

Needle Aponeurotomy Terminology and Methodology

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Introduction

The purpose of this document is to introduce a standard terminology and methodology to a technique of percutaneous fasciotomy performed with a small needle under skin wheal local anesthesia. This procedure is an alternative to fasciectomy for Dupuytren's contracture. Its advantage is that it can be performed in the office, and usually allows return to heavy manual activities within a week of the procedure, allowing both hands to be treated on consecutive days, and allowing releases in poor risk patients, including patients on anticoagulants. As described, there is a negligible incidence of either nerve injury, flare reaction or RSD. Disadvantages include recurrences occurring more rapidly than open surgery and an inability to either skin shortage or some PIP contractures.

Based on other methods of fasciotomy, conventional teaching is that "blind" palmar fasciotomy is dangerous, ineffective, and is always followed by rapid recurrence. In reality, compared to surgery, the Lermusiaux technique of percutaneous needle fasciotomy is far safer in terms of flare reaction, RSD, stiffness, and nerve injury, and has far better overall patient satisfaction.

Standard guidelines and coordinated record keeping are essential for future evaluation of the procedure.

Definition

Needle aponeurotomy is a type of percutaneous fasciotomy performed with the tip of a small gauge needle to release contractures of the palmar fascia due to Dupuytren's disease.

History

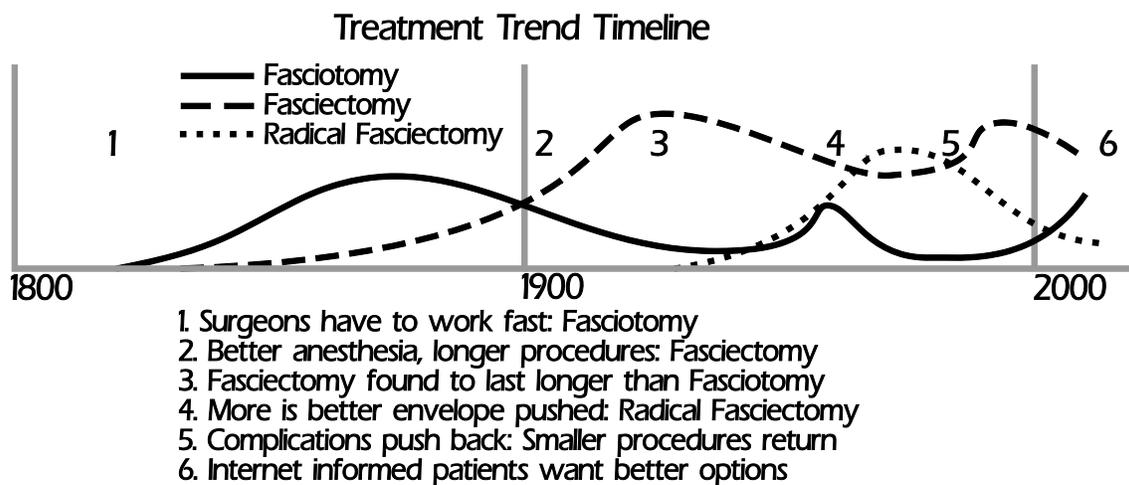
Percutaneous fasciotomy for Dupuytren's contracture is probably the first surgical procedure described for the treatment of Dupuytren's contracture. In the 1822 publication "A Treatise on Dislocations and Fractures of the Joints", Sir Astley Cooper wrote "*The fingers are sometimes contracted in a similar manner by a chronic inflammation of the thecae, and aponeurosis of the palm of the hand... when the aponeurosis is the cause of the contraction, and the contracted band is narrow, it may be with advantage be divided by a pointed bistoury, introduced through a very small wound in the integument. The finger is then extended, and a splint is applied...*" At this time, (prior to Dupuytren's 1831 presentation of open fasciotomy), the concept of percutaneous procedures was well established, referred to as "subcutaneous surgery". Percutaneous release of Dupuytren's contracture was reported by many surgeons of the era. In 1879, William Adams FRCS, former president of the Medical Society of London, published a 63 page monograph "Observations on Contraction of the Fingers (Dupuytren's Contraction) and its Successful Treatment by Subcutaneous Divisions of the Palmar Fascia, and Immediate Extension". This publication clearly and elegantly describes the concept, implementation and case studies of percutaneous release of Dupuytren's contracture using long, narrow scalpels, performing "*multiple*

subcutaneous divisions of the fascia...by as many punctures as may be necessary".

Recurrence after fasciotomy was recognized as a problem, and fasciectomy, pioneered by Goyrand, was developed to address this issue. Fasciectomy was demonstrated to have a longer period of disease control, and by the nineteen hundreds replaced fasciotomy as the preferred procedure. In the mid nineteen hundreds, fasciotomy was still advocated for selected cases by Hueston and by Luck, but complications associated with this blind procedure (nerve and tendon injury) prevented it from reentering the mainstream.

