Editorial

Is Posttraumatic First Web Contracture Avoidable?
Prophylactic Guidelines and Treatment-Oriented Classification

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The first web is a complex, multilayered anatomic region spanning the first and second metacarpals. It has a triangular shape, with its vertex located at the base of the first and second metacarpals; the skin web that joins the metacarpophalangeal joints of the index finger and thumb corresponds to its base. It is covered by glabrous skin on the palmar side and minimally hairy skin on the dorsum. It harbors the radial extension of the superficial palmar (nataatory and transverse) and deep ligaments and the bellies of the adductor pollicis and first dorsal interosseous muscles with their investing fascia. The radial artery deepens from dorsal to palmar at its most proximal aspect.

Suppleness and strength are the main characteristics of the web and can be highlighted during grasping and pinching. In grasping, the web has to be supple to allow maximal opening of the thumb for grabbing large objects. Once the object is held, power is needed to keep it in the hand; the muscles of the web are responsible for 80 percent of pinch strength.¹

First web contracture is common after trauma to the hand, particularly the radial part, and has a tremendous negative effect on hand function. Even minor contractures will limit the ability to grab large objects. Because of its triangular shape, small limitations of aperture at its base have a major effect on the extremes of the triangle (the thumb and index pulps).

First web contracture is an ongoing process, and the amount of time elapsed since the injury, independent of the severity, worsens the prognosis in two ways. First and more important, the web reduction initially is elastic (or reversible) but soon becomes irreversibly fixed (except with an operation). Second, there is a phenomenon of progressive involvement of formerly healthy layers²–⁴ in such a way that the problem may start in one structure (e.g., deficient skin) but in time it becomes widespread on the web (i.e., affects muscle, fascia, ligaments). The surgeon will have to divide structures that were formerly healthy and functional to open the web.

Much of the interest has been focused on the surgical treatment of fixed first web contracture. In those articles, systematic release of skin, fascia, muscles from their origins or insertions, and trapeziometacarpal ligaments and even resection of the trapezium itself are recommended for the sake of placing the thumb in an abducted position,²–¹⁴ and several types of flaps have been presented to cover the resulting defect.¹⁵–²¹ Regrettably, it has been our experience that although an operation can restore the span of the web, the function of the web (e.g., pinch strength, allowance of thumb pronation, pinch dexterity) often will never be restored.

Most of us have been educated as if first web contracture were an unavoidable bad companion (collateral damage) of some forms of trauma to the hand, and the surgeon’s role was limited to releasing the contracture. Taking into account the fact that once established, the damage is irreversible, we challenged this passive attitude more than 10 years ago and set the hypothesis that fixed first web contracture could be prevented. In this editorial, we...
present a treatment-oriented classification that was created by answering in a stepwise fashion the question, “What causes first web contracture?” The purpose of this editorial is to present guidelines to abort the progression to a fixed first web contracture and, as an aside, to conclude, based on the evidence (after more than 6,000 hand injuries, most work-related, over a 10-year period without a restricting contracture when those guidelines were followed), that fixed first web contracture is avoidable. Five types of posttraumatic first web contracture have been recognized: idiopathic, retracting band, major skin loss, deep scar, and ischemic.

IDIOPATHIC

Even after minor trauma, the surgeon may be surprised by a severe first web contracture in the middle term. Aside from the obvious reasons, such as the splinting or dressing tightly binding the first metacarpal to the second metacarpal, which was common in the past, other less apparent factors surreptitiously drive the first metacarpal to the second.

Swelling

As the hand swells, the previously flattened skin will expand until the hand is nearly balloon-shaped. In this process, the first metacarpal moves toward the second metacarpal to allow the skin envelope to deform as a sphere (Fig. 1).

Antifunctional Postures

Most patients, after a hand or wrist injury, carry their wrist in flexion as an antalgic position. While the wrist is in flexion, the extensor pollicis longus muscle will passively drag the thumb into extension and, most importantly, into adduction-supination. At this stage, it is appropriate to note that, independent of the severity, there are two types of first web contracture according to thumb position: pure and supinated. In the former, only the ability to hold large (or small) objects is limited. In the latter, because the thumb is supinated, the span is restricted and the thumb does not pinch, offering not the pulp but its ulnodorsal aspect (Fig. 2, below). The supinated contracture is caused solely by the traction of the extensor pollicis longus, as this muscle is the only thumb supinator.

A similar thumb deformity has been noticed after combined median-ulnar nerve palsy, but the pathomechanics are different.

Functional Positions

Standard functional position after trauma to the upper limb (elbow flexed in a sling with the hand up against the trunk) also promotes first web contracture. In this position, if the forearm is in neutral rotation, the thumb is cranial and will spontaneously fall against the index finger by its own weight, thus closing the web. The situation is worsened if the forearm is in pronation, because then the body squeezes the thumb against the hand (Fig. 2).

This tendency of the thumb to adduct by swelling and functional and antifunctional positions is aggravated because abductor forces are much weaker than flexor adductor forces.

Periods of Evolution

The feasibility of correcting idiopathic first web contracture depends mainly on the time elapsed since the injury. The fluid seen after any trauma is rich in proteins (from the lymph and the hematoma), and in the process of its resorption, collagen is deposited that, as it matures, becomes rigid and unyielding. We have recognized three periods of evolution in first web contracture that are independent of its severity: elastic, reversible, and fixed.

