ORTHOPAEDIC CLINICAL QUIZ

The following questions are based on the photographs and images provided. Answers and further information are available in this issue.

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Question 1

Fig 1.

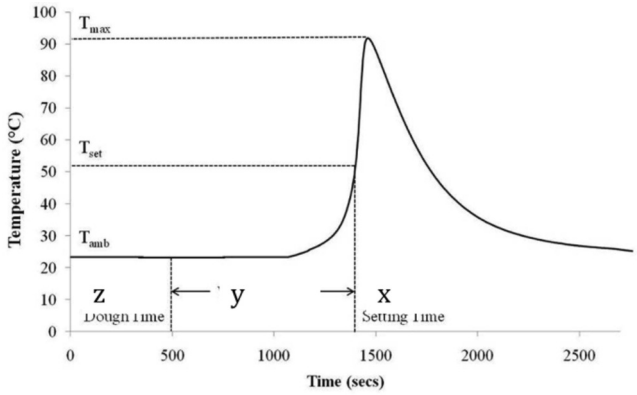
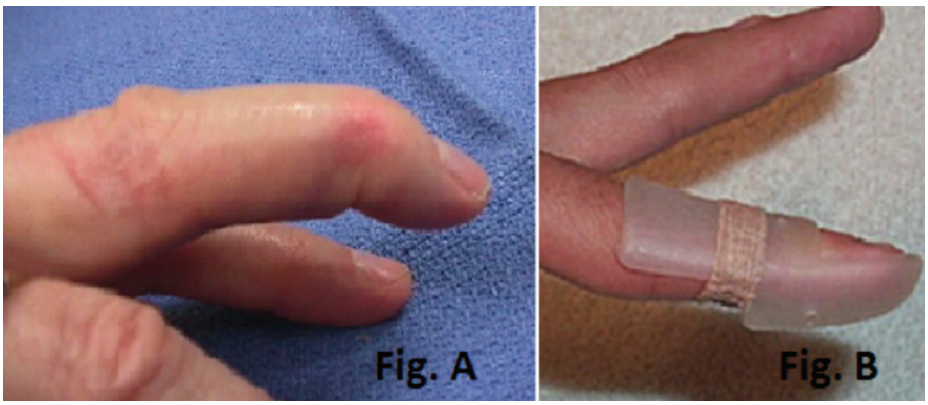


Fig 2.

The photo shows a pre-mixed substance used commonly in arthroplasty surgery

a) Name A and B in Fig. 1 and its constituents
b) How does this substance anchor implants to bone?
c) Based on Figure 2 - Label the phases x, y and z
d) List factors which can affect the duration of the above phases
e) List 2 (TWO) common side-effects of using this substance

Question 2



A 38-year-old man sustained an injury to his middle finger while doing home renovation. He developed pain, mild swelling and deformity of the affected finger (Figure A), and was treated with an orthosis (splint) shown in Figure B.

a) What is the diagnosis and what is the name of the orthosis (splint)?
b) Name the investigation to diagnose the injury and why should we do this?
c) What is the minimum period for the application of this splint? What important instructions should we give the patient and why?

Description 1

Bone Cement

In joint replacement surgery, polymethyl methacrylate (PMMA) bone cement is primarily used as filler or grout to fill the free space between the prosthesis and the bone, and forms mechanical interdigitations with the cancellous bone. Due to its' viscoelasticity, the bone cement can evenly cushion the hoop stress acting against the bone. Besides, bone cement can act as carrier matrix for antibiotics.

PMMA bone cement consists of two components: polymer powder and a liquid monomer. The contents of the polymer powder are PMMA/ methacrylate copolymers, benzoyl peroxide (initiator), xray contrast agent (barium sulphate/ zirconium dioxide) and antibiotic (Gentamicin sulphate, Clindamycin hydrochloride, Tobramycin, Erythromycin-glucoheptonate or Colistin-methane-sulphonate-sodium). On the other hand, the monomer liquid contains MMA, N,N-dimethy-p-toluidine (activator), hydroquinone (inhibitor) and coloring agent (chlorophyll). These two components are mixed at an approximate ratio of 2:1 to form PMMA cement.

When they are mixed, the free-radical polymerization, which is a highly exothermic chemical reaction, occurs. There are three important phases of polymerization namely: dough phase, working phase and setting phase. Dough phase (several minutes) includes the time from mixing the cement until the cement achieves a non-sticky consistency and is ready for use. The working phase (2-4 minutes) is the period when the cement is injected into the bone prior to implantation of the prosthesis. The setting phase (1-2 minutes) is the period when cement hardens and sets completely.

The mechanical properties of the bone cements are influenced by various modifiable or non-modifiable factors such as type of cement, additional of radiopacifying agents and antibiotics, mixing methods, environmental conditions such as temperature and humidity, bone preparation such as presence of blood or fat as well as implant design.