In the mid nineteen hundreds, more extensive fasciectomy procedures were devised in an effort to produce a surgical "cure". These efforts demonstrated that much more radical fasciectomy procedures had significantly higher risk of complications, but only marginally longer control of disease unless they included dermofasciectomy and skin grafting. As this was recognized, radical fasciectomy lost popularity as a primary procedure.

In the nineteen seventies, the French rheumatologist, Dr. Jean-Luc Lermusiaux, reexplored percutaneous fasciotomy for Dupuytren's using a 25 gauge needle rather than a scalpel. On his first attempt, he recalled that "...the patient was so happy, she jumped up and kissed me". The simple modification of using a small needle rather than a scalpel allowed the procedure to be performed with only pinpoint skin anesthesia, which dramatically reduced the incidence of nerve and tendon injury compared to percutaneous scalpel fasciotomy. This procedure spread by word of mouth and then through the internet. In 2003, the procedure was introduced to the American hand surgery community. This technique, modified and standardized according to hand surgery principles is presented in this document along with technical tips based on personal experience.

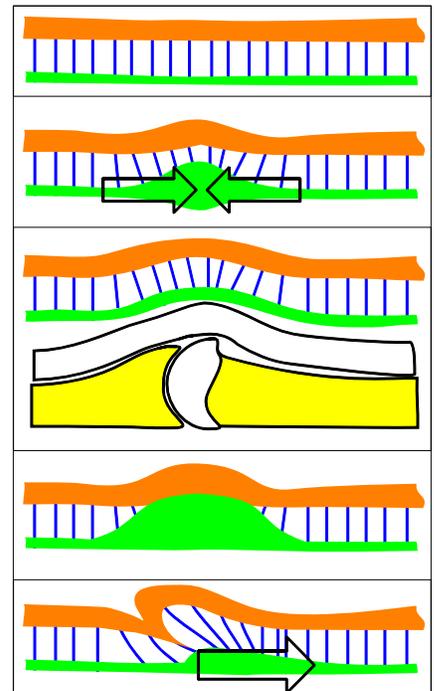


Concept and implementation

The prolonged recovery and postoperative inflammatory and dystrophic complications of open procedures for Dupuytren's are due to the disproportionate regional tissue response to skin wounds. Because of the mechanical design of the needle, needle fasciotomy does not produce enough skin wounding to provoke these issues, and predictably results in a quick recovery and few complications compared to open procedures. Nerve and tendon injuries are avoided by the use of minimal skin wheal anesthesia, made possible with the use of a needle instead of a standard scalpel. Neither sedation nor tourniquet are required. Specifically, nerve injuries are minimized by monitoring distal sensibility during the procedure, and the patient is instructed to report any paresthesias or numbness during the procedure. Tendon injuries are minimized by asking the patient to actively flex and extend the fingers when the needle tip position is potentially close to flexor tendons.

Anatomic Considerations

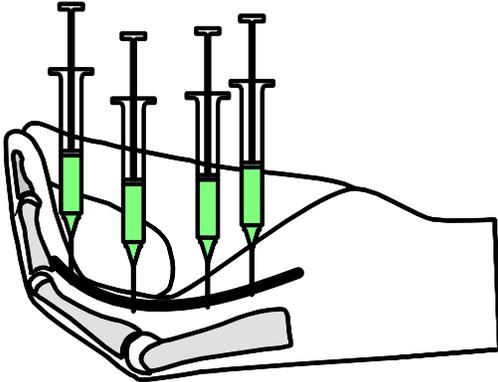
- **Normal Anatomy:** Longitudinal section of normal structures - skin, fibrous septae, fascia:
- The **prominence** of a nodule is from either fascial thickening, skin bunching from pull of fibrous septae, skin thickening, or a combination. There is slight regional edema, resulting in *fingerprint prominence*.
- A "**pseudonodule**" may actually be flexor tendon over the prominence of metacarpal or phalangeal head. Attempts to divide a pseudonodule will result in tendon damage.
- **Dermal involvement** tethers the skin and makes it inelastic - not optimal for a needle entry portal: Skin tethering prevents cord retraction and increases the risk of a skin tear if a portal is used in the area.
- **Dimples** are due to asymmetric fibrous septa retraction:



Significance of Findings		Texture		
		Soft	Firm	Varies with joint
Prominence	None (flat)	Normal	Skin Contracture	Adjacent skin tethering
	Linear	Adjacent skin tethering	Skin involvement	Cord or Tented Skin
	Rounded	Adjacent skin tethering or Spiral Cord	Nodule or Tendon Prominence	Cord + Nodule

Principles:

