The Journal of Foot & Ankle Surgery

ORIGINAL RESEARCH

In Vivo Comparison of Screw versus Plate and Screw Fixation for First Metatarsophalangeal Arthrodesis: Does Augmentation of Internal Compression Screw Fixation Using a Semi-Tubular Plate Shorten Time to Clinical and Radiologic Fusion of the First Metatarsophalangeal Joint (MTPJ)?

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A retrospective analysis of first metatarsophalangeal joint fusion in 26 consecutive patients (34 feet), treated between April 1998 and February 2002, comparing single compression screw versus a compression screw supplemented with a dorsal quarter tubular plate, was undertaken. The study aimed to assess whether or not plate augmentation of the single interfragmental compression screw lead to an earlier fusion. There were 18 women and 8 men with a mean age of 54.6 ± 11.02 years and a mean follow-up of 2.9 ± 1.1 years. Successful fusion was determined clinically and radiologically by means of identifying transarticular trabeculation. The overall incidence of fusion was 97.06% (33/34 fusions). Observed complications included 4 cases of superficial wound infection, each of which resolved with antibiotic therapy; 3 cases of paraesthesia involving the dorsomedial aspect of the big toe; and 2 cases of transfer metatarsalgia. Statistical analyses did not reveal any significant associations between the type of fixation and time to fusion, patient satisfaction, and complications. In regard to the methods of osteosynthesis compared in this investigation, the choice of first metatarsophalangeal fusion fixation can be determined based on surgeon's preference. ACFAS Levels of Clinical Evidence: 2c. (The Journal of Foot & Ankle Surgery 47(1):2–7, 2008)

Key Words: arthrodesis, interfragmental compression, internal fixation, metatarsophalangeal joint, osteosynthesis, surgical fusion

Hallux rigidus, a form of osteoarthritis, is a common cause of painful restriction of movement in the first metatarsophalangeal joint (MTPJ). Arthrodesis of the first MTPJ is a commonly performed operation for hallux rigidus. Many different osteosynthesis techniques for first MTPJ arthrodesis have been described, including crossed Kirschner wires (K-wires), vertical or horizontal intraosseous wire sutures, dorsal plate and screws, interfragmentary screws, and memory staples. Clinical evidence suggests an overall 80% to 100% success rate for first MTPJ arthrodesis when it is used for the treatment of hallux rigidus.

Contradictory evidence exists in the literature in regard to cadaveric biomechanical studies aimed at assessing the strength and rigidity of different fixation methods used to

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1067-2516/08/4701-0002$34.00/0

doi:10.1053/j.jfas.2007.10.006

Figure 1 Anteroposterior and lateral radiographical view: first metatarsophalangeal joint fusion with a compression screw 6 months postoperatively.

Figure 2 Anteroposterior and lateral radiographical views revealing first metatarsophalangeal joint fusion with low profile plate along with a compression screw 6 months postoperatively.

achieve first MTPJ arthrodesis. Curtis et al (1) and Sykes and Hughes (2) found the interfragmentary lag screw fixation method to be the most stable fixation method. On the contrary, Neufeld et al (3) found that combined plate and screw constructs were statistically significantly stronger in regard to force to failure and initial stiffness, in comparison to compression screw constructs in a cadaveric biomechanical study. Unfortunately, there are few studies comparing in vivo fusion rates of proven constructs that have been evaluated in the biomechanical laboratory. Dorsal plating or interfragmental compression screws are considered by many to be a standard approach to fusion of the first MTPJ (4, 5). This retrospective clinical investigation aimed to evaluate the in vivo fusion rate for first MTPJ arthrodesis performed using either a single interfragmental compression screw or an interfragmental compression screw augmented with a dorsal one-quarter tubular neutralization plate. Our secondary aims focused on comparing foot-related quality of life and complications between the 2 fusion groups.

Patients and Methods

A retrospective study was conducted using the medical records of consecutive patients from 2 consultants' practice in the national health service, who had undergone first MTPJ arthrodesis using either a single screw or a screw supplemented combined with a dorsally placed quarter tubular plate and screws, between April 1998 and February 2002. All operations were carried out by the 2 consultant orthopedic surgeons. To be included in the investigation, patients had to have osteoarthritis (OA) in the form of hallux rigidus, and they had to have undergone first MTPJ arthrodesis using a single interfragmental compression screw (Figure 1) or a single screw augmented with a quarter tubular neutralization plate and screws (Figure 2). The rationale behind using one or the other method of fixation was based solely on the consultant surgeon's preference, after evaluation and discussion with the patient. None of the patients were noted to have previous history of trauma, gout, or other inflammatory or metabolic arthritis leading to hallux rigidus.

In all of the cases, arthrodesis of the first MTPJ was achieved by means of a dorsal, midline longitudinal skin incision made over the first MTPJ, just medial to the extensor hallucis longus (EHL) tendon. Following arthrotomy, cheilectomy was performed and all osteophytes were removed from the head of the first metatarsal and the base of the proximal phalanx. Thereafter, the articular cartilage and subchondral bone were resected in such a way that planar surfaces were left for fusion. No alterations were made to the sesamoids of the first MTPJ. The 2 segments were then aligned for fusion such that the great toe remained parallel to the second toe in the transverse plane and elevated dorsally in the sagittal plane (10- to 20-degree dorsiflexion and abduction), and temporarily held with a Kirschner wire. The proposed fusion alignment was assessed intraoperatively and then via postoperative anteroposterior (AP) and lateral radiographs. Arthrodesis was then achieved either by means of a single lagged interfragmentary compression screw (CS group) directed from the proximal and medial aspect of the first metatarsal into the proximal phalanx; or,