The Use of a Third Metacarpal Base Osteoarticular Flap for Treatment of Metacarpophalangeal Joint Traumatic Defects

Xu Zhang, MD, Xiugui Fang, MD, Xinzhong Shao, MD, Sumin Wen, MD, Hongwei Zhu, MD, Chunzhen Ren, MD

Purpose To describe the use of a pedicled osteoarticular flap harvested from the base of the third metacarpal for the treatment of traumatic defects of the metacarpophalangeal (MCP) joints.

Methods From February 2006 to January 2008, we included in the study 15 patients with posttraumatic defects of the MCP joints. The mean age of the patients was 35 years. The injured MCP joints were located in the thumb (n = 6) and index (n = 4), middle (n = 4), and ring fingers (n = 1). Of the 15 patients, 10 presented with acute injuries and 5 with old injuries. At follow-up, we assessed active motion and pinch strength and compared all measurements with those from the opposite hand. In patients with old MCP joint injuries, we also compared preoperative and postoperative motion and pinch strength. We assessed hand function using the Disabilities of the Arm, Shoulder, and Hand questionnaire.

Results At the final follow-up (mean, 28 mo), the mean motion arc of the reconstructed MCP joints and the opposite joints was 46° and 91°, respectively, and the mean pinch strength of the injured and opposite sides was 5.4 and 7.1 kg, respectively. For the 5 patients with old injuries to the fingers, the mean preoperative and postoperative motion arc was 2° and 43°, and the mean preoperative and postoperative pinch strength was 1.6 and 5.3 kg, respectively. The mean Disabilities of the Arm, Shoulder, and Hand score of the entire patient series was 9, whereas the mean preoperative and postoperative scores of the 5 patients with old injuries were 44 and 17, respectively.

Conclusions The use of a pedicled osteoarticular flap harvested from the base of the third metacarpal is a reliable technique for the treatment of traumatic defects of the MCP joints.

Type of study/level of evidence Therapeutic IV.

Key words Metacarpophalangeal joint, defect, pedicled osteoarticular flap, third carpometacarpal joint, dorsal metacarpal artery.

From the Hand Surgery Department, Second Hospital of Qinhuangdao, Changli, Qinhuangdao, Hebei; the Emergency Department, No. 463 Hospital of the People's Liberation Army, Shenyang, Liaoning; and the Hand Surgery Department, Third Hospital of Hebei Medical University, Shijiazhuang, Hebei, China.

Received for publication January 6, 2012; accepted in revised form June 4, 2012.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Xu Zhang, MD, Hand Surgery Department, Second Hospital of Qinhuangdao, Changli, Qinhuangdao, Hebei 066600, China; e-mail: ahand@sina.com.

0363-5023/12/37A09-0005$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2012.06.004

The metacarpophalangeal (MCP) joints are important for finger function, because their average active range of motion (ROM) accounts for 36% of total finger motion.[1] Intra-articular injuries to the MCP joints can lead to posttraumatic arthritis and functional disability as a result of joint pain and loss of motion.[2,3] Although patients may benefit from the painless stability provided by thumb MCP joint arthrodesis, preservation of motion remains a laudable goal, even at the thumb MCP joint.

Previous anatomical studies have shown that nutrient arteries penetrate into the dorsum of the base of the third metacarpal,[4] and these nutrient arteries arise from the distal and middle dorsal carpal arches, which run distally to the second to fourth dorsal metacarpal arteries (DMAs)[5] (Fig. 1A, B). The first DMA originates from the radial artery (in 93% of cases), which connects to the dorsal carpal arches, although the first DMA has also been shown to originate from the distal dorsal carpal arch. This anatomical organization was the basis for our development of a reverse DMA-based osteoarticular flap. Moreover, this flap technique can be modified according to anatomic variations. For example, the middle dorsal carpal arch is routinely present in all cases, whereas the distal dorsal arch is present in only 73% of the population.[4] Thus, in a patient with no distal dorsal arch, the flap could be designed to obtain its blood supply from the DMAs of the middle dorsal carpal arch.

The third metacarpal has a widened proximal base, and the surface that articulates with the capitate is convex anteriorly and concave dorsally and extends to the styloid process on the dorsolateral aspect of the metacarpal base[4] (Fig. 1C–E). This unique contour led us to investigate the feasibility of using a portion of this articular surface for MCP joint reconstruction. We found that the convex and concave surfaces were most useful for reconstructing the metacarpal head and the base of the proximal phalanx, respectively.

Here, we report our experience in reconstructing traumatic defects of the MCP joints through the use of a DMA-based osteoarticular flap created from the third metacarpal.

MATERIALS AND METHODS

The institutional review boards of the hospitals involved approved this study. We obtained informed consent and Health Insurance Portability and Accountability Act consent from each patient.

From February 2006 to January 2008, we included in the study 15 patients with traumatic defects of the MCP joints (Table 1). There were 12 male and 3 female patients, with a mean age of 35 years (range, 18–45 y). Of these patients, 10 presented acutely and 5 presented with old injuries, which we defined as those more than 2 weeks old. All of the patients' injuries were caused by power saws. The mean time period between the injury and the operation was 9 days (range, 0–68 d).

We performed perioperative radiographs for all patients and used them to assess the articular defects. We also performed perioperative computed tomography (CT) imaging for patients with old injuries, to more accurately assess the extent of the defects. Intraoperative assessment was critical in determining whether to perform the tissue transfer, and all injuries involved either the proximal or distal MCP joint articular surface.

Patients underwent the pedicled flap procedure if they exhibited a traumatic osteoarticular defect at either the proximal or distal MCP joint surface; had lost a quarter or more of the entire joint surface according to the radiographic, CT imaging, or intraoperative findings; and showed either the presence of absence of MCP joint subluxation. We excluded patients if they had an injury involving both MCP joint surfaces, a defect encompassing less than a quarter of the entire joint surface, or an associated infection or underlying diabetes, rheumatoid arthritis, or gout.

Surgical technique

We selected the first, second, and third DMAs for the vascular pedicle, mainly because of their reach and their reliable position and size, as they display less anatomical variation and a greater vascular caliber than the fourth and fifth DMAs.[4] Table 2 shows our protocol; we excluded injured DMAs.

We located the DMAs perioperatively using a Doppler probe and performed the surgeries under brachial plexus anesthesia with tourniquet control. We made a lazy S- or L-shaped incision over the DMA that was selected as the vascular pedicle (Fig. 2). At the wrist, the incision was curved transversely over the capitate-metacarpal joint. We identified the DMA and its accompanying 2 veins according to where they coursed along the dorsal interosseous fascia. In some cases, to ensure sufficient exposure, we partially released the insertion of the extensor carpi radialis brevis tendon and retracted it laterally. If a large bone flap was required to simultaneously reconstruct a condylar defect, we completely released the extensor carpi radialis brevis insertion and sutured it to the extensor carpi radialis longus (we performed this procedure in 4 of 15 cases). We incised the periosteum of the third metacarpal transversely at the level of the previous epiphysis, which was