A Case of Surgical Correction Via Metacarpal Step-Cut Osteotomy of a Proximal Phalanx Malunion

Descrição de um Caso de Osteotomia em *Step-Cut* de Metacarpiano para Correção de Consolidação Viciosa de Falange Proximal

Renata Vaz[1]*; Pedro Martins Branco[2]; Paulo Rego[2]; Carolina Baptista[2]

1. Department of Orthopedics and Traumatology, Unidade Local de Saúde Amadora-Sintra, Sintra, Portugal
2. Department of Orthopedics and Traumatology, Hospital da Luz Lisboa, Lisbon, Portugal

https://doi.org/10.82189/spot.78

ABSTRACT

Malunion of phalangeal fractures, especially those involving rotational deformities, can significantly impair hand function. Many surgical techniques have been described to address such deformities. This case report presents the successful surgical correction of a symptomatic rotational malunion of the proximal phalanx of the right ring finger in a 72-year-old woman. A metacarpal step-cut osteotomy was performed and stabilized using three 2.0 mm lag screws. Postoperative care included a tailored rehabilitation program. The procedure achieved complete realignment of the digit, with radiographic evidence of bone healing and restoration of full hand function. This case highlights the importance of appropriate initial fracture management and the potential need for surgical intervention when symptomatic malunion occurs. Metacarpal step-cut osteotomy offers precise intraoperative control, a large surface area for bone healing, and stable fixation—enabling early mobilization. Thus, it should be considered a viable surgical option for correcting symptomatic phalangeal rotational malunions.

Keywords: Finger Phalanges/injuries; Finger Phalanges/surgery; Fractures, Malunited/surgery; Metacarpal Bones/injuries; Metacarpal Bones/surgery; Osteotomy; Range of Motion Articular

RESUMO

A consolidação viciosa das fraturas das falanges, particularmente quando associada a deformidades rotacionais, pode comprometer significativamente a função da mão. Diversas técnicas cirúrgicas têm sido descritas para corrigir este tipo de deformidade. Apresenta-se o caso clínico de uma mulher de 72 anos com consolidação viciosa rotacional sintomática da falange proximal do quarto dedo da mão direita, corrigida cirurgicamente com sucesso. Foi realizada uma osteotomia em degrau (*step-cut osteotomy*) do metacarpo, estabilizada com três parafusos de compressão (*lag screws*) de 2,0 mm. O protocolo pós-operatório incluiu um programa de reabilitação individualizado. O procedimento permitiu o realinhamento completo do dedo, com evidência radiográfica de consolidação óssea e recuperação integral

*Autor Correspondente/Corresponding Author: Renata Vaz [renata_vaz9@hotmail.com], Address: Av. Lusíada 100, 1500-650 Lisboa, Portugal.

Recebido/Received: 2025/07/02 **Aceite/Accepted:** 2026/07/15 **Publicado online/Published online:** 2026/08/31 **Publicado / Published:** 2026/11/03

© 2026 Orthopedic SPOT. Este é um artigo de acesso aberto sob a licença CC BY-NC 4.0. Reutilização permitida de acordo com CC BY-NC 4.0. Nenhuma reutilização comercial.
© 2026 Orthopedic SPOT. This is an open-access article under the CC BY-NC 4.0. Re-use permitted under CC BY-NC 4.0. No commercial re-use.

da função da mão. Este caso destaca a importância de uma abordagem inicial adequada das fraturas e a eventual necessidade de intervenção cirúrgica perante uma consolidação viciosa sintomática. A *step-cut osteotomy* proporciona um controlo intraoperatório preciso da correção, uma ampla superfície de contacto para consolidação óssea e uma fixação estável, permitindo mobilização precoce. Assim, esta técnica constitui uma opção cirúrgica válida e eficaz para a correção de consolidações viciosas rotacionais sintomáticas das falanges.

