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Irreducible dislocation of the hallucal interphalangeal joint

蹈趾節間關節的不可復歸性脫臼

Irreducible dislocation of the hallucal interphalangeal joint is a rare condition, with only 41 cases reported in the literature. We present a patient with a Miki type 2 irreducible dislocation of the hallucal interphalangeal joint and review literature pertinent to this condition.

蹈趾節間關節的不可復歸性脫臼是一種罕見的情況，在文獻中僅有41宗類似的病例。我們介紹一宗Miki2型蹈趾節間關節的不可復歸性脫臼病例，並總結了相關的文獻。

Introduction

Toe dislocation is an uncommon disorder. Most reported cases are of dislocation of the metatarsophalangeal joint of the great toe owing to its greater mobility and longer lever arm.[1] Irreducible dislocation of the hallucal interphalangeal joint is a rare disorder. In the past six decades, only 41 cases have been reported in the literature, 13 in English language sources,[1-11] one in German,[12] and 27 in Japanese sources.[6,11]

According to Miki et al,[6] dislocation of the hallucal interphalangeal joint can be classified into two types based on radiographic and clinical findings. We report on a patient with a Miki type 2 dislocation and review literature pertinent to this condition.

Case report

A 17-year-old high-school student complained of left big toe swelling and pain following completion of a 'slam-dunk' in a basketball game. The mechanism of injury described was one of hyperextension, with pain precluding further participation in the game. The patient had attended a bonesetter who manipulated his toe. As pain had persisted, he attended the casualty department the next day. Examination at this time showed a swollen left big toe with a small depression over the dorsum of the interphalangeal joint. No external wound was present. The patient was referred to the orthopaedic service after failed closed reduction with radiographic findings of a dorsal dislocation of the hallucal interphalangeal joint and an interposed small oval bone (Fig 1). No fracture had been identified.

An emergency open reduction of the dislocation via the dorsal approach was performed. Arthrotomy revealed the volar plate with its sesamoid bone over the proximal phalangeal head. The interposed structure was moved in the plantar direction while the distal phalanx was under traction. After relocation of the volar plate, the joint was stable, with full range of motion. No fracture was identified and collateral ligaments were intact. An axial Kirschner wire was then fashioned to provide stability for the volar plate during healing.

The interphalangeal joint space remained widened. In keeping with other cases reported in the literature,[6] this is thought to reflect overstretching of the joint construct at the time of injury (Fig 2). The patient was given a rocker bottom shoe and the wire was removed 4 weeks after the injury. Recovery was unremarkable.

Key words:
Dislocations;
Hallux;
Sesamoid bones

關鍵詞：
脫臼；
大蹈指；
籽骨

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Fig 1. (a) Anterior-posterior radiograph showing a widened hallucal interphalangeal joint space. The hallucal interphalangeal sesamoid is evident; and (b) the lateral radiograph shows a dorsally dislocated interphalangeal joint with hyperextension deformity. The sesamoid is seen to override the proximal phalanx head

Discussion

The sesamoid bone

Few osseous structures have received as little attention from anatomists and surgeons as the hallucal interphalangeal sesamoid bone (os sesamoidium interphalangeus hallux) has.[13] The name 'sesamum' was first used for this bone by Galen in approximately AD 180 due to its resemblance to a sesame seed (*Sesamum indicum*).[14] Since then, the limited attention probably reflects difficulty in recognition of the sesamoid and uncertainty on its nature. There is still controversy regarding whether it is a rudimentary structure, an accessory ossicle, or a pressure-induced reactive bone formation. The sesamoid bone is known, however, to be associated with several clinical pathologies, ranging from the relatively minor painful hyperkeratotic plantar lesion to irreducible interphalangeal dislocation.

The sesamoid bone varies in size from 0.05 to 1.0 cm.[15] The dorsal surface, with two facets, is predominantly cartilaginous and articulates largely with the head of the proximal phalanx. The non-articulating part is osseous and firmly embedded within the plantar capsule of the interphalangeal joint, commonly termed the volar plate. Loose connective tissue spans the space between the volar plate and the flexor hallucis longus tendon proper. Whether or not the bone is contained within the fibres of the flexor hallucis longus tendon remains controversial, complicating discussion since a sesamoid bone, by definition, must be located within the substance of a tendon.[13] The bone is found in 57% of embryological specimens as a well-defined osseous structure, allowing it to be classified as an accessory ossicle within an otherwise normal foot.[13] One theory proposed suggests that it is a rudiment of the 'lost' middle phalanx of the hallux, given that it develops between week 11 to 15 of gestation, approximately the same time that the proximal and distal phalanx evolve.[13] However, the view that its pleomorphism in terms of size, shape, and degree of ossification, is dependent on physical stress and pressure has not been discounted.[13]

