Case Report | Journal of Orthopaedic Case Reports 2022 December:12(12):Page 1-5

# Digital Arterial Occlusion at the Metacarpophalangeal Joint with Hypothenar Hammer Syndrome-like Symptoms: A Case Report

Gaku Niitsuma[1], Keikichi Kawasaki[2], Katsunori Inagaki[1]

**Learning Point of the Article:**

When a patient presents with hypothenar hammer syndrome-like symptoms and is unresponsive to conservative treatment, we should use contrast-enhanced computed tomography for evaluating the entire upper extremity and consider surgical treatment.


## Abstract

**Introduction:** We present a rare case of ischemia caused by blunt trauma at the metacarpophalangeal joint, with no fracture or dislocation. This case resulted in digital arterial injury of the little finger with a pathological mechanism similar to that of hypothenar hammer syndrome (HHS).

**Case Report:** Pre-operative computed tomography (CT) revealed an occluded ulnar artery at the brachial artery bifurcation and occluded ulnar digital artery in the little finger. The blunt trauma to the radial digital artery of the little finger caused ischemia. Arterial anastomosis was performed microsurgically to preserve the little finger. Necrosis was successfully prevented. The condition of the finger improved gradually, with no restriction in the range of motion.

**Conclusion:** When a patient presents with HHS-like symptoms and is unresponsive to conservative treatment, surgical treatment should be considered. We recommend using contrast-enhanced CT for evaluating the entire upper extremity, even for ischemia associated with blunt hand trauma, such as HHS.


**Keywords:** Hypothenar hammer syndrome, metacarpophalangeal joint, ulnar artery, hand, ischemia, anastomosis.

## Introduction

Hypothenar hammer syndrome (HHS) is caused by blunt trauma to the hypothenar due to a single strong or repeated external insult. We report a rare case of ischemia caused by blunt trauma at the metacarpophalangeal (MP) joint, without fracture or dislocation. This case resulted in digital arterial injury of the little finger, with a pathological mechanism similar to that of HHS. The little finger was rescued by performing arterial anastomosis.

## Case Presentation

A 70-year-old man complained of color change on the right side of his little finger, which was injured while hitting a metal can repeatedly with a wrench for the 1st time, and presented to our hospital on the same day. His condition was diagnosed as atrial fibrillation and hypertension 14 years ago, for which he took the anticoagulant warfarin (3 mg/day) along with a β-blocker (2.5 mg/day) and an angiotensin-converting enzyme (ACE) inhibitor (2.5 mg/day) for 14 years. The patient had no history of smoking.

The injury was on his right hand (the dominant side). The ischemic change in the skin was distal to the distal interphalangeal (DIP) joint of the little finger (Fig. 1a-c). He reported sensory disturbance and pain in the same region, and a

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2022.v12.i12.3440

*Author's Photo Gallery*


Dr. Gaku Niitsuma


Dr. Keikichi Kawasaki


Dr. Katsunori Inagaki

[1]Department of Orthopaedic Surgery, Showa University School of Medicine, Hatanodai, Shinagawa-Ku, Tokyo, Japan,
[2]Department of Orthopaedic surgery, Showa University Northern Yokohama Hospital, Chigasaki-Chuou, Tsuzuki-Ku, Kanagawa, Japan.

**Address of Correspondence:**
Dr. Gaku Niitsuma,
Department of Orthopaedic Surgery, Showa University School of Medicine, 1-5-8, Hatanodai, Shinagawa-Ku, Tokyo 142-8666, Japan.
**E-mail:** gaku-nii09@med.showa-u.ac.jp

Submitted: 09/08/2022; Review: 28/09/2022; Accepted: November 2022; Published: December 2022

