

CASE REPORT

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Post-traumatic synostosis of the metatarsals – a case report

Jun Rui Don Koh^{1*}, Matthew Au² and Kinjal Mehta¹

Abstract

Background Synostosis refers to the abnormal fusion of bones, which have varying aetiologies as well as sites which are commonly affected. Existing literature mostly describes the condition arising congenitally, and affecting the radio-ulnar joint.

Case presentation A 57-year-old gentleman presented to our department with symptomatic malunion and synostosis of the fourth and fifth metatarsals, two years following non-operative treatment of a closed fifth metatarsal fracture. The patient subsequently underwent surgical excision of the synostosis, but had complications of recurrence at the two-year post-operative date. Repeat surgical excision was performed with eventual good functional outcome and no signs of recurrence.

Conclusion Our paper aims to describe the first known case of post-traumatic synostosis affecting the metatarsals, as well as provide a review of the current literature.

Keywords Synostosis, Metatarsals, Post-traumatic, Orthopaedics, Foot

Background

Synostosis refers to the abnormal fusion of bones through osseous or fibrous bridges. Due to this pathological fusion, symptoms such as pain and restricted range of motion can arise [1]. Various classifications for synostosis exist in current literature, and include classification according to histological tissue type, as well as aetiology [2, 3].

Synostosis arising as a complication of trauma has already been previously described in previous papers. However, majority of the existing literature discussing post-traumatic synostosis revolves around the more commonly affected radio-ulnar site [4]. Whilst post-traumatic

synostosis has also previously been described to affect the lower limb in the tibiofibular region, there is still no literature discussing synostosis affecting the metatarsals [5, 6]. Our paper aims to describe the first known case of post-traumatic synostosis affecting the metatarsals, and provide a narrative review of current literature.

Case presentation

The reported patient is a 57-year-old male with no significant past medical history. He first presented to the orthopaedic department with a left fifth metatarsal shaft fracture secondary to a fall, which was treated conservatively (Shown in Fig. 1).

The patient was next seen again in clinic two years post the initial injury as he had defaulted follow up. He presented with complaints of persistent pain in his left foot at the previous fracture site and denied any new trauma to the foot. Physical examination of the foot did not reveal any gross deformity or evidence of injury,

*Correspondence:

Jun Rui Don Koh
kohjrd92@gmail.com

¹Changi General Hospital, 2 Simei St 3, Singapore 529889, Singapore

²University of Birmingham, Birmingham, UK





Fig. 1 X-Ray Foot DP/Oblique views depicting a Left 5th MT shaft fracture



Fig. 2 Plain film radiographs of the Left Foot DP and Oblique views showing synostosis of the fourth and fifth metatarsals



Fig. 3 Bony bridging between the fourth and fifth metatarsal shafts shown on CT Axial (Left) and Coronal (Right) views

the neurovascular status of the foot was also intact. Plain film radiographs of the foot were initially performed, followed by further evaluation with a Computed Tomography (CT) scan of the foot which revealed bony bridging between the fourth and fifth metatarsals (Shown in Figs. 2 and 3).

The patient was diagnosed with symptomatic malunion and synostosis, and subsequently underwent surgical excision of the synostosis. A dorsal intermetatarsal incision was made between the fourth and fifth metatarsals, osteotomy was then performed under direct vision with the use of an E-Pen. The fourth and fifth metatarsal shafts were additionally smoothed with rongeurs and bone files. Intra-operative imaging was used to confirm that adequate excision was performed. The post-operative stay was uneventful, and the patient was discharged well after a short period of inpatient recovery. Follow-up was unremarkable, and the patient was allowed to ambulate with full weight bearing on his affected foot. (Pre and post-operative X-rays shown in Fig. 4).

At two-year follow-up, the patient again complained of pain over the fourth and fifth metatarsal region which had been gradually worsening. Physical examination this time noted a well healed surgical scar with no signs of infection, and no other bony deformity. Tenderness was elicited on palpation over the site of previous synostosis between the fourth and fifth metatarsals. The patient first underwent a trial of conservative management which included analgesia and physiotherapy. After a period of six months, the patient reported no improvement in symptoms and a repeat imaging was performed. An MRI of the foot and plain film radiographs both revealed signs of recurrence of the synostosis in the form of osseous bridging between the proximal fourth and fifth metatarsal shafts (Shown in Fig. 5).