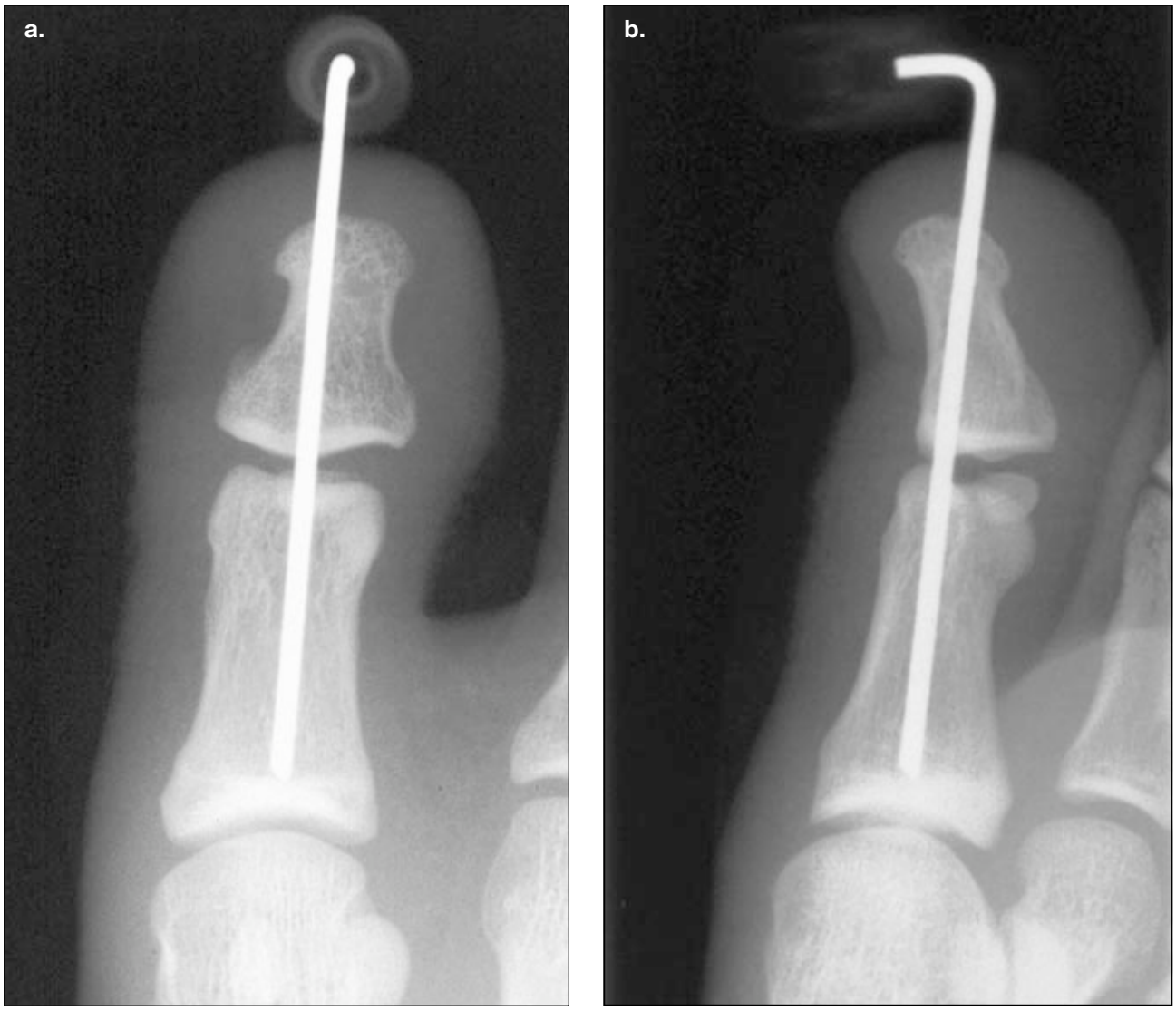

Fig 2. (a) Anterior-posterior radiograph showing the reduced interphalangeal joint with persistent widened joint space; and (b) oblique radiograph showing the reduced sesamoid bone

