

Enchondromas of the Hand: Treatment With Curettage and Cemented Internal Fixation

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Removal by means of curettage is the mainstay of surgical treatment of enchondromas of the hand. Reconstruction traditionally entails filling the tumor cavity with a bone graft, or it may be decided not to perform a reconstruction. In either case a period of protected activity is needed until the tumor cavity has healed. The current study describes the use of cemented internal fixation for the purpose of reconstruction of these cavities. This technique provides immediate mechanical stability and allows early mobilization. Between 1986 and 1999, we treated 13 patients who were diagnosed as having enchondroma of the hand. Surgery included tumor removal with hand curettes and high-speed burr drilling. The remaining tumor cavity was reconstructed by using bone cement and intramedullary hardware. All patients were followed-up for more than 2 years. There were no postoperative infections or fractures, and all patients returned to their presurgical functional capability within 4 weeks. At the most recent follow-up evaluation, none of the patients had local tumor recurrence. Although 7 patients had a decrease in flexion of the metacarpophalangeal or interphalangeal joints, none reported a functional limitation. Reconstruction of the tumor cavity with cemented hardware provides immediate mechanical stability, allows early mobilization, and is associated with good functional outcome. (*J Hand Surg* 2002;27A:870–875. Copyright © 2002 by the American Society for Surgery of the Hand.)

Key words: Enchondroma, curettage, polymethylmethacrylate, internal fixation.

Enchondroma of the hand is a common benign tumor composed of mature cartilage. The age of the

patients varies widely.^{1–3} The small bones of the hand are the most frequent anatomic site for enchondromas with approximately 40% of the cases occurring at this site.^{2,3} These lesions are most frequently located in the proximal phalanx, followed by the middle phalanx, metacarpals, distal phalanx, and, rarely, in the carpal bones.^{1,4–6} Enchondromas commonly present as a pathologic fracture associated with pain, deformity, and swelling.^{1,6} Dysfunction of the flexor and extensor tendons of the fingers as a result of fracture and detachment of their insertion sites at the phalanges have also been described.^{7–10} Malignant transformation of monostotic enchondromas of the hand is rare and is associated with a very low rate of metastatic dissemination.¹¹

Curettage is the mainstay of surgical treatment of

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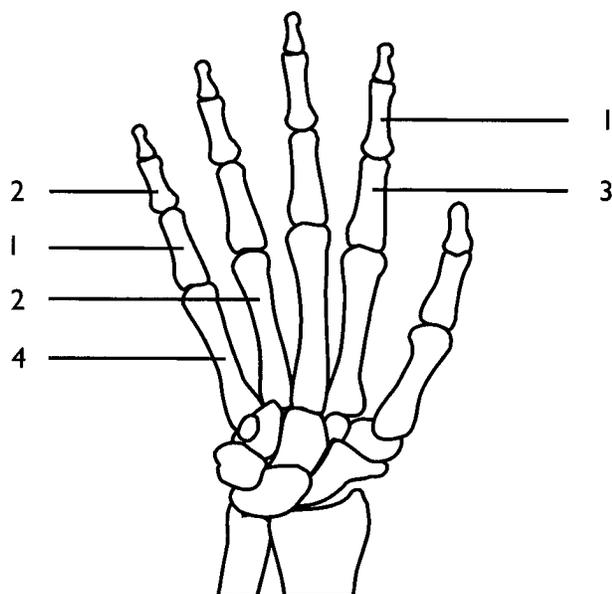


Figure 1. Anatomic site of enchondroma in 13 patients treated by curettage and cemented hardware.

enchondromas of the hand. In some patients no reconstruction is undertaken after curettage whereas in others, the remaining tumor cavity is filled with bone graft.^{4-6,12-15} Local tumor control and good functional outcome are anticipated in the majority of patients.¹³⁻¹⁵ To allow adequate time for bone healing, however, patients who have undergone these reconstructions must wait for 4 to 6 weeks before they can resume unrestricted activity with the operated hand. Moreover if patients present with a pathologic fracture, surgical intervention must often be

delayed until it has healed.^{6,15} In this study cemented hardware has been used to reconstruct the resultant cavity caused by enchondroma excision. It was assumed that this technique would provide immediate mechanical stability and allow early mobilization of the operated hands. We are unaware of a description of this surgical technique having been published before in these tumors.

