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Indications

1. Status post upper extremity revascularization with compartmental hypertension
2. Crush injury with concomitant fracture and severe soft tissue damage
3. Circumferential burn with delayed care and compartment syndrome
4. Warm ischemia secondary to vessel injury for more than 4–6 h
5. Tense compartment/compartment pressures exceeding 40 mmHg

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Possible Complications

1. Nerve injury
2. Bleeding
3. Infection and wound healing complications
4. Exposure of vital structures
5. Volkmann's ischemic contracture if performed late after a delayed diagnosis

Essential Steps

Preoperative Marking

1. Upper arm: mark a line between deltoid insertion and the lateral epicondyle.
2. Forearm:
 - (a) Volar approach:
 - Mark the crease between the thenar and hypothenar eminence and palmaris longus (if the patient has one) for carpal tunnel decompression.
 - Draw a curvilinear line extending transversely across the wrist flexion crease to the ulnar side of the wrist, then arched across the volar forearm, back to the ulnar side at the elbow just radial to the medial epicondyle, and finally across the antecubital fossa.
 - (b) Dorsal approach: Draw a line from the lateral epicondyle between the extensor

digitorum communis (EDC) and extensor carpi radialis brevis (ECRB), extending distally approximately 10 cm toward the midline of the wrist.

3. Hand:

- (a) Draw a line on the radial side of the thumb metacarpal for the release of the thenar compartment.
- (b) Draw a line over the index finger metacarpal for the release of first and second dorsal interossei.
- (c) Draw a line over the ring finger metacarpal for the release of third and fourth dorsal interossei.
- (d) Draw a line at the ulnar aspect of the small finger metacarpal to release hypothenar muscles.

Intraoperative Details

4. Placed in supine position

5. General anesthesia or monitored anesthesia care

6. Arm:

- (a) Lateral skin incision from deltoid insertion to the lateral epicondyle.
- (b) Spare larger cutaneous nerves.
- (c) At fascial level, the intermuscular septum between the anterior and posterior compartment is identified, and the fascia overlying each compartment is released with longitudinal incisions; protect the radial nerve as it passes through the intermuscular septum from the posterior compartment to anterior compartment just below the fascia.

7. Forearm: longitudinal centrally placed incision over the extensor compartment and curvilinear incision on the flexor aspect beginning at the antecubital fossa

- (a) Apply a tourniquet to the upper arm if ischemia is not threatening the extremity. Fasciotomy can be performed without use of a tourniquet in emergency or if critical ischemia time is being approached.

(b) Exsanguinate the arm with an Esmarch bandage and inflate tourniquet to 100 mmHg higher than systolic pressure.

(c) Volar approach for release of flexor compartments:

- Palmar incision is made between the thenar and hypothenar musculature in palm, releasing carpal tunnel as needed.
- Incision is extended transversely across the wrist flexion crease to the ulnar side of the wrist, then arched across the volar forearm, and back to the ulnar side at the elbow.
- At the elbow, just radial to the medial epicondyle, incision is curved across elbow flexion crease; deep fascia is then released.
- At the antecubital fossa, fibrous band of the lacertus fibrosus overlying the brachial artery and median nerve is carefully released.
- This incision allows for soft tissue coverage of neurovascular structures at the wrist and elbows and prevents soft tissue contractures from developing at flexion creases.

(d) Dorsal approach for release of dorsal compartments:

- Pronate forearm.
- Make dorsal skin incision beginning distal to the lateral epicondyle between the extensor digitorum communis and extensor carpi radialis brevis, extending distally approximately 10 cm toward midline of the wrist.
- Gently create skin flaps so that the mobile wad can be identified.
- Release the fascia overlying the mobile wad of Henry and the extensor retinaculum.
- Leave skin incision open.
- Apply sterile moist dressings to volar and dorsal skin incisions.
- Place the long-arm splint making sure to not flex the elbow beyond 90°.

