Arthrodesis of First Metatarsophalangeal Joint by Plate and Screws for Treatment of Hallux Rigidus

(Systematic Review and Meta-Analysis)

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List of Abbreviations

Abb.	Full term
AOFAS	*American orthopedic foot and ankle society*
CENTRAL	*Cochrane central register of controlled trials*
CI	*Confidence interval*
FHSQ	*Foot health status questionnaire*
HIPJ	*Hallux interphalangeal joint*
ICJME	*International committee of medical journal association*
MD	*Mean difference*
MOOSE	*Metaanalysis of observational studies in epidemiology*
MTP	*Metatarsophalangeal*
MTPJ	*Metatarsophalangeal joint*
PRISMA	*Prefereed Reporting Items For Systematic Review and meta analysis*
RR	*Relative risk*
SC	*Standard deviation*
SMD	*Standard mean difference*

INTRODUCTION

With continued loss of dorsiflexion of the 1st MTP, degenerative changes occur within the joint with severe restriction of movement and increase in pain, which leads to the condition known as hallux rigidus. The amount of dorsiflexion may be reduced to 0-10 degrees with pain on both active and passive motion. [(1)] Hallux limitus, and hallux rigidus, are the most common terms used in the literature and in clinical setting. Hallux rigidus is thought to occur over the age of 60 years. Trauma is a frequentl etiological factor, especially for unilateral hallux rigidus. Generalized osteoarthritis and inflammatory arthropathies, such as rheumatoid arthritis, can also result in hallux rigidus. Other documented factors associated with hallux rigidus are a flat or chevron-shaped joint, hallux valgus interphalangeus or metatarsus adductus, bilaterality in persons with a positive family history. Elevation of the first ray noted radiographically is a sign of worsening metatarsophalangeal joint function. [(2)]

Irrespective of the causative factors involved, end-stage disease results in articular cartilage loss and loss of joint space. Subsequent pain and loss of motion results in abnormal gait patterns and can interfere with simple daily tasks such as walking and stair climbing. The severity of hallux rigidus can be classified using the system suggested by Coughlin and Shurnas. Early disease, grades 0 to 2, can respond well to non-

operative measures such as non-steroidal anti-inflammatory medication and footwear modification. Cheilectomy to remove impinging dorsal osteophytes can also be successful in early cases as the disease initially affects the dorsal portion of the joint. End-stage disease, grade 3 to 4, does not, however, respond as well to such measures and remaining options include osteotomies, joint arthrodesis or arthroplasty. [37] Osteotomies of the proximal phalynx and distal first metatarsal osteotomies have been performed as joint preserving procedures, to maintain motion on MTP joints. These procedures can be combined with Cheilectomy in the case of the proximal phalanx osteotomy. The principle works by a dorsal closing wedge osteotomy which shifts the limited MTP arc of motion dorsally and placing the hallux in a more dorsiflexed position to allow for improvement of function. The various first metatarsal osteotomies have been designed to decompress the joint by shortening the metatarsal or realigning the healthier planter articular cartilage dorsally, or to realign the articular cartilage to bring the arc of motion in a more functional range **(3)**

First MTP Joint arthrodesis is currently considered to be the gold standard for the treatment of end-stage hallux rigidus, with reported union rates ranging between 90% and 100%. Arthrodesis does, however, predispose the patient to interphalangeal joint osteoarthritis and the loss of dorsiflexion can interfere with activities such as kneeling and squatting, and

wearing footwear with raised heels can be problematic, Post-operative rehabilitation can also be prolonged and there is up to a 10% risk of non-union, which may require a revision procedure. Thus as an alternative, arthroplasty of the first MTPJ has been attempted. [4] Silicone implants were initially used following their successful implantation in the hand. Early results were promising with high rates of patient satisfaction. Unfortunately, problems with silicone wear, osteolysis and foreign body reactions limited their longevity. This lead to the development of metallic implants in both total toe replacement and hemiarthroplasty designs.Total toe implants have demonstrated good early patient satisfaction. Early loosening, however, was once again a problem. This is thought to be due to the large dorsally directed shear forces the metatarsal implant is exposed to during toe-off [5].

AIM OF THE WORK

Systematically reviewing available evidence from published articles to assess the effectiveness of arthrodesis of first metatarsophalangeal joint by plate and screws in hallux rigidus. The assessment also would encompass safety, side effects, and complications of this mode of treatment.