Materials and Methods

Between 1986 and 1999 we treated 13 patients who were diagnosed as having a solitary enchondroma of the hand. None of the patients had Ollier's disease or Maffucci's syndrome. There were 8 women and 5 men who ranged in age from 23 to 58 years (median, 32 y). Six of the lesions were in the metacarpal bones, 4 in the proximal phalanx, and 3 in the middle phalanx. Figure 1 shows the anatomic distribution of the tumors and Table 1 summarizes the clinical presentation, anatomic location of the enchondroma, and extent of bone involvement. All 13 patients presented with significant pain and 8 of them had an associated pathologic fracture. Patients who presented with a pathologic fracture underwent surgery within 10 days from the day of presentation.

Surgery included tumor removal using hand curettes and high-speed burr drilling followed by reconstruction with bone cement and intramedullary hardware. All participating surgeons were trained together and used the same techniques of tumor removal and reconstruction. The institutions' Helsinki ethics committees approved this surgical pro-

Table 1. Clinical Presentation, Anatomic Location of Enchondroma, and Extent of Bone Involvement

Patient	Sex	Age (y)	Clinical Presentation	Anatomic Location of Enchondroma	Extent of Bone Involvement			
					Proximal Fourth	Second Fourth	Third Fourth	Distal Fourth
1	F	23	Pathologic fracture	Metacarpus (ring finger)		✓	✓	✓
2	M	43	Pain, swelling	Metacarpus (small finger)		✓	✓	✓
3	F	32	Pain	Metacarpus (small finger)		✓	✓	✓
4	M	29	Pain	Metacarpus (ring finger)			✓	✓
5	M	47	Pathologic fracture	Metacarpus (small finger)			✓	✓
6	M	24	Pain	Metacarpus (small finger)			✓	✓
7	F	37	Pathologic fracture	Proximal phalanx (index finger)	✓	✓	✓	✓
8	M	41	Pathologic fracture	Proximal phalanx (small finger)	✓	✓	✓	✓
9	F	28	Pathologic fracture	Proximal phalanx (index finger)		✓	✓	✓
10	F	31	Pathologic fracture	Proximal phalanx (index finger)			✓	✓
11	M	40	Pathologic fracture	Middle phalanx (index finger)		✓	✓	✓
12	M	58	Pain, swelling	Middle phalanx (small finger)	✓	✓	✓	✓
13	M	28	Pathologic fracture	Middle phalanx (small finger)	✓	✓	✓	✓

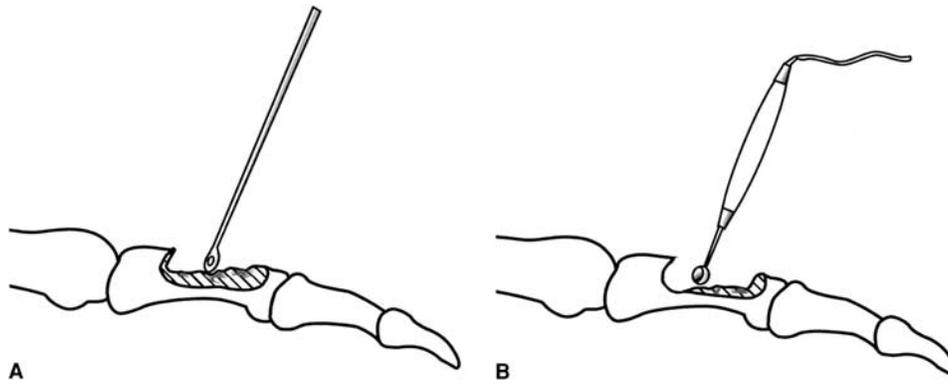


Figure 2. Tumor is removed by curettage (A) followed by meticulous burr drilling (B).

cedure and informed consent was obtained from all patients.