The hallucal interphalangeal sesamoid can be identified radiographically with a frequency varying from 4.3% to 93% according to the penetration and focus of the film.[15] Bilateral occurrence has been reported in 94% of cases,[15] and in up to 95.5% in a study based on macroscopic examination of over 144 cadaveric feet.[6]

Dislocation: biomechanical considerations

The mechanism of dislocation of the hallucal interphalangeal joint is known to be a combination of axial loading with hyperextensive force.[3] This is supported both by patient recall and by occasional lacerations seen over the plantar surface, suggesting a significant hyperextension force acting on the plantar skin at the time of injury.[6,7]

The stability of the hallucal interphalangeal joint appears dependent on the volar plate, joint capsule, collateral ligaments, and the tendons of extensor and flexor hallucis longus acting together to prevent the joint from hyperextension of more than 20°. The collateral ligaments not only confer side-to-side stability but also limit the amount of hyperextension. When these ligaments and the joint capsule are cut, further extension is possible up to the end-point limited by the volar plate.

A cadaveric study performed by Miki et al[6] demonstrated that when the volar plate is detached from either the proximal or distal phalanx, dislocation of the interphalangeal joint becomes possible. However, the volar plate still cannot be invaginated into the joint. It is only when the attachment to both phalanges is disrupted that this can occur, as seen in reported cases. As the interposed sesamoid effectively 'tightens' the intact collateral ligaments, close reduction becomes very difficult, if not impossible.[11,13]

Clinical management

Irreducible dislocation of the hallucal interphalangeal joint is rare and consequently there is a paucity of literature on the topic. Not uncommonly, resumption of an apparently normal alignment disguises the unreduced dislocation.[2,6] However, restricted range of motion and persistent pain

