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Original Research

Joint Preserving Procedure for Moderate Hallux Rigidus: Does the Metatarsal Index Really Matter?

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ABSTRACT

Surgical treatment of moderate hallux rigidus remains controversial and the optimal surgical technique has yet to be defined. Decompressive metatarsal osteotomy is one of the procedures available; however, one of the potential drawbacks is the effect of the metatarsal shortening. We evaluated the global effect of the decompressive metatarsal osteotomy, accounting for the metatarsal index. We retrospectively evaluated 78 patients with stage II and III hallux rigidus who had undergone Youngswick osteotomy and analyzed their outcomes according to the metatarsal index. The candidates for inclusion underwent clinical and radiographic evaluation, including the visual analog scale foot and ankle score, first metatarsophalangeal joint range of motion, and first metatarsal protrusion distance to define the metatarsal index. Also, shortening of the first metatarsal was measured postoperatively, and the occurrence of metatarsalgia was considered a postoperative complication. The mean follow-up period was 53 ± 17 months. The groups stratified according to the metatarsal index (index plus, index plus minus, and index minus) presented with similar results ($p > .05$). The average preoperative visual analog scale foot and ankle score of 56.4 ± 13.8 points improved significantly to 84.1 ± 5.5 points postoperatively ($p < .0001$). Also, the mean preoperative dorsiflexion of 20.4° ± 1.5° improved to 37.3° ± 1.6° postoperatively ($p < .0001$). Of the 78 patients, 97% would recommend the procedure to a family member or friend. Four patients (6%) experienced postoperative metatarsal pain. We found consistent results with this procedure. The reported functional score and dorsiflexion improvement provide evidence that good outcomes and high levels of patient satisfaction can be achieved, regardless of the metatarsal length.

Hallux rigidus is a condition characterized by pain and restriction in the motion of the first metatarsophalangeal joint (MTPJ), especially in dorsiflexion (1,2). The symptoms commonly associated with degenerative arthritis of the first MTPJ were initially reported by Davies-Colley (3) in 1887, although Cotteril (4) is credited with proposing the term *hallux rigidus*.

Surgical treatment depends on the etiology and severity of the deformity (3–5). Operative procedures have been divided into joint preserving techniques (e.g., cheilectomy and phalanx and first metatarsal osteotomies) and joint sacrificing techniques (e.g., arthrodesis, arthroplasty). The ultimate goal of the treatment is to correct the underlying deformity, relieve the pain, and obtain long-term functional results (6).

Decompressive osteotomy would theoretically be able to alleviate pain and improve function. A number of techniques have been described in published studies, including the Watermann procedure, which offers relocation of the articular capital fragment to a more dorsal location, thus allowing more dorsiflexion of the hallux (7). A modification of this technique is the Green-Watermann (8), which involves decompression and offers a more stable configuration of the osteotomy. Finally, the long-arm decompression osteotomy was proposed by Robinson and Frank (9) as an intermediate to the distal decompression osteotomies and more proximal plantarflexory osteotomies. They reported that it offered the possibility of greater shortening and greater plantarflexion than its more distal counterparts and was also more stable than the proximal osteotomies.

The Youngswick modification of the Austin osteotomy is one of the described decompressive procedures; however, one of the potential drawbacks of these techniques is the effect of metatarsal shortening, especially for relatively short first metatarsals (10).

The Youngswick osteotomy is a procedure conceived for relatively long first metatarsals (index plus), a characteristic that has been

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associated with the pathogenesis of hallux rigidus (10). Nevertheless, studies of this procedure that assessed the overall results and the rate of transfer metatarsalgia as a consequence of first metatarsal shortening are lacking.

We were interested in determining whether the first metatarsal relative length would affect the overall result of the Youngswick decompressive osteotomy. We hypothesized that good functional results would be achieved, regardless of the metatarsal length. Our primary aim was to evaluate the effect of the Youngswick osteotomy on the visual analog scale foot and ankle score (11), accounting for the metatarsal index. Changes in dorsiflexion, postoperative shortening, and satisfaction were also evaluated.

Patients and Methods

Patients

A review of 78 consecutive patients (78 feet) who had undergone decompressive osteotomy by 2 of us (G.S. and G.P.) during a period of 85 months (from May 2005 to June 2012) was performed. The candidates for the operation met the following inclusion criteria: (1) pain located at first MTPJ; (2) clinical loss of range of motion of the first MTPJ, defined as $<55^{\circ}$ of hallux dorsiflexion at the preoperative visit; (3) radiographic changes to the first MTPJ consistent with hallux rigidus stage II and III; and (4) a minimum 12-month follow-up period. The Coughlin modified classification scheme was used to grade the severity of the degenerative joint changes preoperatively (12,13).

Those patients who had undergone previous surgical procedures in the forefoot and those who had sustained trauma at the first MTPJ were excluded. The candidates for inclusion into the present study underwent a clinical evaluation preoperatively, and the clinical data recorded in the patients' medical records were reviewed retrospectively. All clinical measurements were taken at the initial preoperative examination and at the final follow-up visit by a member of the investigational team (V.L.). The patients were seen for follow-up visit at 3, 6, and 12 months postoperatively and then annually. The clinical examination included the visual analog scale for foot and ankle (11) to evaluate the changes in function and symptoms in the preoperative period and at the last follow-up visit, because it is a scale validated by having sufficient correlation with the Medical Outcomes Study short-form 36-item survey (14). The foot and ankle visual analog scale includes 20 questions requiring purely subjective answers in 3 different categories (pain, n = 4; function, n = 11; and other complaints, n = 5). The questionnaire uses a visual analog scale rating and computerized evaluation. For each question, a visual analog scale value from 0 to 100 points is possible. The total value for the entire scale (all 20 questions answered) is therefore 0 to 2000 points. This total is then divided by 20, resulting in a possible total score ranging from 0 to 100 points.