- Needle used as scalpel
- Multiple levels of release
- Passive extension separates cords
- Cords *slide* relative to skin
- Minimal trauma
- Surface anesthesia safety net

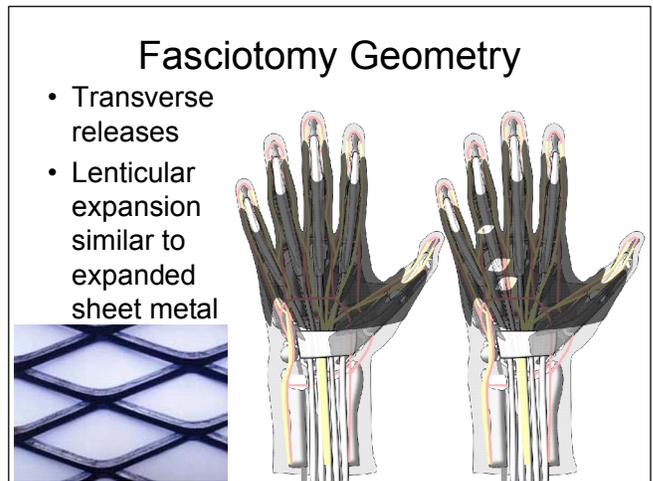
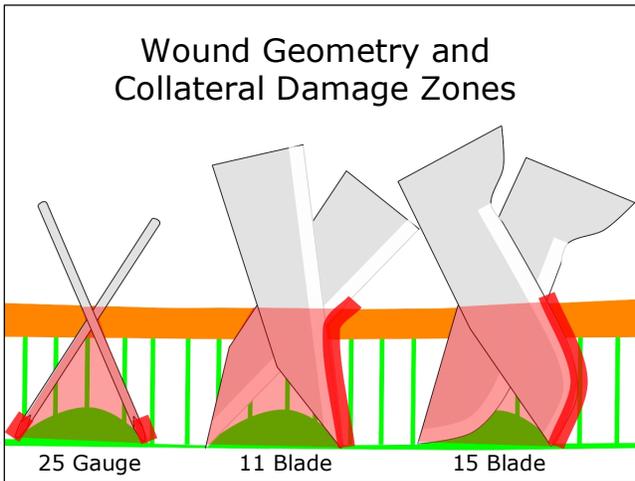
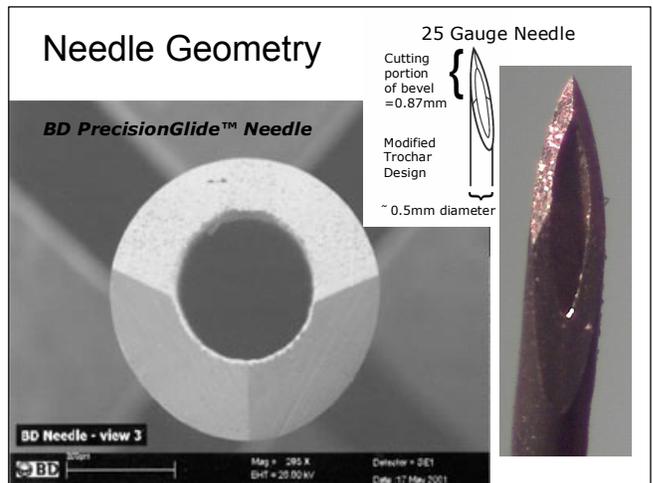
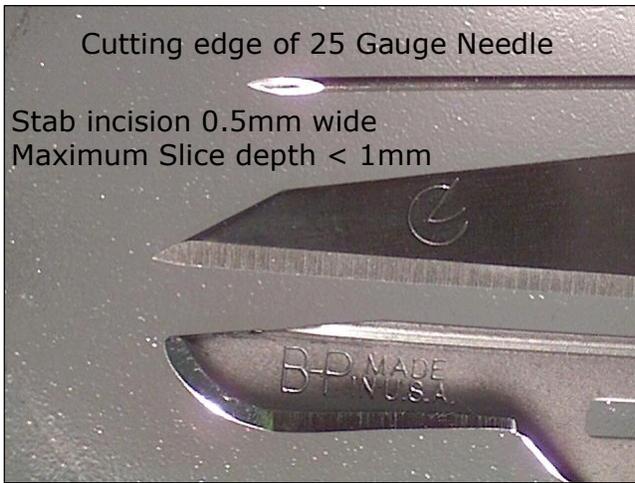
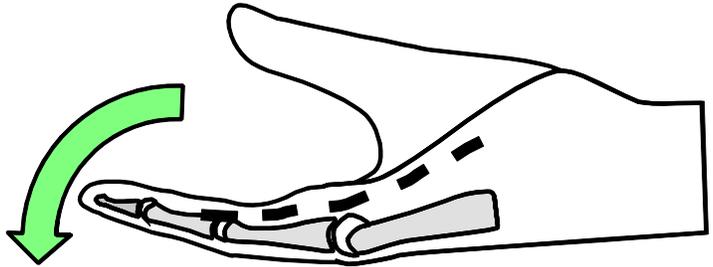


