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Masquelet technique for the treatment of acute osteomyelitis of the PIP joint caused by clenched-fist human bite injury: A case report

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ABSTRACT

INTRODUCTION: The Masquelet technique is a well-known and efficient procedure for lower limb soft tissue reconstruction after severe osteomyelitis requiring bone excision. However, this technique is rarely used in the hand.

PRESENTATION OF CASE: The patient was 38-year-old man. We used this technique to reconstruct a proximal interphalangeal (PIP) joint osteochondral defect after osteomyelitis caused by clenched-fist human bite injury. The pathogen was *Prevotella intermedia*, which is an anaerobic pathogenic bacterium involved in periodontal infections and is a black-pigmented periodontal pathogen. Following completion of the Masquelet method, the bone remodeled at an angle at the PIP joint.

DISCUSSION: *Prevotella intermedia* is known as *Bacteroides melaninogenicus* subsp. *intermedius*. When the infection site is black-pigmented, this pathogen is highly suspected. The Masquelet technique is rarely used in the hand, and when used, it has been in a straight fashion in the hand. We were able to reconstruct a more anatomical, bent PIP joint, and the fixed angle of the PIP joint at 40° of flexion using Masquelet technique.

CONCLUSION: The angled joint resulting from this technique created a relatively normal permanently bent PIP joint.

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1. Introduction

Clenched-fist injuries are commonly caused by human bites sustained during fighting, and standard treatment consists of washing the injured site with soap, thorough debridement, antibiotic therapy, and hospitalization for 48 h in certain cases [1]. In some cases, these injuries develop purulent arthritis or osteomyelitis as serious complications.

The Masquelet technique [2] is a well-known and efficient procedure for lower limb or upper extremity soft tissue reconstruction after severe infection [3–5], however, it is rarely used in the hand [6]. We hypothesized that this technique was also useful for osteochondral defects even with a bent final position in the proximal interphalangeal (PIP) joint in the hand. The work has been reported in line with the SCARE criteria [7].

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2. Case report

A 38-year-old man was referred to our hospital because of left long finger PIP joint infection. He worked as a building contractor, and suffered a clenched-fist injury by punching his father's face six days earlier. The wound was still open and purulent discharge was seen (Fig. 1A). He suffered from psychological depression and was receiving medication; he was also a heavy smoker. Blood laboratory testing revealed a white blood cell count of 11,630/mm³ and C-reactive protein level of 1.94 mg/dl, and magnetic resonance imaging revealed osteomyelitis of the proximal phalanx (Fig. 2). We immediately performed soft tissue debridement and irrigation, and intraoperatively the PIP joint cartilage and proximal phalanx intramedullary canal were black-pigmented; however, we could not find a tooth mark in the bone or cartilage at the inoculation site (Fig. 1B,C). The results of anaerobic and aerobic bacteriological tissue cultures revealed *α-Streptococcus*, *Prevotella intermedia*, *Prevotella spp.* and *Eubacterium lentum*; the latter three are usually isolated from oral samples and can cause periodontal disease. Because the infection was not responding to therapy, we proposed amputation of the affected finger; however, the patient and his family sincerely wished to salvage his affected finger. We also pro-



Fig. 1. Macroscopic findings of the patient's hand.

(A) Photograph on admission showing that the wound was still open and purulent discharge was present.

(B) After soft tissue debridement. The proximal phalangeal joint cartilage was black-pigmented, but we found no tooth mark in the bone or cartilage at the inoculation site.

(C) Head of the proximal phalanx was resected. The proximal phalanx intramedullary canal was black-pigmented.

posed vascularized 2nd toe PIP joint transfer or arthrodesis of the affected finger PIP joint. As he and his family chose arthrodesis, we planned intensive debridement followed by reconstruction. We first performed extensive debridement of the PIP joint because of the middle phalanx intramedullary canal was black-pigmented. The debridement including the distal half of the proximal phalanx and base of the middle phalanx was done, which resulted in about 2 cm of bony gap between proximal phalanx and middle phalanx (Figs. 3A and 4A). The wound was left open. At the second step three weeks later, we performed an island flap from the ring finger for soft tissue coverage and left a cement spacer infused with antibiotics (panipenem/betamipron) in the defect of the PIP joint then applied an external fixator to preserve bone length (Figs. 3B,C, 4B). At the third stage four weeks after the second operation, we removed the cement spacer and fixed the PIP joint at 40° of flexion with a bent dorsal plate (modular hand T-plate, Synthes, Paoli, PA), then filled the defect with cancellous bone from the iliac crest (Figs. 3D, 4C).