8. Hands: Four incisions
 - (a) Apply tourniquet to the upper arm if ischemia is not threatening the extremity. Fasciotomy can be performed without the use of a tourniquet in emergency or if critical ischemia time is being approached.
 - (b) One incision on radial side of the thumb metacarpal releases thenar compartment
 - (c) Dorsal incision over the index finger metacarpal used to release first and second dorsal interossei and to reach the ulnar-to-index finger metacarpal and to release the volar interossei and adductor pollicis.
 - (d) Dorsal incision over the ring finger metacarpal used to release third and fourth dorsal interossei and to reach down along radial aspect of the ring finger and small finger metatarsal to release the volar interossei.
 - (e) Incision placed at the ulnar aspect of the small finger to release hypothenar muscles.
 - (f) Wound must be debrided of all devitalized tissue and covered with a sterile dressing without early closure.

Postoperative Care

1. Elevate affected extremity for 24–48 h after surgery.
2. Wound must be regularly debrided of all devitalized tissue including necrotic muscle.
3. Closure options:
 - (a) Delayed primary closure when swelling subsides.
 - (b) If delayed primary skin closure cannot be performed within 5 days, perform split-thickness skin grafting.
 - (c) Healing by secondary intention.
4. Negative pressure wound closure devices may be useful.
5. Overall, the rehabilitation protocol is dependent upon the underlying injury that caused the compartment syndrome and need for fasciotomy.

6. Perform dressing changes at bedside or in OR as deemed appropriate per clinical situation.
7. Perform standard suture or staple removal and postoperative wound checks.

Operative Dictation

Diagnosis: Compartmental hypertension of the upper extremity

Procedure: Upper extremity fasciotomy

Indications

This is an X patient presenting with pain and increasing swelling of the right/left arm/forearm/hand s/p underlying injury/procedure that caused the compartment syndrome. Compartment pressures were obtained and were elevated greater than 35 mmHg. The risks and the benefits of the procedure have been discussed with the patient who agreed with the plan of care.

Description of the Procedure

After the informed consent was verified, the patient was taken to the operating room and placed in supine position. The patient's name, hospital number, procedure, and surgical site were verified during a time-out. General anesthesia was instituted. Preoperative antibiotics were given. The *right/left* upper extremity was prepped and draped in the usual manner.

Using a #15 scalpel, a carpal tunnel release incision was performed. Dissection was deepened down to the subcutaneous tissues until reaching the transverse carpal ligament that was opened. The median nerve was identified and protected. The tunnel was opened completely distally until reaching the deep palmar arch that was identified and preserved. Proximally, the incision was extended in a semilunar fashion until reaching the antecubital fossa that was overpassed to the distal

arm as well. Dissection was deepened down using a #15 scalpel and Stevens tenotomy scissors until reaching the deep investing fascia of the volar forearm muscles for complete release of the superficial and deep compartments. The superficial cutaneous nerves were identified and protected. Through the same incision on the radial side, the dorsal compartments were released as well in the proximal aspect. Hemostasis was secured.

Attention was directed to the *right/left* hand; multiple incisions were done at the level of the interosseal spaces. Dissection was deepened in a similar fashion as before until complete release of the interosseal muscles.

Attention was directed to the arm. A lateral curvilinear skin incision was performed centralized over a line drawn from the deltoid insertion to the lateral epicondyle. Dissection is deepened through subcutaneous tissues where large cutaneous nerves were identified. When deep investing fascia was reached, the intermuscular septum between the anterior and posterior compartment was identified, and the fascia overlying each compartment was released with longitudinal incisions.

The radial nerve whenever encountered as it passes through the intermuscular septum from the posterior compartment to anterior compartment just below the fascia was identified and protected.

After completing all fasciotomies, all the compartments were checked to be soft, and the fingers had good capillary refill.

Hemostasis and copious irrigation was done. Dressing was applied. The patient tolerated the procedure and was transferred to the recovery room in stable condition.

Suggested Reading

- Leversedge FJ, Moore TJ, Peterson BC, Seiler III JG, et al. Compartment syndrome of the upper extremity. *J Hand Surg.* 2011;36:544–60.
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