Palavras-chave: Amplitude de Movimento Articular; Falanges dos Dedos da Mão/lesões; Falanges dos Dedos/cirurgia; Fraturas Mal-Unidas/cirurgia; Ossos Metacarpais/lesões; Ossos Metacarpais/cirurgia; Osteotomia

INTRODUCTION

Malunion of phalangeal fractures can significantly impair hand function, particularly when involving rotational deformities. A seemingly minor 5º rotational malunion of the proximal phalanx can result in a 1.5 cm overlap at the fingertip when the digits are flexed, leading to weakened grip strength and function deficit.[1-3] No consensus exists about the acceptable limits of deformity, therefore, surgical correction is considered based on clinical findings and patients' subjective functional limitation and recovery goals. In addition to clinical deformity, the surgeon needs to assess neurovascular status, joint mobility, signs of infection and any soft tissue complications like scarring or tendon adhesions. Surgical management of phalangeal malunions aims to restore proper alignment and function through corrective osteotomy. Various techniques with similar outcomes have been described in the literature, including transverse osteotomies or step-cut osteotomies, with fixation with Kirschner wires, interosseous wires, plate and screw or headless screws.[4] Thus, the choice of osteotomy technique and fixation method must be tailored to each individual case. Moreover, for the correction of phalangeal malunions, it is debated whether an extra-anatomic metacarpal or an *in situ* phalangeal osteotomy should be performed. *In situ* phalangeal osteotomy offers several advantages, including the ability to address other concomitant phalangeal deformities and the opportunity to perform tenocapsulolysis. However, it carries the risk of inadvertent intraoperative injury and requires more time for bone healing. In turn, the advantage of metacarpal osteotomy is the fact that there is no need to expose the phalangeal malunion site, avoiding the lesion of important structures. In terms of disadvantages, metacarpal osteotomy may cause a zigzag finger deformity and has a limited rotational correction of digit due to deep transverse metacarpal ligaments. The correction for index, middle and ring fingers was limited to 19°, and the small finger was limited to 30°.[3,5] Weckesser was the first to report the functional effect of finger rotational deformities from metacarpal and phalangeal malunions, emphasizing the importance of early mobilization. He described a transverse osteotomy at the base of the metacarpal, secured by Kirschner wires, for metacarpal and phalangeal malunions.[6] Kirschner wires have the advantage of being less invasive, but range of motion (ROM) exercises must be delayed until bony union has been achieved. Although some authors argue that osteotomy at the phalanx level could limit digital ROM because of development of adhesions in the flexor and/or extensor tendons, some have shown no impact in postoperative digital ROM.[7-9] Lucas and Pfeiffer showed that AO plates and screws could be used effectively for stabilization of osteotomy sites with rotational malunions[10]; however, more extensive surgical approach is needed, and irritation of the extensor tendon by the hardware is a potential issue.[2] In other series, osteotomies fixed exclusively with lag screws were found to have rapid healing and stable fixation.[1,11] Manktelow and Mahoney described a novel technique for digital rotational deformities - a metacarpal step-cut osteotomy. Performing the procedure on 22 cadaveric digits and on 10 patients, they concluded that a step-cut osteotomy provided extremely precise correction, reliable union with a large healing surface area and strong fixation with interosseous wires. They calculated that the removal of 1 mm of dorsal cortex allowed for 8.6±2.5 mm of fingertip correction.[9,12] Other authors modified this technique by using lag screws as fixation method[11] or performing the osteotomy at the malunion site,[13] with report of hand function improvement and fast union of osteotomy site.[9] Therefore, we describe a case of symptomatic malunion in the proximal phalanx of ring finger and its outcomes after step-cut metacarpal osteotomy and screw fixation.