No signs of infection were seen postoperatively, and bone union without absorption of the grafted bone was confirmed on X-ray

examination 2 months after the final operation. At 32 months after the Masquelet procedure, the angle of the PIP joint was unchanged from the angle at the time of arthrodesis, and there were no problems related to the island flap (Figs. 4D,E, 5). Quick-DASH score was 2.27. The patient was able to return to his previous work, thereafter.

3. Discussion

Clenched-fist injuries are a common cause of human bites known as being the worst human bites, and the bacterial contamination consists of a mixed flora of aerobic and anaerobic microorganisms; therefore, aerobic and anaerobic culture is mandatory. Group A *Streptococci* are common in human bite wounds [1]. Clenched-fist injuries often show penetration of the bone or cartilage with a tooth mark at the inoculation site, but we could not identify a tooth mark in our case. *Prevotella intermedia*, which was detected in our case, is an anaerobic pathogenic bacterium involved in periodontal infections and is a black-pigmented periodontal pathogen [8]. This organism is known as *Bacteroides*

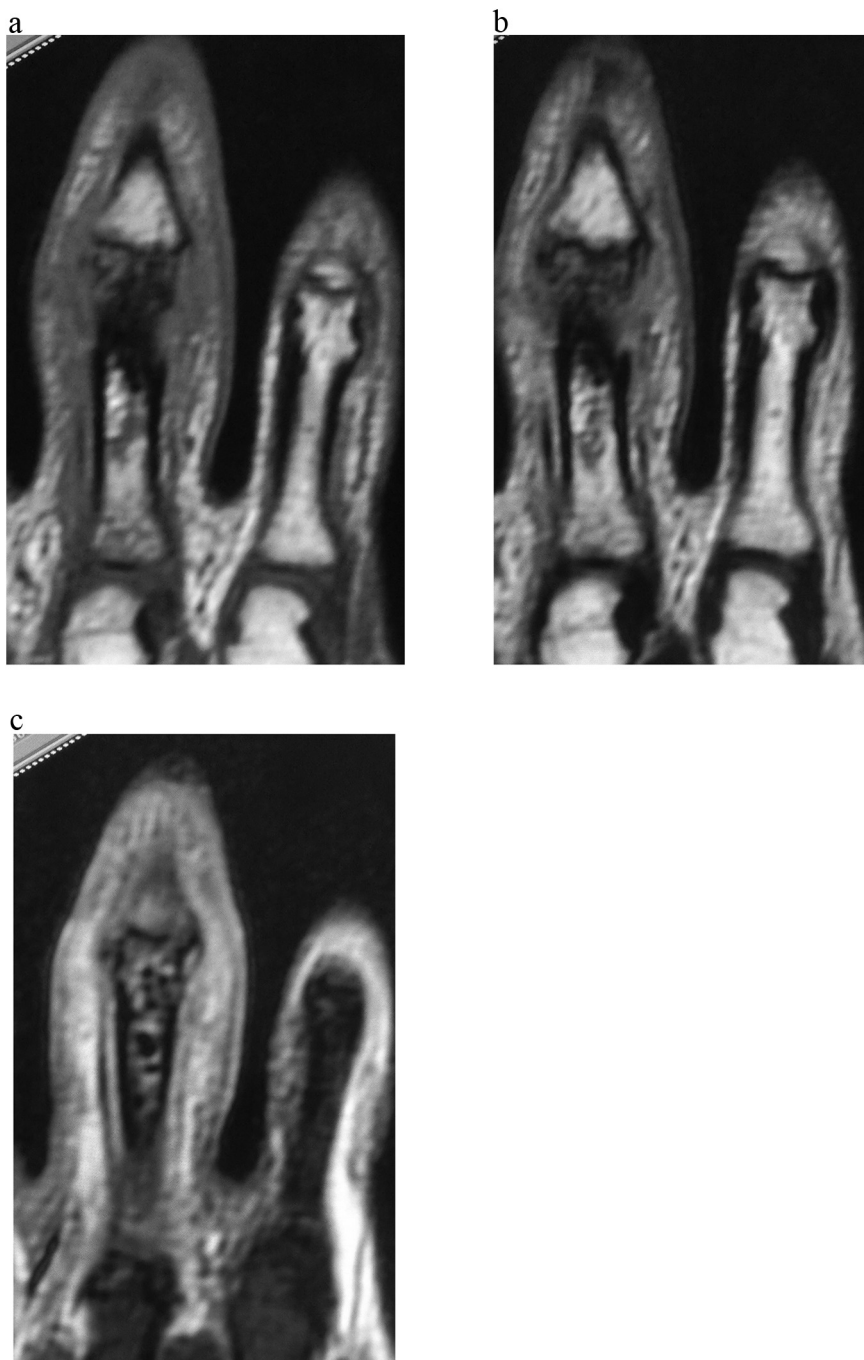


Fig. 2. Magnetic resonance images at the first visit. Magnetic resonance images indicated osteomyelitis of the proximal phalanx.

(A) T1-weight image.

(B) T2-weight image.

(C) T2 STIR image showing speckled intensity.

melaninogenicus subsp. *intermedius*. When the infection site is black-pigmented, this pathogen is highly suspected.

The induced-membrane technique of bone reconstruction described by A.C. Masquelet [2] is a well-known and efficient procedure for long bone reconstruction after severe infection. However, to obtain optimal results, it is essential to follow the principles of the two stages of the procedure. After debridement, the technique involves separately placing a foreign body membrane using a cement methyl methacrylate polymer spacer followed by a second procedure to fill the defect with cancellous bone. This technique is

rarely used in the hand, and when used, it has been in a straight fashion in the hand [6].

Our patient's osteomyelitis was very serious but successfully treated with radical bone debridement followed by the Masquelet technique. Using the Masquelet technique in our patient, we were able to reconstruct a more anatomical, bent PIP joint, and the fixed angle of the PIP joint at 40° of flexion was maintained 32 months after the surgery. The grafted bone united with the phalangeal bones without absorption. To our knowledge, ours is the first report