DOI: https://doi.org/10.13107/jocr.2022.v12.i123440

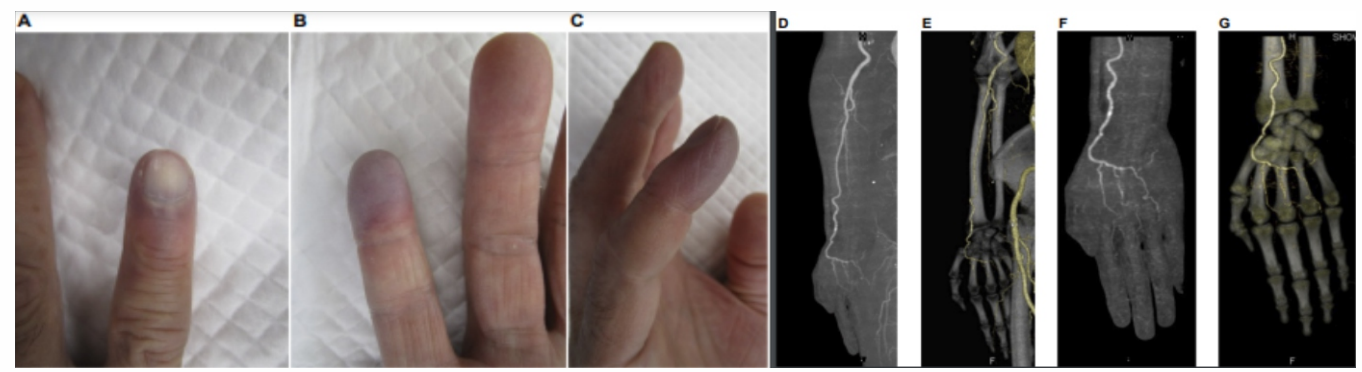


**Figure 1:** Physical and radiological findings of the patient. (a-c) The ischemic change in the skin was distal to the DIP joint of the little finger of the right hand. (d and e) Enhanced CT showed that the ulnar artery was occluded at the bifurcation from the brachial artery. (f and g) Enhanced CT showed a superficial palmar arch from the radial and palmar metacarpal arteries. The radial digital artery of the little finger was interrupted at the MP joint. CT: Computed tomography, DIP: Distal interphalangeal, and MP: Metacarpophalangeal.

feeling of coldness distal to the MP joint. The digital Allen test was negative. The range of motion (ROM) was normal. The manual muscle testing (MMT) of the flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) yielded a 5/5 score. The Semmes-Weinstein monofilament test (S-W test) score was 4.56 (normal: 1.65–2.83, diminished light touch: 3.22–3.61, diminished protective sensation: 3.84–4.31, loss of protective sensation: 4.56–6.65, and untestable: ≥6.65).

X-ray findings were normal. Computed tomography (CT) images showed no fracture. Contrast-enhanced CT showed a superficial palmar arch from the radial and palmar metacarpal arteries. The ulnar artery was occluded at the bifurcation from the brachial artery (Fig. 1d and e). The radial digital artery of the little finger was interrupted at the proximal metacarpal bone (Fig. 1f and g). The superficial palmar arch, common palmar digital artery, and ulnar digital artery of the little finger were also not enhanced.

Intravenous prostaglandin E1 (PGE1) administration slightly improved the skin color, and the disorder was considered to be reversible vasospasm, with no neuropraxia. We prescribed PGE1 tablets and instructed the patient to continue taking warfarin, β-blocker, and ACE inhibitor as before. He was also instructed to keep his finger warm using protective gloves and recommended to rest at home during the observation period. In addition, we prescribed acetaminophen for inflammation and pain relief. After 1 week, his symptoms did not improve. The patient presented with signs of ischemia restricted to the tip of his little finger, which did not correspond to the CT findings. As the signs of ischemia were restricted to the distal end, surgical intervention was necessary to confirm the viability of the blood vessels. Urgent adventitial dissection of the artery was performed.

An axillary nerve block was performed under echo guidance. However, blood flow did not improve due to the vasodilatory effect of the block. Blood flow did not resume sufficiently despite adventitial dissection of both sides of the digital arteries at the DIP joint. Therefore, arterial occlusion was suspected to be caused by thrombus formation and not by spasm. Furthermore, extending the adventitial dissection to the proximal revealed extensively occluded ulnar digital artery (Fig. 2a). Dissecting the MP joint revealed a bruise around the radial digital artery, which was adhering to the surrounding tissue. Proximal to the site, the artery had good pulsation (Fig. 2b). However, blood flow did not recanalize with the adventitial dissection of the digital artery. Thrombi, occlusion, and a corkscrew appearance were observed in the area extending from the DIP joint to the MP joint on the ulnar side, which was different from the radial side (Fig. 2a).

Radial digital artery reconstruction was scheduled. We made a partial incision in the wall of the occluded artery. The thrombus in the arterial lumen was removed, and the incised arterial wall was subsequently sutured. However, blood flow did not recanalize. It was completely occluded in this region. Approximately 5 mm of the injured artery was resected, and a thrombus found distal to the arterial lumen was removed (Fig. 2c). The normal artery was anastomosed. The digital artery recanalized thereafter (Fig. 2d).