Elastic first web contracture is the term used when it is possible to correct the deformity passively after some traction on the thumb by the examiner. This stage lasts for about 4 to 6 weeks. Full correction can be expected if the patient passively abducts the thumb and performs active exercises to strengthen the abductor muscles. When the patient is seen later than 4 to 6 weeks, the surgeon will be unable to...
fully open the web by traction, and this is considered inelastic first web contracture. Treatment in this stage is based on the reversibility of collagen cross-linking and involves applying a light continuous force in the opposite direction of the deforming force. Several methods and splint designs have been presented in the literature.\textsuperscript{28,29} We prefer custom-made splints made with eight to 12 layers of cast (Fig. 3). The splint is worn at night and held in position with a bandage; care should be taken to avoid concentrating pressure at any given point while steady distraction is being performed at the index finger and thumb. (Below) The splint should be made to “sit” in the depths of the web, with gentle pressure at the point where the thumb and index finger meet.

months old. After that time, the response varies (i.e., fixed first web contracture).

**CUTANEOUS: LINEAR**

It is axiomatic that any linear wound that crosses a flexion crease or a concavity will heal by forming a retracting band; the first web is no exception. The surgeon can abort this progression by performing as many Z-plasties as required at the time of emergency treatment.

**CUTANEOUS: MAJOR DEFECT**

Any major skin loss on any part of the body will recruit skin from the neighboring structures. On the dorsum of the hand, the only mobile part is the first web, and the contracting forces will slowly drag the first metacarpal toward the second.

Lost skin should be replaced with a well-padded, noncontracting flap as an emergency or early procedure to slow the progression to a fixed contracture. The posterior interosseous
flap is ideally suited for this purpose. When the defect is too large or a better-vascularized flap is required, a free flap is favored, and among them we prefer the ipsilateral lateral arm flap. In our opinion, skin grafts have no role in this scenario; besides the requirement that they must fully take to avoid secondary retraction, their inherent tendency to contract is difficult to control. A postoperative splinting program is required to achieve a successful result.

Although much has been written on the necessity of Kirschner cross-wiring and on the use of external or internal devices to maintain the first web during the immediate posttrauma period after major web injury, we have found these approaches unnecessary. In fact, it may be harmful, as Kirschner wire insertion will produce additional damage to the muscles and hence promote contracture. Use of Kirschner wires may, however, be considered when there is damage to the ulnar collateral ligament of the metacarpophalangeal joint of the thumb or radial collateral ligament of the metacarpophalangeal joint of the index that will prohibit the use of web splints during the immediate posttrauma period. Similarly, when the thumb can hyperextend because of volar plate laxity, splints will fail to control a palmar contracture as in a volar burn. Finally, when the thumb has been amputated near its metacarpophalangeal joint, the lack of a lever arm to apply a cast and the lack of use of the thumb cause rapid first web contracture development. We have found the best option in the latter scenario to be an early toe-to-hand transfer.

**Deep Scar**

Major penetrating trauma to the first web is generally accompanied by partial muscle destruction (first dorsal interosseous or adductor pollicis muscle) and/or fractures, sometimes with concomitant bone loss. The skin envelope may or may not be deficient, but this is unimportant in this type of contracture. What is important in this scenario are the hemorrhagic fluid, edema, and contused-necrotic muscle that fill up the web space, which will resolve by forming a cicatricial-retracting magma in the depths of the web. After this type of trauma, neighboring structures not directly damaged by the injuring agent will be filled with edematous fluid (e.g., the carpometacarpal ligaments, muscle fascia), and as stated, this will resolve with fibrosis and stiffness in a shortened position.

The critical step in halting the progression of this form of first web contracture is immediate radical débridement of all devitalized tissues to diminish the potential cicatricial mass and to minimize the risk of infection, and hence inflammatory edema. This should be followed by rigid bony fixation and primary coverage with a nonretracting flap. Kirschner cross-wiring or an external fixator is discouraged; however, a program of night splinting should be scrupulously followed in the posttrauma period.

**Ischemic**

Failure to release swelling muscles confined in closed osteofascial compartments invariably causes muscle death and, subsequently, contracture. At the radial part of the hand, this will cause an adduction contracture (with antepulsion or retropulsion). In contradiction to the small number of cases of acute compartment syndrome of the hand reported in the literature, even in large trauma centers, we noticed a high number of patients who, after sustaining a closed crush injury to the hand, developed acute compartment (or compartments) of the hand with minimal symptoms. We are firmly convinced that "silent" (untreated) compartment syndrome of the radial part of the hand is behind the scenes in many fixed first web contractures. By the same token, early recognition and treatment allow complete recovery. For these reasons, the clinician must have a low-threshold policy to indicate measuring the intracompartmental pressure, because elevated subfascial pressure may be present despite the fact that classic signs and symptoms are absent.

Treatment requires opening the offended compartments (and subcompartments) by one incision in the thenar area and one in line with the second metacarpal if only the radial compartments are affected. Detailed information on the surgical technique can be found in classic textbooks. The surgeon has to have the sagacity when releasing the compartments to place the incisions in such a way that after internally fixing the fractures, he or she is able to fully protect the hardware. Skin grafting and delayed closure should be used as necessary. Again, use of Kirschner cross-wiring or an external fixator has minimal, if any, effect on
postoperative contention of the web; splinting, however, is once more a critical part of care.

We believe that fixed first web contracture is often preventable if the appropriate surgical and orthotic steps are taken in due time. Because time is a negative factor in this entity and release of a fixed first web contracture will not restore things to normal, the surgeon is obliged to act diligently to halt the progression to a fixed widespread retraction.

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REFERENCES