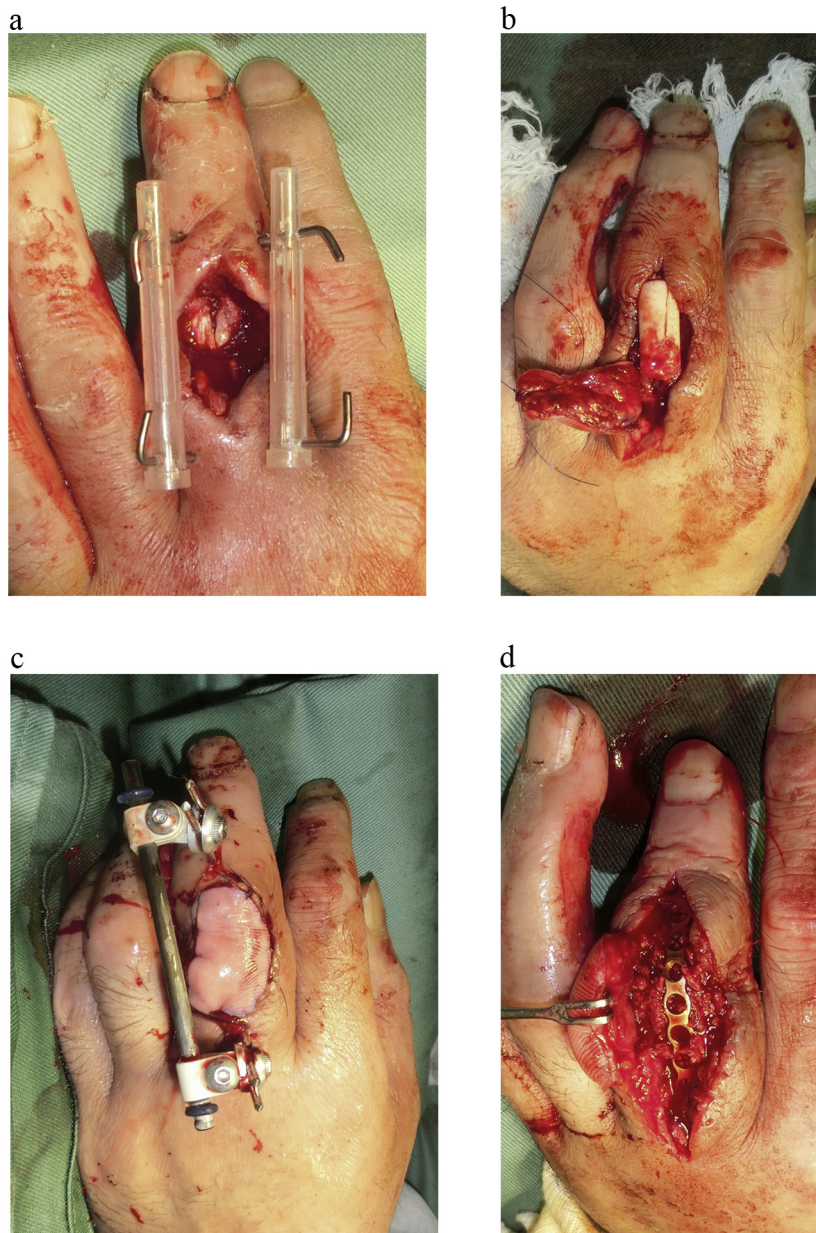


Fig. 3. (A) The first step: Proximal interphalangeal joint resection. The wound was left open following debridement and handmade external fixation was applied. (B) The second step: An antibiotic-infused cement spacer was placed in the bone defect. (C) The wound was covered with an island flap from the ring finger. (D) The third step: The proximal interphalangeal joint was fixed with a plate and iliac bone grafting was performed.

to demonstrate that the Masquelet method is useful for bent-bone arthrodesis in the finger.

Conflict of interest

None of the authors have conflict of interest.

Sources of funding

We have no source.

Ethical approval

It is retrospective case report and no ethical approval was required.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request. Patient's name, initials, or hospital numbers are not used in this manuscript.

Author contribution

Akira Hara and Minoru Yokoyama conducted a literature search and drafted the manuscript.

Akira Hara and Minoru Yokoyama performed the operation.