Fig. 4 Pre and post excision of synostosis X-Rays

Following diagnosis, the patient subsequently underwent repeat surgical excision of the synostosis. An incision was made over the previous surgical scar. Hard callus was then excised, and the fourth and fifth metatarsals separated with use of a lamina spreader. The synostosis was then excised using osteotomes, ronguers, as well as a 3 m high speed Burr. Fluoroscopy was again used to ensure adequate excision was performed (Shown in Fig. 6). Following which, bone wax was also inserted. The post-operative stay was again uneventful, and the patient was allowed to full weight bear on the foot.

The patient was last seen at 1.5 years post second operation and was reported to be well and able to ambulate with no pain in his left foot. There was also no evidence of recurrence on follow up X-Ray imaging (Shown in Fig. 7).

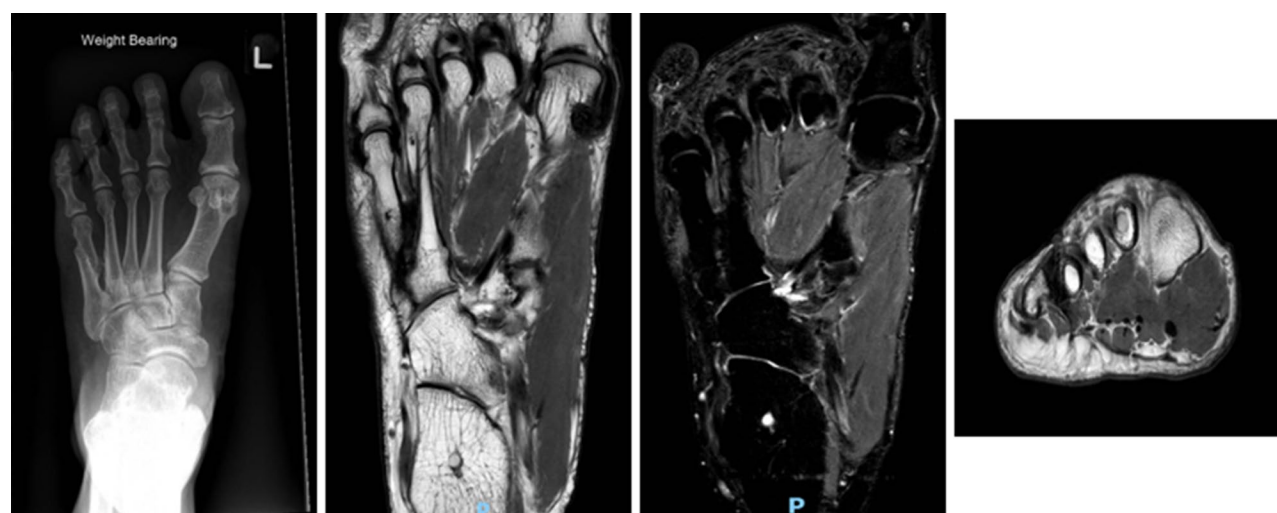


Fig. 5 Left foot AP view X-ray and MRI Left Foot Axial and Coronal views (Left to Right) showing largely hypointense signal focus bridging the fourth and fifth metatarsal shafts representing the recurrence of synostosis

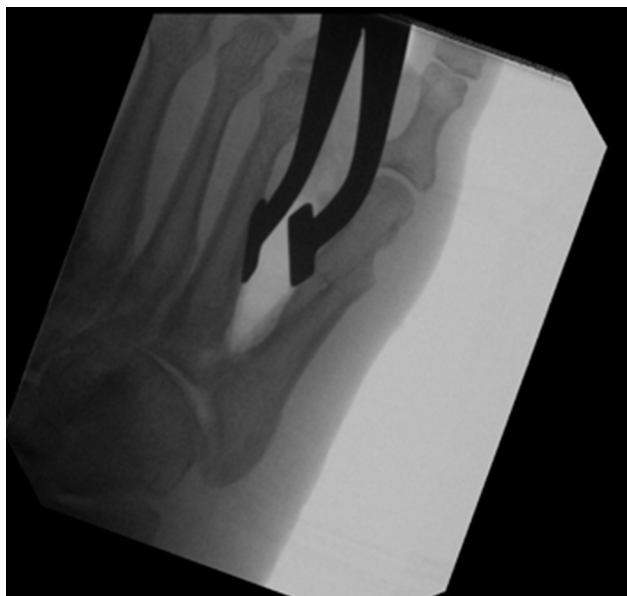


Fig. 6 Intra-operative imaging showing adequate synostosis excision between the fourth and fifth metatarsal shafts



Fig. 7 Left Foot AP/Oblique view X-Rays showing no recurrence of synostosis

Discussion and conclusions

Our paper describes the first known case of post-traumatic synostosis affecting the metatarsals.