CASE REPORT

A 72-year-old female patient presented with a malunion of the proximal phalanx of the ring finger following an initial fracture treated with immobilization with a Zimmer splint, for 5 weeks, in another institution. Upon removal of the splint, a significant ulnar rotation was observed, with finger overlap during grasping and finger flexion (Fig. 1). Despite undergoing physiotherapy (40 sessions) the patient continued to experience substantial impairment in daily activities,

prompting her to seek further treatment at our clinic at 3 months post-trauma. Upon evaluation, the decision was made to proceed with surgical correction through a metacarpal step-cut osteotomy. Before the surgical procedure, the amount of rotational deformity was measured. The deformity is largest at the midpoint of finger flexion and decreases as the finger moves into a fully flexed position. At the maximal point of deformity, the degree of rotation was estimated relative to the normal position of the finger. This measurement is used to determine the amount of dorsal bone resection needed for correction, with the guideline that 2 mm of resection achieves a 20° or 2 cm correction at the fingertip. Two hemi-transverse cuts were made 2 cm apart in the metacarpal shaft. The direction of the transverse step-cuts was marked on the skin before incision, in order to help visualize the position of the cuts. The position of the hemi-transverse cuts should be according to the direction of rotation, and since the proximal segment of the metacarpal is fixed by ligamentous attachments to the carpus, the distal hemi-transverse cut was made in the direction of the deformity. The deformity was corrected through resection of a dorsal wedge of bone that connects these hemi-transverse cuts. A dorsal linear incision was made over the metacarpal shaft of the affected finger. The extensor tendon was retracted and periosteum over the metacarpal shaft was opened longitudinally. An oscillating saw was used to make a hemi-transverse cut in the proximal and distal diaphysis. Two parallel, dorsal longitudinal cuts were made to remove a strip of bone, leaving the volar cortex intact. The dorsal cortical gap was reduced, cracking the volar cortex while keeping the periosteum intact. The digital rotation was checked with passive flexion and extension of the wrist. Fixation was achieved with three 2.0 mm lag screws (HPS-Medcomtech®) (Fig. 2). Postoperative care included a tailored rehabilitation program to facilitate recovery and restore hand function, with passive and active ROM therapy beginning 2 weeks after surgery. Full activity was permitted after radiographic evidence of healing at 2 months after surgery.



Figure 1. Right hand ring finger rotational deformity.

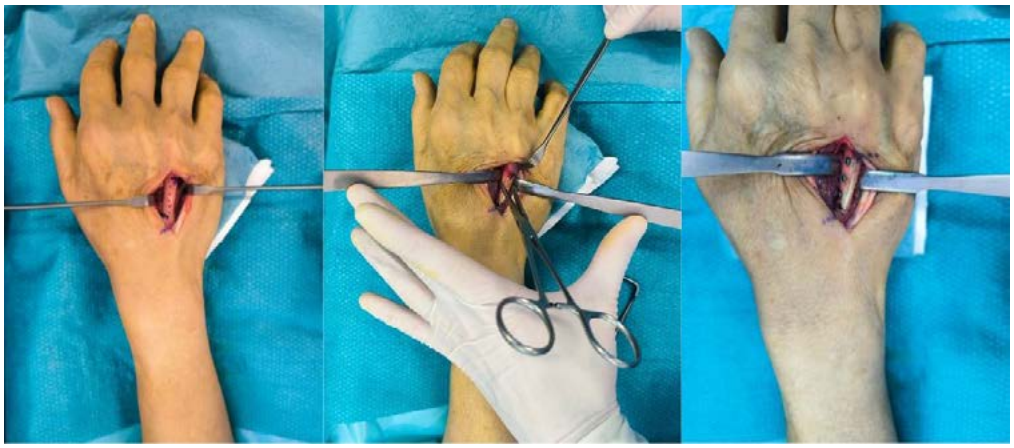


Figure 2. A Z-shaped osteotomy is made at the metacarpal with removal of dorsal wedge of bone, with the direction of the distal cut dictating the rotation of the digit.

The surgical correction successfully realigned the finger, addressing the malrotation. The patient demonstrated significant improvement in hand function, with no limitation during daily activities at 3 months post-operatively. The

QuickDASH score was 0, with patient only complaining of heavy weight bearing with the affected hand. The patient returned to daily activities after surgery. Metacarpophalangeal joint achieved 90º of flexion and complete extension and proximal interphalangeal joint achieved 80º of flexion and 0º of extension. Follow-up assessments showed proper bone healing and stable fixation with no signs of recurrent deformity (Figs. 3 and 4).

