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Mid-Term Results of Two Different Fixation Methods for Chevron Osteotomy for Correction of Hallux Valgus

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ABSTRACT

We compared 2 different fixation methods (bioabsorbable pins and cannulated screws) after chevron osteotomy for the treatment of hallux valgus. We reviewed consecutive proximal chevron osteotomies in 80 patients (100 feet) performed by 2 surgeons. Of the 100 feet (80 patients), 48 feet (40 patients) were stabilized with bioabsorbable pins, and 52 feet (40 patients) were stabilized with cannulated screws. In the pin group, 8 patients were male (20%) and 32 were female (80%). In the screw group, 10 patients were male (25%) and 30 were female (75%). The mean patient age was 43.1 (range 24 to 60) years in the pin group and 43.5 (range 20 to 60) years in the cannulated screw group. The visual analog scale, intermetatarsal angle, and hallux valgus angle decreased significantly and the American Orthopaedic Foot and Ankle Society scores increased significantly in all patients in both groups after surgery ($p < .05$). No statistically significant differences were found between the 2 groups ($p > .05$). Both fixation methods were found to be safe and reliable under the appropriate conditions and when performed by an experienced surgeon.

Hallux valgus is the most common problem of the forefoot in adults (1). It is progressive and involves several stages, beginning with lateral deviation of the great toe (hallux) and medial deviation of the first metatarsal (metatarsus primus varus) (2). Management of hallux valgus generally begins with conservative treatment, especially in juvenile hallux valgus. Surgical correction is indicated for cases of failed conservative management, progressive and painful deformity, or disruption of lifestyle or activity (3).

More than 140 surgical procedures have been described to correct hallux valgus. The chevron osteotomy has become widely accepted for correction of mild to moderate hallux valgus deformities (4). This technique includes removal of the medial eminence and a horizontally directed V-shaped osteotomy of the distal first metatarsal (5). The indications for this procedure include the following: failed conservative treatment, mild to moderate deformity (metatarsophalangeal angle <35° and an intermetatarsal angle [IMA] <15°), and the absence of arthritis in the first metatarsophalangeal joint.

Currently, nondegradable implants are primarily made of steel or titanium. Although these implants provide maximum stability, the disadvantages include interference with imaging modalities such as direct radiography and magnetic resonance imaging. In addition, they might require an undesirable second operation for hardware removal. Moreover, the mechanical properties of nondegradable implants are quite different from those of cortical bone, potentially resulting in inhomogeneous stress transfer and limited bone healing. This constellation of effects is referred to as "stress shielding." Therefore, it might be beneficial to use implants with a Young's modulus close to that of cortical bone. Biodegradable implants are currently in clinical use for fixation in distal chevron osteotomies. These implants are mechanically weaker than their metallic counterparts and have been associated with foreign body reactions and osteolysis (6,7). However, bioabsorbable pins have been shown to provide a similar correction of the IMA and to have comparable rates of complications compared with cannulated screws (8).

The aim of the present study was to compare the outcomes using cannulated screws and bioabsorbable pins for fixation after chevron osteotomy in the surgical treatment of hallux valgus.

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Patients and Methods

We reviewed 100 distal chevron osteotomies in 80 patients performed by 2 surgeons (B.K., B.Y.) from March 2014 to February 2016. Our local ethics committee approved the study. The mean follow-up period was 14 (range 2 to 27). All the patients provided written informed consent before enrollment in the study. Of the 100 feet, 48 feet (40 patients) were stabilized with bioabsorbable pins by 1 surgeon (B.K.) and 52 feet (40 patients) were stabilized with cannulated screws performed by 1 surgeon (B.Y.). This method was chosen to minimize surgical bias. In the pin group, 8 patients were male (20%) and 32 were female (80%). In the screw group, 10 patients were male (25%) and 30 were female (75%). The mean patient age was 43.1 (range 24 to 60) years in the pin group and 43.5 (range 20 to 60) years in the cannulated screw group. Patients with rheumatoid arthritis, hallux rigidus, or failed previous hallux valgus surgery were excluded from the present study. Clinical results were obtained using the American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score and the visual analog scale (VAS) for pain. Radiographically, the hallux valgus angle (HVA) (Fig. 1), IMA (Fig. 2), and distal metatarsal articular angle (DMAA) (Fig. 3) were measured and compared between the 2 groups. The HVA was measured as the angle between the center of the longitudinal axis of the first metatarsal and the axis of the great toe. The IMA was measured as the angle between the line of the first metatarsal and the line bisecting the diaphyseal portions of the second metatarsal. Finally, DMAA was calculated as the angle between the articular surface of the distal first metatarsal and the longitudinal axis of the first metatarsal.