The pain subsided immediately after surgery. A continuous infusion of heparin (8,000 units/day) and PGE1 was administered for 1 week. Cefazolin (2 g/day) was infused for 3 days after surgery. The color tone improved and stabilized (Fig. 3a). Final ROM (flexion/extension) values were MP 85/5, PIP 80/-5, and DIP 70/-5 (Fig. 3b). The S-W test score also normalized (1.65), and MMT results of the FDP and FDS were stable (5/5). The digital artery was examined using a color Doppler system (SONIMAGE MX1, Konica Minolta Inc., Tokyo, Japan; L11-3 MHz Linear probe, total scan depth of 20 mm). Echography revealed stable blood flow in the

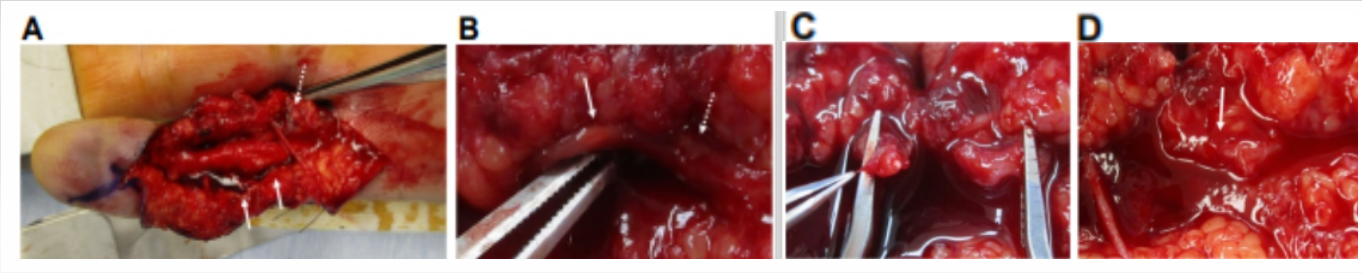


**Figure 2:** Intraoperative findings of the patient. (a) Thrombosis and occlusion in a wide area around the ulnar digital artery to the MP joint, and arterial pulsation had disappeared (solid arrows). The radial digital artery of the little finger on the MP joint was bruised (dashed arrow). (b) Intraoperative findings of the MP joint of the radial digital artery. A white thrombus was distal to the obstruction (solid arrow). Redness, swelling, and adhesion with the surrounding artery, indicating suspected arterial damage, were visible (dashed arrow). (c) The damaged site of the radial digital artery of the little finger was resected approximately 5 mm, and the thrombus in the distal arterial lumen was removed. (d) Anastomosis with microsurgery of the normal part with 10-0 nylon. Blood flow was resumed (arrow). MP: metacarpophalangeal.

anastomosed artery on the radial side (Fig. 3c). The blood flow was lower in the ulnar digital artery of the MP joint than in the radial side on the sagittal view (Fig. 3d). The ulnar-side artery had a smaller diameter and less blood flow than the radial side on the coronal section at the DIP joint (Fig. 3e).

Contrast-enhanced CT re-evaluation of the artery 1 month after the surgery revealed persistent ulnar artery occlusion at the bifurcation of the brachial artery (Fig. 4a, solid arrow). The proper palmar digital artery of ulnar side was occluded (Fig. 4a, dashed arrow). Therefore, the occlusion was thought to have existed before this trauma. The radial side from radial artery was enhanced (Fig. 4b, dashed arrow), and anastomosis was effective. The patient's recovery was unremarkable, with no associated symptoms observed at the final follow-up visit one year after surgery.

### Levels of expertise of the surgeons

The levels of expertise of the surgeons involved with this article, according to Tang and Giddins [1], were as follows: Author 1 (Level 4-Specialist, highly experienced); author 2 (Level 5-Expert); and author 3 (Level 5-Expert).

## Discussion

We described a rare case of ischemia caused by blunt trauma at the MP joint without fracture or dislocation, which resulted in digital arterial injury of the little finger. The previous reports have described HHS caused by such blunt trauma [2]. However, we did not observe finger ischemia due to digital arterial injury associated with blunt trauma at the MP joint.

Causes of arterial occlusion, including HHS, can be trauma, embolism and thrombus, arterial malformation, thoracic outlet syndrome and quadrilateral space syndrome (i.e., constriction), medium and small-vessel vasculitis, Raynaud's disease, antiphospholipid antibody syndrome, myeloproliferative disorders, sclerosis, hypercoagulable states, and immune-mediated/inflammatory disease [3, 4]. Miyayama et al. reported two patients with heart disease and thrombosis of the upper extremity, which accounted for 19% of the total thrombosis [5].