The use of bone cement is associated with some complications such as bone cement implantation syndrome, pulmonary or fat embolism, paradoxical cerebral embolism and periprosthetic osteolysis.

Reference

1. N Dunne, J Clements, J-s Wang. Acrylic cements for bone fixation in joint replacements. Joint Replacement Technology (Second Edition), 2014 , 212-256

Diagnosis: Mallet Finger (Baseball Finger)

Description 2

Mallet finger is a flexion deformity of the finger that results from *avulsion or rupture of terminal extensor tendon* at the base of the distal phalanx. It can involve either a bony avulsion injury of the distal phalanx or a rupture of the extensor tendon with no bony involvement (Figure 1). The finger is usually painful, swollen, and bruised.

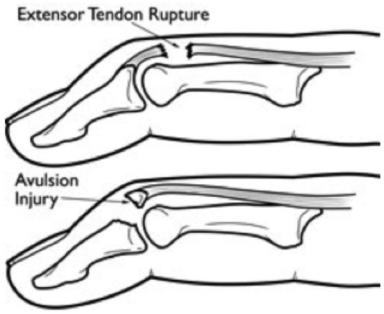


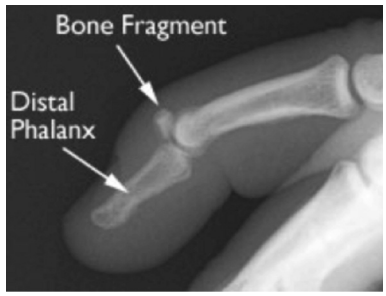
Fig 1.

Mallet finger is a common athletic injury. The injury usually results from a blow causing forced flexion of an extended finger. This most commonly occurs at the index or middle fingers. The injury also can occur because of a crushing accident on the job

Examination

1. Mallet Finger Tests; Hold the affected finger at middle phalanx and ask the patient to straighten the distal phalanx on his own. He will not be able to do that.

2. Radiograph of the middle finger (AP and Lat) is required to determine whether this is a bony mallet or soft tissue injury as management may differ.



Nonsurgical Treatment

The majority of mallet finger injuries can be treated without surgery with a splint. A Mallet Splint /Stack Splint will hold the fingertip in slight hyperextension until it heals. Tendinous injuries require 6-8 weeks of splinting, and bony injuries require 4-5 weeks.

The splint allows the tendon to return to normal length. If the finger is bent during these weeks, the healing is disrupted, the process must start all over again and patient will need to wear the splint for a longer period of time. For some patients, the splinting regimen is very difficult. The surgeon may decide to insert a temporary pin across the DIP joint to hold it straight for 6 to 8 weeks.

Surgical Treatment
Surgical treatment is used when the mallet finger presents as an open injury or if the bony mallet involves more than 30% of the articular surface of the joint or there is a large fracture fragment or the joint is subluxed. In these cases, internal fixation is carried out.

Rehabilitation
Rehabilitation focuses mainly on keeping the other joints mobile and preventing stiffness from disuse. The occupational therapist or Physical therapist teaches home exercises to make sure the joints do not become stiff.

Complications
The most bothersome complication from closed management of a mallet finger is a dorsal pressure sore over the DIP joint. This results from excessive pressure of the splint at that site and is probably potentiated by a hyperextension posture of the joint.

Some people will develop a long-term deformity known as a swan neck. This may require additional surgical correction.

References:
Anderson D, Mallet finger Management and Patient Compliance. Australian Family Physician Vol. 40, No. 1/2, January/February 2011
B Okafor et al. Mallet deformity of finger, five year follow-up of conservative treatment. JBJS (Br) 1997; 79-B: 544-7.

Interventions for treating mallet finger injuries (Review), Collaboration and published in The Cochrane Library 2008, Issue 3, http://www.thecochranelibrary.com

ANSWERS

Question 1:

a) A: Polymer powder – polymethylmethacrylate
   B: Monomer liquid - methylmethacrylate

b) Forms a mechanical bond between the cement and the bone and the cement and the prosthesis, acts as a filler or grout (not as “glue” or adhesive”)

c) x = Doughy time/phase
   y = Working time/phase
   z = Setting time/phase

d)
- Ambient temperature
- Mixing process
- Type of cement
- Powder to liquid ratio
- Humidity

e)
- Hypotension
- Pulmonary or fat embolism

Question 2:

a) Mallet
   finger/Avulsion or Rupture of terminal extensor tendon/Mallet splint

b) Radiograph of the middle finger (AP and Lat)
   - To determine whether this is a bony mallet or soft tissue injury as management may differ

c) 6 weeks (or 8 weeks)

Instructions:

- Wear the splint
- 24 hours a day (DO NOT REMOVE the splint) as the repair process will be interrupted
- Active flexion-extension of the PIPJ is encouraged to keep the joint supple.