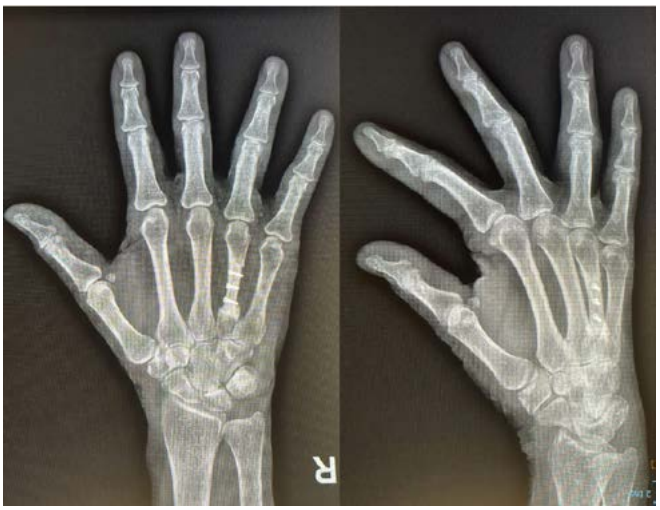


Figure 3. Anteroposterior and oblique x-ray views 4 months after metacarpal step-cut osteotomy and fixation with lag screws.

DISCUSSION

Phalangeal fractures are common injuries and have the risk of developing into malunions if not properly managed. Malunion corrections should be considered, in a shared decision-making manner, when severe angulation or malrotation results in finger overlap or impingement or intra-articular deformities and hand functional deficits are present.[1,2] Once the decision is made, ROM as well as intrinsic and extrinsic strength should be maximized preoperatively.[4]

Several techniques have been proposed in the literature to correct malunion with symptomatic rotational deformities, with preference given to those that allow rigid fixation and early ROM.[2] Metacarpal step-cut osteotomy can effectively restore anatomical alignment and hand function and, unlike other types of osteotomies, this technique permits precise intraoperative control at the osteotomy site, a large surface area for bony healing and rigid fixation with early digital motion.[11] Other methods of performing a metacarpal osteotomy use a simple transverse cut with plate and screw fixation, which may require a second surgery for implant removal due to implant failure or to perform tenolysis due to ROM limitation resulting from adhesion formation.[14] Moreover, osteotomy at the phalanx level could limit digital ROM because of development of adhesions in extensor tendons and risk of injury to nearby structures during approach.[7,9,14,15] Although no complications were found in this case, some studies have reported persistent deformity or Z-deformity after the use of metacarpal step-cut osteotomy.[14]



Figure 4. Clinical appearance 4 months after metacarpal step-cut osteotomy.

In conclusion, metacarpal step-cut osteotomy with screw fixation can be considered as a viable and effective surgical option for correcting symptomatic malunions in the proximal phalanx of hand. This approach can significantly enhance

hand function and improve the quality of life of patients suffering from rotational deformities post-fracture.

Responsabilidades Éticas

Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse na realização do presente trabalho.

Fontes de Financiamento: Não existiram fontes externas de financiamento para a realização deste artigo.

Confidencialidade dos Dados: Os autores declaram ter seguido os protocolos da sua instituição acerca da publicação dos dados de doentes.

Consentimento: Consentimento do doente para publicação obtido.

Proveniência e Revisão por Pares: Não comissionado; revisão externa por pares.

Ethical Disclosures

Conflicts of Interest: The authors have no conflicts of interest to declare.

Financing Support: This work has not received any contribution, grant or scholarship.

Confidentiality of Data: The authors declare that they have followed the protocols of their work center on the publication of patient data.

Patient Consent: Consent for publication was obtained.

Provenance and Peer Review: Not commissioned; externally peer-reviewed.

Declaração de Contribuição

RV: Preparação do material, recolha e análise dos dados, redação do rascunho original e análise estatística.

PMB e CB: Preparação do material, recolha e análise dos dados, redação do rascunho original, conceptualização e supervisão.

PR: Conceptualização e supervisão.

Todos os autores aprovaram a versão final do manuscrito para publicação e assumem a responsabilidade por todos os aspetos do trabalho, garantindo a exatidão e a integridade dos dados apresentados.