Congenital synostosis affecting the metatarsals is a known entity, although much less common compared to the mid and hindfoot [7]. Whilst they typically occur as part of a congenital malformation syndrome, isolated non-syndromic cases have also been previously described [8].

Given the clinical presentation of our patient and the absence of any anomalies, we conclude that synostosis in our case arose due to trauma. Due to the rarity of

such cases, the pathophysiology of this condition has yet to be fully elucidated although certain hypotheses have been proposed. In our case, repeated microtrauma during fracture healing may have caused chronic bleeding and inflammation in the intermetatarsal space may have resulted in bone formation between the two metatarsals [9].

Predisposing risk factors for the formation of post-traumatic synostosis have been identified from studies centred around radioulnar synostosis. These include open fractures, or fractures with a high degree of soft tissue injury, a high degree of comminution, and having directly adjacent fractures [10, 11]. Furthermore, a study on post-traumatic synostosis after treatment for distal tibiofibular fractures also suggested that fracture patterns had a direct relation with the type and extent of post-traumatic synostosis [12].

Iatrogenic trauma is also another known aetiology, with tibiofibular synostosis having been described as a complication after surgical fixation of fractures with either an intramedullary nail, or plate fixation [13]. A study on patients who developed synostosis as a complication after surgery for ankle fractures identified risk factors such as suffering an associated dislocation of the tibiotalar joint, use of syndesmotic screw fixation, and the male gender [14].

The reported patient in this case had none of the previously discussed risk factors associated with the development of post-traumatic synostosis, except for the male gender. However, further evidence is required to draw a conclusion of gender predisposition for the development of synostosis after surgery, as in our case the patient was treated non-operatively.

While there are differing opinions on the optimal management of synostosis, surgical excision of the bony bridge is an option in cases for symptomatic treatment or deformity correction following a failure of non-operative management through physiotherapy and analgesia. Goals of surgical treatment are to restore baseline range of motion by excision of the bony bridge and to prevent recurrence, with good outcomes being seen from various surgical techniques which range from a simple osteotomy, to the addition of associated procedures such as soft tissue interposition [15, 16].

Recurrence of synostosis is unfortunately not uncommon, and thus strategies to have been previously explored. Adjunctive pre and post-operative radiotherapy, intra-operative interposition after excision of the bony bridge with either soft tissue or inert material and their variations have both shown good evidence for preventing recurrence [17–19]. Lack of bone wax application after the first surgical excision may have increased the patient's risk of recurrence in our case. Chronic bleeding and inflammation have also been shown to be a possible

mechanism of the formation of synostosis, therefore haemostasis has also been highlighted as a crucial step during surgery. In our case, haemostasis was performed and bone wax applied both to the bleeding bone edges after, as a form of soft tissue interposition, with good outcomes and no signs of recurrence. These practices should therefore be considered when approaching this pathology in the future [20].

Our paper describes the first known case of post-traumatic synostosis affecting the metatarsals. Synostosis should be considered as a possible late complication in the setting of trauma, which should be diligently evaluated in patients presenting with the new onset of symptoms long after their initial injury. Our paper also highlights the utility of repeating radiological studies at interval periods if the patient reports persistent pain, as there may be radiographical lag such as seen in our case. As the literature increases, better practices can be developed to reduce the rates of recurrence of synostosis, and improve surgical outcomes.

Abbreviations

MRI Magnetic Resonance Imaging
CT Computed Tomography

Acknowledgements

There are no acknowledgements for this paper.

Author contributions

All authors were involved in the following: Conceptualization, Methodology, Formal analysis, Data Curation, Writing – Original Draft, Visualization. All authors approve of the submitted version and have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

Funding

The authors received no financial support for the research and authorship of this article.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethical approval

No ethical board approval was required for this paper.

Guardian/patient's consent

Consent was obtained by the patient.

Competing interests

The authors declare no competing interests.

Received: 4 June 2024 / Accepted: 4 November 2024

Published online: 08 November 2024

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