Surgical Technique

The surgical technique used for both study groups was the same except that different implants were used, as described. The chevron osteotomy was performed in both groups through a medial longitudinal incision starting from the base of the proximal phalanx and extending 5 to 7 cm proximally to the metatarsal head. The subcutaneous tissue and bursa were dissected, and the capsule of the joint was identified. The capsule of the joint was incised in a Y-shaped fashion, and a straight longitudinal incision was continued out to the bone. The toe was then adducted, and a bunionectomy was performed using an oscillating saw. The medial eminence was removed, and the "V" osteotomy was performed with an angle of 50° to 60° between the cuts. After the osteotomy had been completed, the distal metatarsal head was slid laterally and displaced 3 to 4 mm. Once this displacement was complete, the osteotomy site was first fixed with Kirschner wires, after which bioabsorbable pins composed of biodegradable copolymers L-lactide, D,L-lactide, and trimethylene carbonate (OTPS Biodegradable Pins, Inion, Tampere, Finland) or cannulated screws (Herbert headless cannulated titanium screws, TST Tibbi Aletler San., Istanbul, Turkey) were applied to hold the fragments in position (Fig. 4). Postoperatively, all operative feet in both groups were placed in a splint for ~3 weeks, and weightbearing on the first toe was not allowed until the seventh postoperative week (Fig. 5). No differences were found in terms of the surgical approach or postoperative management for the patients in either group.

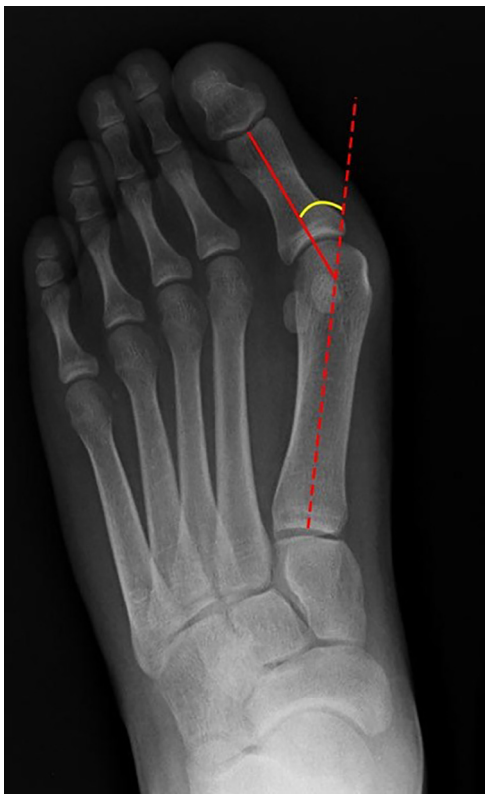

Fig. 1. Plain radiograph showing hallux valgus angle of the first metatarsal.

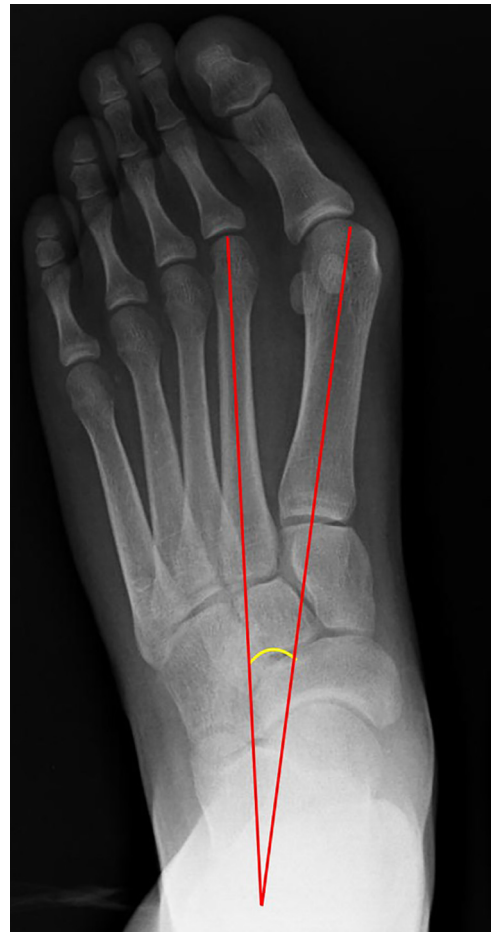

Fig. 2. Plain radiograph showing intermetatarsal angle of the hallux.

Statistical Analysis

Descriptive statistics were used to describe the continuous dependent variables (mean, standard deviation, minimum, median, and maximum). The Wilcoxon signed-rank test was used to compare the dependent data that were not normally distributed, and the Mann-Whitney *U* test was used to compare the independent data that were not normally distributed. Data were deemed statistically significant when $p < .05$. All analyses were performed using MedCalc Statistical Software, version 12.7.7 (MedCalc, Ostend, Belgium; available at: http://www.medcalc.org; 2013).

Results

We compared the age and sex distribution between the bioabsorbable pin and cannulated screw groups and found no statistically significant difference between them (Tables 1 and 2).

Changes in the HVA, IMA, and DMAA with respect to the time after surgery in the 2 groups are presented in Tables 3–5. Preoperatively,