Of the thromboembolisms in the upper arm, Haimovici reported that ulnar artery occlusion occurred in 1.6% of all cases, and it often developed anatomically on the right side [6]. Thromboembolism of the ulnar artery occurred in 0.3% of all cases.

Our patient had a history of atrial fibrillation and was consuming warfarin, indicating a possibility of thromboembolism. We believe that the subacute ulnar artery occlusion was caused by thrombus formation based on the patient's medical history. If the ulnar artery occlusion was chronic, the collateral vessels would have been more developed. As a consequence, the radial digital artery of the little finger was occluded by blunt trauma in that state.

The treatment for hand ischemia, including HHS, remains unclear. St-Pierre et al. summarized possible treatments of hand ischemia from the previous reports [3]. The first choice of treatment was thrombolytics and anti-platelet drugs within 2 weeks. If symptoms persisted, a catheter was used to clear any blockage. If symptoms persisted or worsened, surgical revascularization was performed. In addition, if the symptoms progressed rapidly, surgical revascularization was required. Thus, the treatment choice was appropriate in this case.

Regarding the indications for and long-term results of surgery, Kitzinger et al. stated that the indications for surgery are severe symptoms and resistance to conservative treatment [7]. They also reported the effectiveness of surgical revascularization and improvement in 9 (75%) of 12 cases. As a caveat, Iannuzzi et al. reported that if the cause of thrombus is investigated but left untreated, it can recur even after surgical treatment [4]. However, regarding conservative treatment, Adams et al.

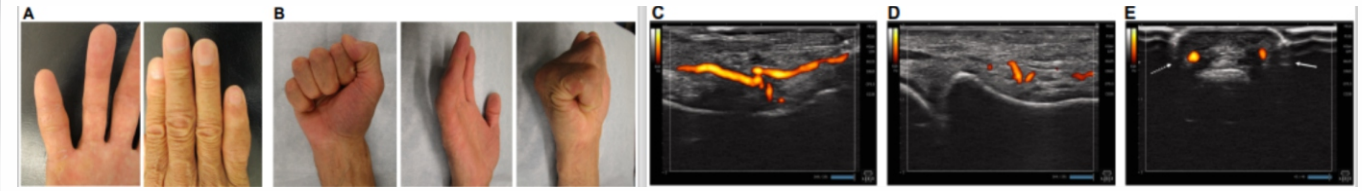


**Figure 3:** Post-operative findings of the patient. (a and b) After the surgery, blood flow, skin tone, and sensory disturbance improved. (c) The digital artery of the little finger was examined with a power Doppler. The echo revealed blood flow (red) in the anastomosed radial digital artery of the MP joint of the little finger on the sagittal view. (d) The echo showed less blood flow in the ulnar digital artery of the MP joint of the little finger than that in the radial side on the sagittal view. (e). The echo showed a coronal section at the DIP joint. The artery on the ulnar side (solid arrow) had a smaller diameter and less blood flow than that on the radial side (dashed arrow). DIP: Distal interphalangeal, MP: Metacarpophalangeal.

reported that the recurrence of symptoms and cold intolerance often persisted [8]. In our case, the patient had a surgical indication, because symptoms persisted despite the conservative treatment and axillary nerve block.

Intraoperative corkscrew appearance and extensive thrombotic occlusion of the ulnar digital artery were diagnosed as changes associated with previous ulnar artery occlusion. Gardiner and Tan reported that ischemia associated with blunt hand trauma is influenced by the history of the artery, the fragility of the arterial walls, and a narrowed arterial lumen that leads to the formation of blood clots [9]. In addition, a corkscrew appearance is a characteristic finding associated with arterial wall weakening. We considered the possibility of peripheral artery changes associated with ulnar artery occlusion or arterial wall weakening due to the underlying condition.

Luczak et al. reported ischemia of the finger due to closed trauma of the MP joint with dislocation of a closed proximal phalanx fracture [10]. However, we could not find any reports of finger ischemia caused solely by blunt trauma of the MP joint without fracture or dislocation. This observation might be explained by the fact that blunt trauma cannot simultaneously damage both digital arteries, and trauma of one digital artery cannot lead to ischemia with the transverse blood flow.

