, the intersesamoid ridge was supinated while the medial sesamoid was still unreduced.

3. Discussion

With these cases, we aimed to obtain a greater correctional power for hallux valgus deformity with the derotation of the metatarsal head than those at the distal metatarsal level. Although our original plan was to achieve three-dimensional correction through this procedure, we realized that the valgus angulation of the distal fragment was unable without a wedge removal. Instead, we tried to correct the axial rotational deformity (pronation) with a transverse osteotomy which allows axial rotational correction more easily than chevron or scarf osteotomies.

Traditionally, two important components have been emphasized for hallux valgus deformity correction; valgus angulation, and lateral translation of the distal fragment after the osteotomy. In addition, the importance of the 1st metatarsal pronation correction has been in the limelight recently; as the modality to measure the axial rotation of the metatarsal head was evolved with a technical development (i.e., weight-bearing computed tomography). Wagner et al.[7] reported that 87% of hallux valgus patient showed metatarsal pronation, which could be presented as the increase in DMAA. Moreover, they also mentioned that an excessive pronation of the metatarsal may result in the malposition of medial sesamoid and arthritis of metatarsal-sesamoid articular surface. However, to date, neither the method to measure the exact amount of metatarsal pronation nor the method to obtain 3-dimensional hallux valgus correction have been established yet.

During our literature review, we found some interesting works done by other surgeons, which introduced novel osteotomy techniques designed to improve pronation of the 1st metatarsal.[8-10] Among them, proximal oblique sliding wedge osteotomy by Wagner et al.[8] had the similar concept to our osteotomy. In their study, angular correction was obtained by transverse osteotomy with an additional closed wedge removal from the distal fragment. After the deformity correction was achieved, they fixed plate and screws to secure the osteotomy site. In our experience with this procedure, shortening of metatarsal bone derived from the wedge removal was inevitable. Therefore, we modified this procedure by leaving out the removal of the closed wedge fragment. Also, we tried to perform this procedure with the fixation of cannulated screws and K-wires across the osteotomy site under a small incision. Our initial plan was to make a slight valgus

angulation after the lateral translation simultaneous with a supination of the distal fragment. However, during the operation, we realized that the fixation was not strong enough to maintain the angulation even with multiple bi-cortical screws and K-wires fixation. In this respect, the technique reported by Zein et al. [10] is noteworthy. After a similar transverse osteotomy to ours, they performed angular correction and axial rotation, simultaneous with displacing the distal fragment to the medial side. However, with their method, DMAA can be increased as they tried to correct the deformity mainly with distal fragment valgus angulation without lateral translation. Interestingly, they inserted two K-wires penetrating the 1st and 2nd metatarsals. We specifically focused on their fixation method as their results showed the successful maintenance of deformity correction with two intermetatarsal K-wires fixation. In our future cases, an additional temporary intermetatarsal K-wire fixation would be worth considering.

The limitation of our procedure includes the fact that, medial sesamoid was still relatively deviated laterally although intersesamoid ridge was largely reduced (pronated) postoperatively. Soft tissue balancing may be one of the factors mitigating the successful reduction of the medial sesamoid. Furthermore, the correctional power for HVA and IMA was not as great as proximal chevron metatarsal osteotomy or scarf osteotomy. However, DMAA was greatly improved

In summary, we expected that proximal transverse derotational metatarsal osteotomy could be effective to correct moderate hallux valgus deformity simultaneous with axial rotation correction. Although the correction for IMA was small without valgus angulation of the distal fragment, we could obtain a satisfactory deformity correction with respect to supination of the 1st metatarsal head. We expect that our clinical experience would benefit future researchers who may concern with the three-dimensional correction of moderate to severe hallux valgus deformity with excessive pronation of the 1st metatarsal.

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