The total range of motion (ROM) of the first MTPJ and plantarflexion and dorsiflexion of the hallux relative to its neutral position were measured. A neutral position of the hallux was defined as the position of the first MTPJ with the foot in stance and the hallux parallel to the weightbearing surface. The first MTPJ ROM was determined clinically with the foot loaded with plantar pressure to the forefoot. Measurements were taken using a goniometer, with the midaxial line of the proximal phalanx and the plantar surface of the foot as reference points (15).

Radiographic examinations were performed preoperatively, immediately postoperatively, and at each patient's last follow-up visit by another member of the investigational team who was unaware of the clinical results (J.P.C.). Standard anteroposterior (AP) and lateral weightbearing foot radiographs were obtained preoperatively. All radiographs were taken using a standardized radiographic technique by the same radiologist. The x-ray beam was directed at a 15° caudocranial angle on the feet in the AP position, centered on the second ray, during weight bearing, with an anode-film distance of 120 cm. The magnification resulting from this procedure was negligible (16). The measurements obtained from the AP radiographs were used to measure the first metatarsal protrusion distance according to the method published by Hardy and Clapham (17). The first metatarsal length was measured and compared with the second metatarsal length on the preoperative AP radiograph (18). The data were measured and recorded in millimeters; measurements within the range of +1 to -1 mm were considered to be equal length. For analysis purposes, the relationship between the first and second metatarsal was classified as follows: plus, plus minus, or minus index according to whether the first metatarsal was longer, equal to, or shorter than the second metatarsal, respectively (Fig. 1).

Evidence of a sesamoid deformity, the shape of the first metatarsal head, the presence of osteophyte formation, loose bodies, and/or subchondral sclerosis, and evidence of nonunion were also noted and recorded from the AP and lateral radiographs to classify each patient. Shortening of the first metatarsal was also determined by measuring the first metatarsal length in the postoperative radiograph. The presence and location of postoperative metatarsalgia was also recorded. The patient satisfaction with the procedure was evaluated by querying whether they would recommend it to a family member or friend.

Surgical Technique

Surgery was performed under local block anesthesia. A tourniquet was applied at the ankle level. The MTPJ was approached through a medial incision. Care was taken not

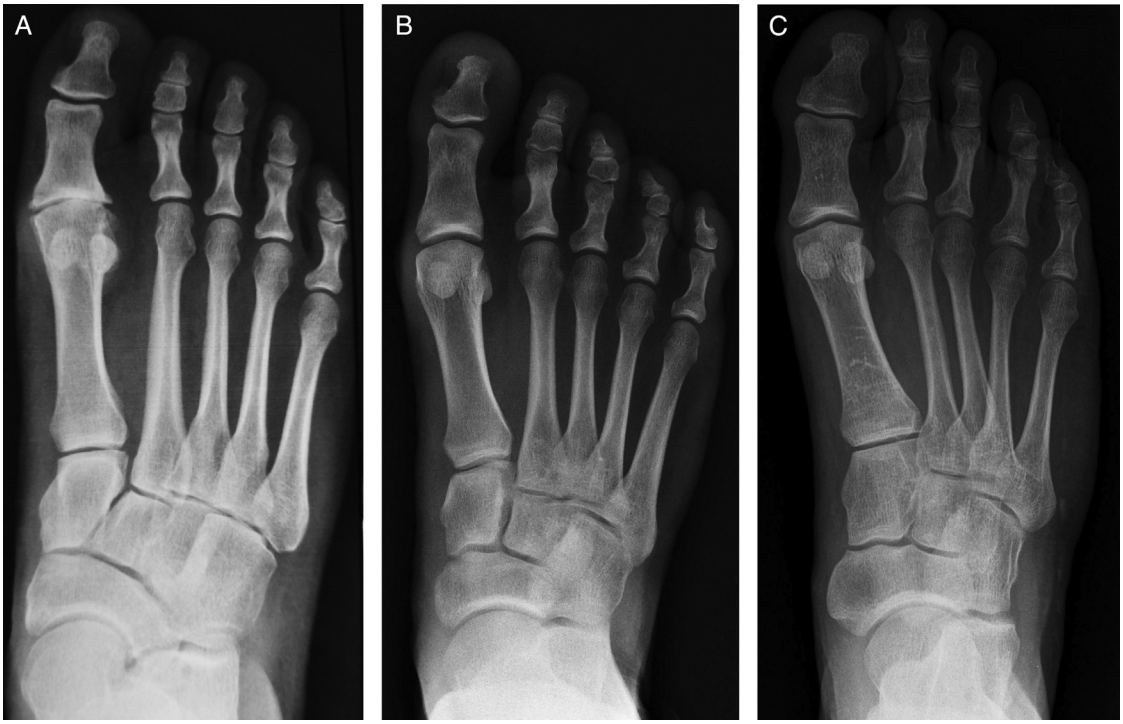

Fig. 1. (*A to C*) Images showing the 3 different metatarsal indexes. Plus indicates a long first metatarsal, plus minus indicates an equal first and second metatarsal, and minus indicates a short first metatarsal.