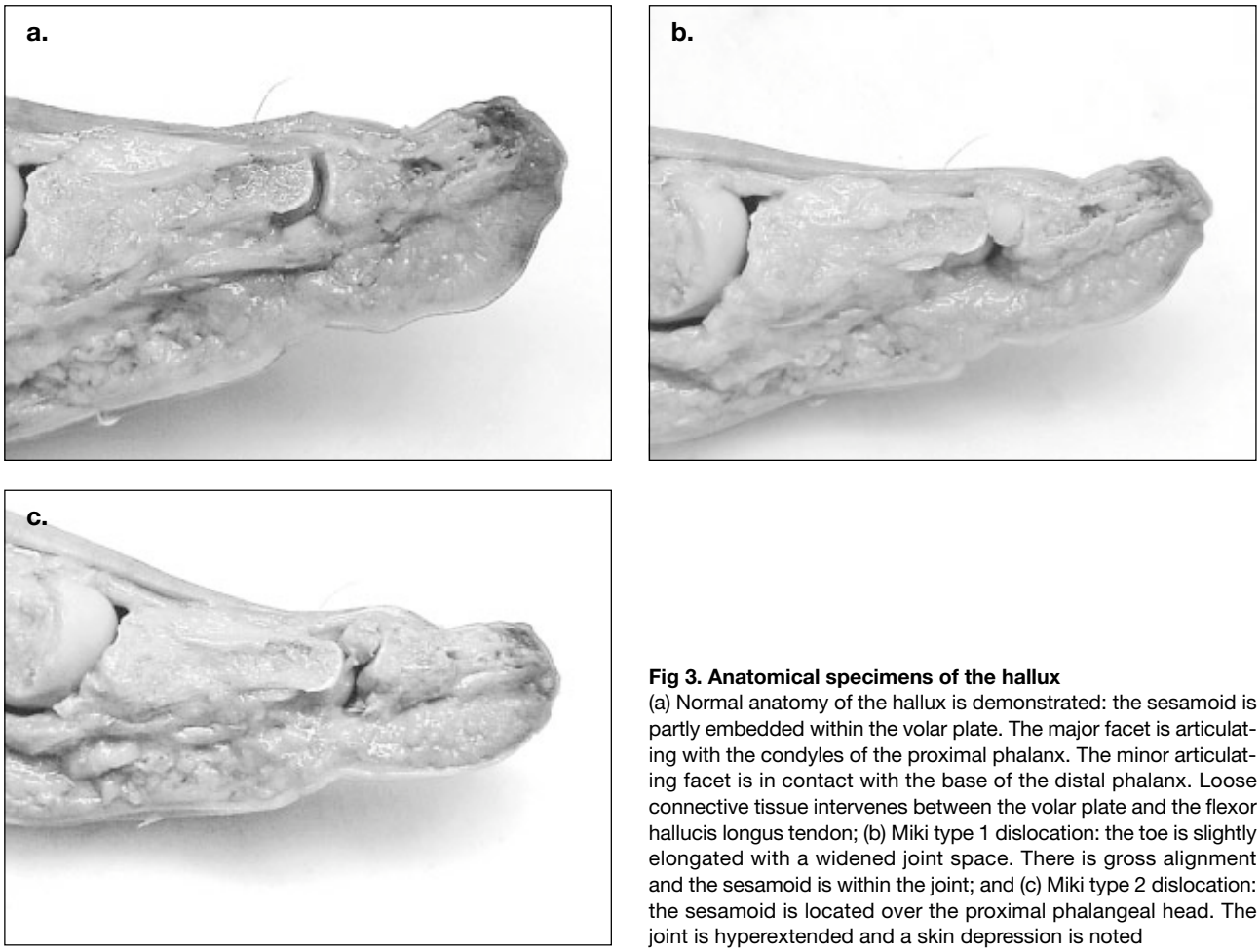

Fig 3. Anatomical specimens of the hallux
(a) Normal anatomy of the hallux is demonstrated: the sesamoid is partly embedded within the volar plate. The major facet is articulating with the condyles of the proximal phalanx. The minor articulating facet is in contact with the base of the distal phalanx. Loose connective tissue intervenes between the volar plate and the flexor hallucis longus tendon; (b) Miki type 1 dislocation: the toe is slightly elongated with a widened joint space. There is gross alignment and the sesamoid is within the joint; and (c) Miki type 2 dislocation: the sesamoid is located over the proximal phalangeal head. The joint is hyperextended and a skin depression is noted

should alert the clinician to this possibility. Miki et al[6] classified dislocation of the hallucal interphalangeal joint into two types (Fig 3). The classification system does not correlate with prognosis, and recovery is generally excellent after successful reduction. Moreover, the type of dislocation may be interchangeable with manipulation.[6]

Difficulty can be encountered during close reduction due to the 'tightened' collateral ligaments and problems handling the short and swollen distal phalanx. Only a handful of successful cases have been reported.[11] This should not preclude a trial of close reduction prior to operative treatment, however.

Surgical approaches including plantar, medial,[3,5,7] dorsal,[1,2,4,6] and dorsal[8] or dorsal-lateral[10] with extensor tendon division approaches have been described.[11] Although the medial approach is favoured by Japanese surgeons, none of the surgical options is clearly superior. Extensor tendon division offers better exposure than required and may result in greater surgical trauma. After reduction, it is not an uncommon practice to remove the offending volar plate.[11] In general, the literature discourages repair of the dislocated volar plate in view of its inherent stability after reduction. Repair of both the origin and insertion of the minute volar plate is technically demanding. Moreover, repair of the volar plate necessitates use of a plantar approach, which is frequently complicated by a hyperkeratotic scar over the weight-bearing area.

Postreduction stabilisation by means of bulky dressing,[1] buddy strapping,[2,3] splinting,[5,6] Kirschner wire,[11] and short leg cast[6,8] have been described. A period of immobilisation (3 to 4 weeks) is commonly recommended.[3,6,11] Non–weight-bearing mobility is described infrequently,[2,8] but use of a specialised postoperative shoe has been noted to confer additional comfort in the early postoperative period. Despite the diversity of surgical techniques and rehabilitation protocols utilised, no significant residual morbidity has been reported in the literature.

Conclusion

The combination of the short lever arm on this rigid construct, and the requirement for complete detachment of the volar plate without severing the collateral ligaments, make dislocation of the hallucal interphalangeal joint a rare occurrence. In addition, the minor deformity seen with a Miki type 1 dislocation and inconsistent demonstration of the sesamoid bone on radiographs contribute to underreporting of this injury.

Most cases of dislocation of the hallucal interphalangeal joint require open reduction, with medial and dorsal

approaches favoured, although the plantar approach remains an option. The consensus view is that after reduction, the volar plate need not be repaired. The mode of immobilisation to be followed is a matter of discussion. Regardless of the method of treatment adopted, the prognosis appears excellent in most, if not all, cases.

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