Contributorship Statement

RV: Material preparation, data collection and analysis, writing of the original draft, and statistical analysis.

PMB and CB: Material preparation, data collection and analysis, writing of the original draft, conceptualization, and supervision.

PR: Conceptualization and supervision.

All authors approved the final version of the manuscript for publication and assume responsibility for all aspects of the work, ensuring the accuracy and integrity of the data presented.

References

1. Caekebeke P, Melkebeke L, Duerinckx J. Minimally invasive corrective derotational osteotomy for proximal phalanx malrotation. Acta Orthop Belg. 2023;89:691-4. doi:10.52628/89.4.12008
2. del Piñal F, Ananos D, Rúas J, Mazarrasa R, Studer A. Minimally invasive procedure for correcting extra-articular malunions of metacarpals and phalanges. J Hand Surg. 2023;48:511.e1-511.e10. doi:10.1016/j.jhsa.2021.11.024
3. Abe Y. A simple, easy, and reliable technique of phalangeal corrective osteotomy for overlapping fingers. Plast Reconstr Surg Glob Open. 2015;3:e454. doi: 10.1097/GOX.0000000000000421.
4. Raducha J, Hammert W. Metacarpal and Phalangeal Malunions-Is It all About the Rotation? Hand Clin. 2024;40:141-9. doi:10.1016/j.hcl.2023.08.005
5. Gross M, Gelberman R. Metacarpal rotational osteotomy. J Hand Surg Am. 1985;10:105-8. doi:10.1016/s0363-5023(85)80259-8
6. Weckesser E. Rotational Osteotomy Of The Metacarpal For Overlapping Fingers. J Bone Joint Surg Am. 1965;47:751-6. doi:10.2106/00004623-196547040-00009
7. Büchler U, Gupta A, Ruf S. Corrective osteotomy for post-traumatic malunion of the phalanges in the hand. J Hand Surg Br. 1996;21:33-42. doi:10.1016/S0266-7681(96)80009-X
8. Haider T, Geisler D, Thalhammer G, Erhart J. Multiple drill-hole osteotomy in hand surgery - description of a novel application and proof of feasibility. BMC Musculoskelet Disord. 2017;18:529. doi:10.1186/s12891-017-1895-4
9. Adıyeke L, Kibar B. In situ transverse osteotomy and locked mini plate for the correction of metacarpal rotational deformity. Eur Res J. 2022;8:428-33. doi:10.18621/eurj.879908
10. Lucas G, Pfeiffer C. Osteotomy of the metacarpals and phalanges stabilized by AO plates and screws. Ann Chir Main. 1989;8:30-8. doi:10.1016/s0753-9053(89)80042-0
11. Jawa A, Zucchini M, Lauri G, Jupiter J. Modified Step-Cut Osteotomy for Metacarpal and Phalangeal Rotational Deformity. J Hand Surg. 2009;34:335340. doi:10.1016/j.jhsa.2008.11.018
12. Manktelow R, Mahoney J. Step osteotomy: a precise rotation osteotomy to correct scissoring deformities of the fingers. Plast Reconstr Surg.1981;68:571-6. doi:10.1097/00006534-198110000-00016
13. Pichora D, Meyer R, Masear V. Rotational step-cut osteotomy for treatment of metacarpal and phalangeal malunion. J Hand Surg. 1991;16:551-5. doi:10.1016/0363-5023(91)90031-6
14. Rellán I, Ferreira L, Decarli P. Outcomes of osteotomy and rigid internal fixation treatment for the correction of phalangeal malunions. Rev Asoc Argentina Ortop Traumatol. 2020;85:125-32. doi:10.15417/issn.1852-7434.2020.85.2.932
15. Potenza V, De Luna V, Maglione P, Garro L, Farsetti P, Caterini R. Post-traumatic malunion of the proximal phalanx of the finger. Medium-term results in 24 cases treated by "in situ" osteotomy. Open Orthop J. 2012;6:468-72. doi:10.2174/1874325001206010468