Surgical Technique

The involved limb was exsanguinated and a pneumatic tourniquet was used during the procedure to decrease local bleeding. The involved bone was exposed through a dorsal approach. The overlying extensor tendon was exposed longitudinally and mobilized medially or laterally to expose the more involved aspect of the bone. A cortical window the size of the longest longitudinal dimension of the tumor was made to allow exposure of the entire tumor and avoid inadequate curettage. The removed bone, which usually was very thin, was not used for reconstruction. In patients who had a pathologic fracture at presentation, the tumor was approached through the retained thinned or destroyed cortex to minimize additional bone loss. All gross tumor material was removed with hand curettes. This was followed by high-speed burr drilling of the inner reactive shell using the Midas Rex (Midas Rex, Forth Worth, TX) or Black Max (Anspach, Lake Park, FL) (Fig. 2).

Reconstruction of the tumor cavity was then performed. It included the use of a 1.6-mm K-wire manually shaped to fit the configuration of the tumor cavity, not placed under tension. The cavity containing the K-wires was then filled with polymethylmethacrylate (PMMA; Howmedica, Shannon, Ireland), as shown in Figs. 3, 4.

Postoperative Management

Oral perioperative antibiotics were administered for 3 to 5 days. The wounds were examined and the dressings were changed on the second postoperative day. After surgery the patients were allowed to per-

form full motion of the operated hand. If soft-tissue healing had progressed satisfactorily, unrestricted activity was allowed after 2 weeks. Patients were not assisted by a physical therapist. All 13 patients were followed-up for a minimum of 2 years (range, 25-182 mo; average, 73.2 mo). They were evaluated at 1 and 2 weeks, at 1, 3, and 6 months after surgery, and semiannually thereafter. On each visit, anteroposterior and lateral plain radiographs were done and the operated fingers were assessed for residual swelling, deformity, and range of motion. Clinical records and plain radiographs were analyzed for each patient by an orthopedic oncologist and musculoskeletal radiologist. The site and extent of each lesion at presentation were observed and the rates of local tumor recurrence and fracture union were determined. The results presented here are based on each patient's most recent follow-up evaluation.

Results

After surgery there were no neurovascular or tendon injuries, superficial or deep wound infections, or delayed stress fractures. All the patients reported

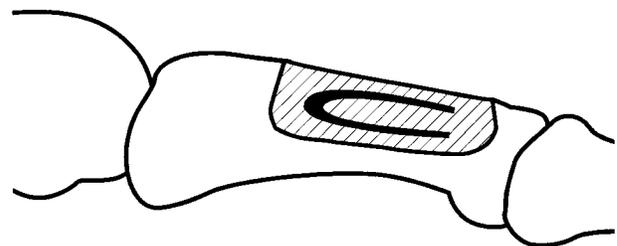


Figure 3. Reconstruction of tumor cavity with cemented hardware.



Figure 4. Enchondromas of the (A) proximal phalanx and of the (B) fifth metacarpal head. (C, D) After tumor removal the tumor cavities were reconstructed with cemented hardware.

Table 2. Postoperative Range of Motion Around the Operated Finger

Patient	Anatomic Location of Enchondroma	Follow-Up (mo)	Postoperative Range of Motion		
			Metacarpophalangeal Joint	Proximal Interphalangeal Joint	Distal Interphalangeal Joint
1	Metacarpus (ring finger)	45	Full	Full	Full
2	Metacarpus (small finger)	60	15° loss of flexion	Full	Full
3	Metacarpus (small finger)	29	Full	10° loss of flexion	Full
4	Metacarpus (ring finger)	62	20° loss of flexion	Full	Full
5	Metacarpus (small finger)	31	Full	20° loss of flexion	Full
6	Metacarpus (small finger)	161	Full	Full	Full
7	Proximal phalanx (index finger)	71	20° loss of flexion	20° loss of flexion	Full
8	Proximal phalanx (small finger)	25	Full	Full	Full
9	Proximal phalanx (index finger)	93	Full	Full	Full
10	Proximal phalanx (index finger)	54	Full	30° loss of flexion	Full
11	Middle phalanx (index finger)	65	Full	Full	Full
12	Middle phalanx (small finger)	74	Full	Full	Full
13	Middle phalanx (small finger)	182	Full	Full	Full