## Conclusion

Herein, we reported a rare case of ischemia caused by blunt trauma to the MP joint that resulted in digital artery injury of the little finger. This trauma had a pathological mechanism similar to that of HHS. The ulnar artery occluded subacutely. In addition to that state, a blunt trauma caused damage and occlusion of the radial digital artery of the little finger, which resulted in ischemia as it occurred. We believe that contrast-enhanced CT is an ideal tool for the evaluation of the entire upper extremity, even for ischemia associated with hand trauma, such as HHS. However, it is necessary to carefully investigate cases with inconsistencies between CT findings and clinical findings.

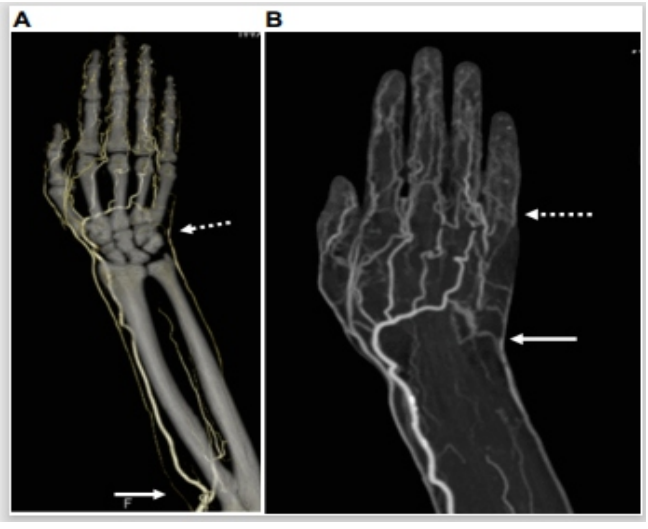


**Figure 4:** Contrast-enhanced CT findings after surgery. (a) 2 months after the surgery, contrast-enhanced CT showed blood vessels. The ulnar artery was nearly occluded at the bifurcation of the brachial artery (solid arrow), and the superficial palmar arch and palmar metacarpal artery were not visible (dashed arrow). (b) The palmar metacarpal artery was occluded (solid arrow). The radial side of the proper palmar digital artery from radial artery was enhanced (dashed arrow). The ulnar digital artery was also recanalized. CT: Computed tomography.

**Clinical Message**

This report showed that it is important to assess blood flow of the whole upper limbs with enhanced CT even if HHS is suspected.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

## References

1. Tang JB, Giddins G. Why and how to report surgeons' levels of expertise. J Hand Surg Eur Vol 2016;41:365-6.
2. Scharnbacher J, Claus M, Reichert J, Röhrl T, Hoffmann U, Ulm K, et al. Hypothenar hammer syndrome: A multicenter case-control study. Am J Ind Med 2013;56:1352-8.
3. St-Pierre F, Shepherd RF, Bartlett MA. Diagnosis of hypothenar hammer syndrome in a patient with acute ulnar artery occlusion. BMJ Case Rep 2019;12:e230963.
4. Iannuzzi NP, Higgins JP. Acute arterial thrombosis of the hand. J Hand Surg Am 2015;40:2099-106.
5. Miyayama S, Yamashiro M, Shibata Y, Hashimoto M, Yoshida M, Tsuji K, et al. Thrombolysis and thromboaspiration for acute thromboembolic occlusion in the upper extremity. Jpn J Radiol 2012;30:180-4.
6. Haimovici H. Cardiogenic embolism of the upper extremity. J Cardiovasc Surg (Torino) 1982;23:209-13.
7. Kitzinger HB, van Schoonhoven JV, Schmitt R, Hacker S, Karle B. Hypothenar hammer syndrome: Long-term results after vascular reconstruction. Ann Plast Surg 2016;76:40-5.
8. Adams NS, Ford RD. Recurrent hypothenar hammer syndrome: A case report. J Hand Surg Asian Pac Vol 2016;21:414-6.
9. Gardiner GA Jr., Tan A. Repetitive blunt trauma and arterial injury in the hand. Cardiovasc Intervent Radiol 2017;40:1659-68.
10. Luczak BP, Maher R, Gurfinkel R, Teh LG. Closed digital artery injury. Ochsner J 2011;11:139-42.

**Conflict of Interest:** Nil
**Source of Support:** Nil

**Consent:** The authors confirm that informed consent was obtained from the patient for publication of this case report

**How to Cite this Article**

Niitsuma G, Kawasaki K, Inagaki K. Digital Arterial Occlusion at the Metacarpophalangeal Joint with Hypothenar Hammer Syndrome-like Symptoms: A Case Report. Journal of Orthopaedic Case Reports 2022 December;12(12):1-5.