ANATOMY

1st Metatarsophalangeal joint (MTP) is biaxial condylar joint that gains stability from the joint capsule, collateral ligaments, and plantar plate, 2 sesamoid bones are located in intrinsic muscles tendons underneath 1st metatarsal head. 1st metatarsal articulates with medial cuneiform and base of the 2nd metatarsal. 1st ray is composed of the 1st metatarsal and medial cuneiform. Hallux carries 40- 60 % of body weight. **(1)**

The 1st (MTP) joint differs from the joints of the other toes in its sesamoid mechanism. The head of the metatarsal carries a large, rounded, cartilage covered prominence, wider than the base of the phalanx with which it articulates. On the plantar surface two grooves are developed for articulation with the two sesamoid bones, and these are separated by a rounded ridge. (Figure 1) **(1)**

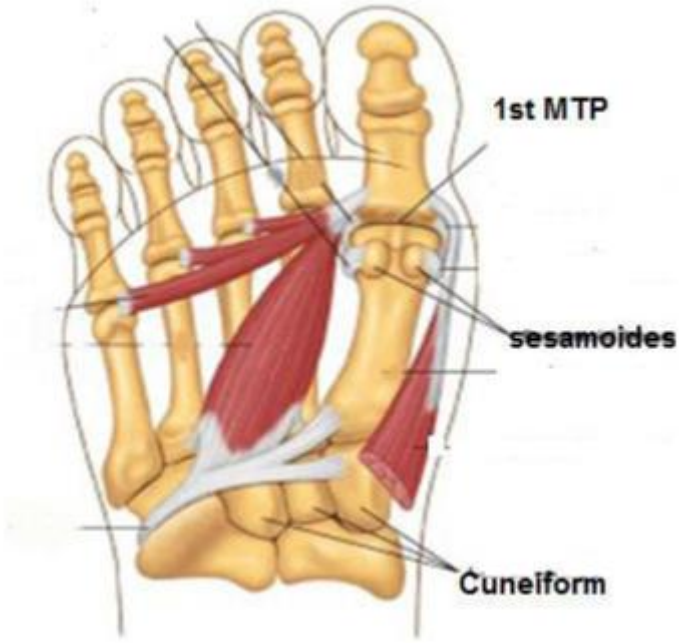

Figure (1): Planter surface of the 1st (MTP) (1)

On the either side, the cartilage overlaps on to the lateral aspect of the bone, to form a smooth surface for the ligaments of the joint. The shaft narrows from the head, but carries a pair of shoulders or epicondyles from which the joint ligaments spring. The basal phalanx has an elliptical concavity for articulation with the metatarsal, and a swollen base which receives the muscular and ligamentous attachments. (2)

The sesamoids are embedded in the plantar pad, a mass of dense fibrous tissue, rectangular in outline. The distal margin of the pad is attached firmly to the base of the phalanx, its lateral margins receive ligamentous and muscular attachments, and its proximal border receives a part of the short flexor and is

attached by a few loose fibers to the distal end of the metatarsal. (1-2)

The plantar surface of the pad is raised on either side by the two sesamoids to form a groove in which the long flexor tendon plays, held in place by its fibrous tunnel. During standing, the sesamoids transmit a part of the pressure from the skin to the head of the metatarsal, relieving the flexor tendon from excessive compression. (2)

Most recent authors have considered the sesamoids as developing in the two heads of the flexor hallucis brevis as they passed to their insertions on the basal phalanx (Figure 2) (3)

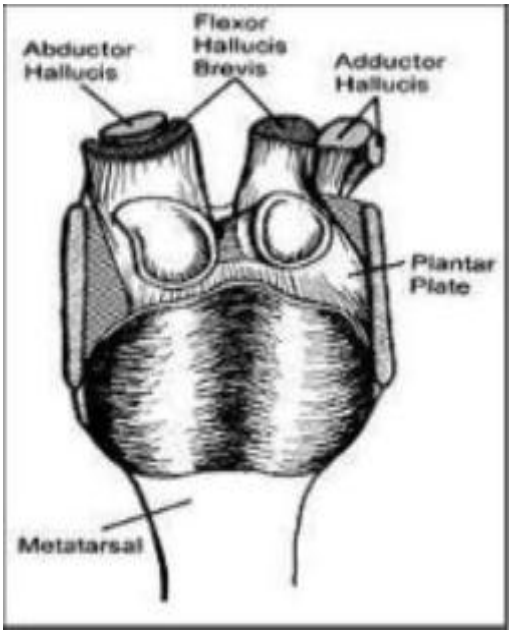

Figure (2): Sesamoids relation to flexor hallucis brevis (3) The binding mechanism of the metatarsal head.