having returned to their presurgical functional capability within 4 weeks after surgery. All the pathologic fractures were united within 3 months of surgery. Three of the patients had loss of flexion at the metacarpophalangeal joint and 4 patients had loss of flexion at the proximal interphalangeal joint, but none considered this a functional limitation. At the most recent follow-up evaluation none of them had local tumor recurrence, residual swelling, or deformity. Table 2 summarizes the postoperative range of motion around the operated finger.

Discussion

Most surgeons who operate on enchondromas of the hand either do not perform any reconstruction of the remaining tumor cavity or they reconstruct using bone graft.^{4-6,12-17} These procedures are considered biologic reconstructions, and therefore require a period of protected activity. We have used cemented hardware for reconstruction of large, curetted tumor cavities in a variety of anatomic locations.¹⁸ This technique provides immediate mechanical stability and thus allows early mobilization and force transmission around the adjacent joints. Reconstruction using a combination of PMMA and internal fixation has been shown to provide superior mechanical support compared with reconstruction using PMMA alone in large tumor cavities of weight-bearing bones.¹⁸ We opined that benign bone tumors of the hand could be treated in the same manner and with similarly good results. An additional benefit of PMMA is that a tumor recurrence is readily discernible at the bone-cement interface.^{18,19}

It was hypothesized that the heat of polymerization of the PMMA could induce necrosis of the adjacent bone and that the monomer would have a direct toxic effect that would result in hypoxia.²⁰ Experimental data, however, showed that the heat of polymerization drops sharply between the center of the PMMA and its interface with the adjacent bone.²¹ Wilkins et al²² reported that bone marrow necrosis occurs at 60°C, that variable and time-dependent necrosis occurs between 50°C and 60°C, and that there is no necrosis below 48°C. The maximum bone-PMMA interface temperature in this study was 46°C.²² Also using a dog model, Malawer et al²³ found no evidence of adjacent bony necrosis after intramedullary placement of PMMA. The main role of PMMA is to provide mechanical stability.

Enchondromas of the hand can be effectively removed by means of curettage alone.^{6,12-16} We have additionally used high-speed burr drilling because this technique has been shown to be effective in the treatment of benign-aggressive and malignant bone tumors.¹⁸ High-speed drilling around the hand should be used with caution to prevent injury to the surrounding soft tissues. We recognize that this study does not show an advantage of curettage and high-speed drilling over curettage alone in the treatment of enchondromas of the hand.

Reconstruction combining PMMA and internal fixation provides immediate mechanical support, permits early motion, and may help prevent pathologic fracture. This is a simple, safe, and reliable technique of reconstruction that is associated with good functional outcome. Furthermore this technique

obviates the delay in surgical intervention for patients who present with a pathologic fracture because fracture healing is not required for mechanical stability of the affected bone. Seven of the 13 patients in this study (54%) had loss of digital flexion at the interphalangeal joints, probably resulting from intrinsic tightness. It is possible that this tightness is related to the magnitude of soft-tissue exposure and mobilization in surgery. Another possible explanation for this loss of digital flexion is extrinsic tightness caused by the proximity of the PMMA to the extensor mechanism. Care must be exercised in using the current technique of reconstruction to prevent PMMA from coming into contact with the extensor mechanism.

Our experience with this approach leads us to recommend the use of cemented hardware for reconstruction of the tumor cavity that remains after removal of enchondroma of the hand. This technique may be an alternative in the reconstruction of relatively large defects remaining after enchondroma excision, but some loss of motion can be expected in over 50% of patients. Smaller, structurally insignificant defects can be left to heal primarily or reconstructed with appropriate bone graft material.

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