Fig. 4. (A) Post first step X-ray. After debridement and handmade external fixation was applied. (B) Post second step X-ray. Cement spacer was interposed with external fixation. (C) Post third step X-ray. The proximal interphalangeal joint was fixed the PIP joint at 40° of flexion with a bent dorsal plate and iliac bone grafting was performed. (D)(E) Radiograph 32 months after the last operation showing that the bone had united in a bent configuration at the same angle set at the final stage of surgery. The hardware was already removed.

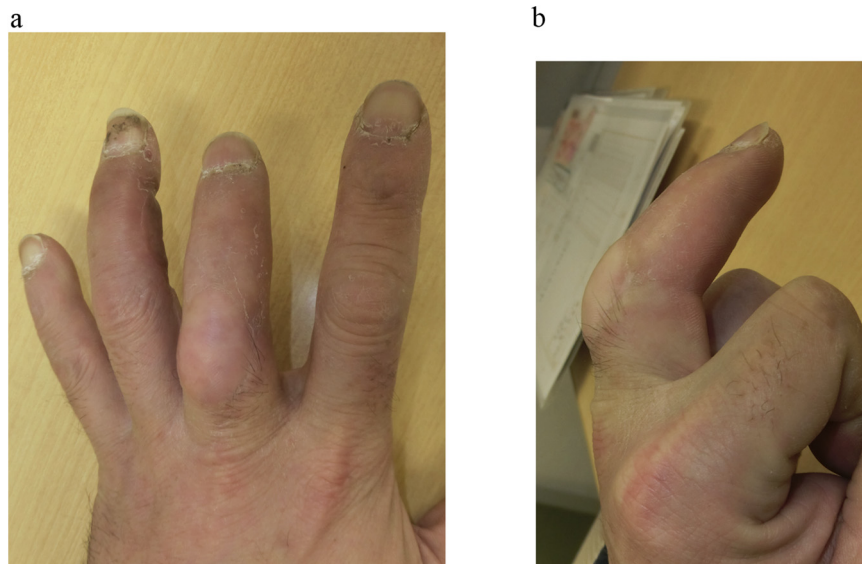


Fig. 5. Photographs of the healed finger at 32 months after the last operation.

Akira Hara, Satoshi Ichihara and Toshiya Kudo contributed during the patient management and participated in the design of the case report and coordination and helped draft the manuscript.

All authors read and approved the final manuscript.

Akira Hara wrote up.

Yuichiro Maruyama was consultant involved in management of patient, main guidance for write up.

Registration of research studies

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