Needle Techniques

NODULES:
Inject with cortisone to soften skin and slow progression

CORDS:
Release the cords by cutting tight strings with the tip of a small needle

Local anesthesia



Needle dimensions

<i>Gauge</i>	<i>Diameter (mm)</i>	<i>Blade Length (mm)</i>
14	2.108	4.2
15	1.829	3.7
16	1.651	3.4
17	1.473	3.0
18	1.270	2.6
19	1.067	2.1
20	0.902	1.8
21	0.813	1.6
22	0.711	1.4
23	0.635	1.3
24	0.559	1.1
25	0.508	1.0
26	0.457	0.9
27	0.406	0.8
28	0.356	0.7
29	0.330	0.6
30	0.305	0.6



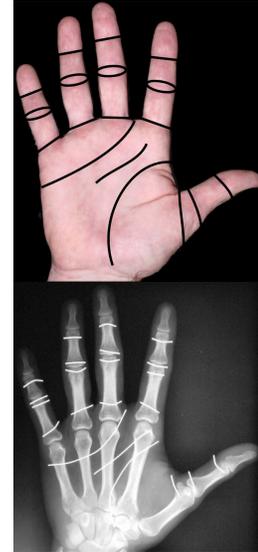
THE PORTAL SYSTEM

Needle entry zones are referred to as **portals**. Similar to arthroscopy portals, fasciotomy portals relate to both surface landmarks and deep anatomy. The location of these zones is determined by a combination of palmar skin crease surface anatomy and common patterns of fascial involvement by Dupuytren's disease. The basis of a system of portal locations is as follows:

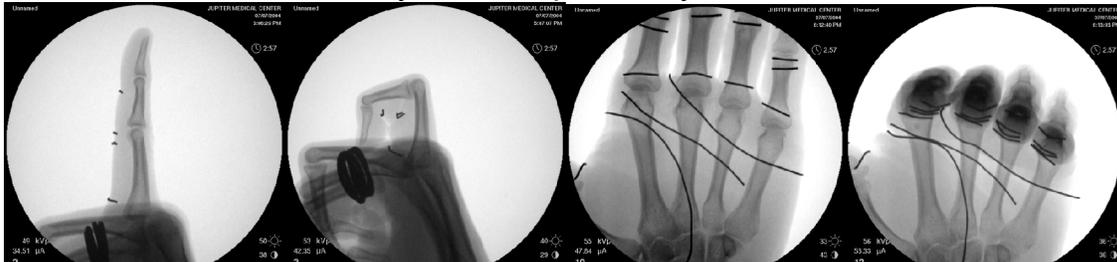
Skin Creases

Normal: Note on the Xray:

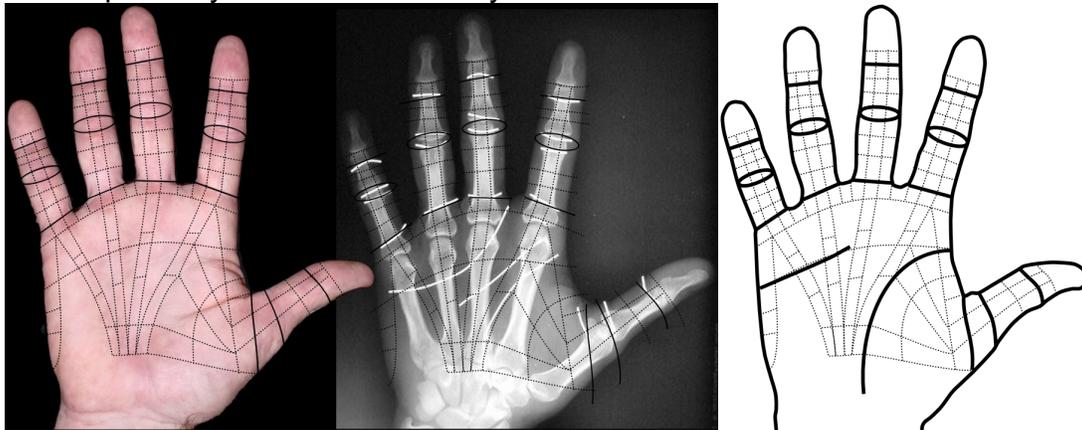
- DIP flexion creases are at the neck of the of the middle phalanx.
- Flexion creases at the bases of the fingers are just distal to the distal MCP joint capsule. These are referred to as the natatory creases.
- With the exception of the natatory creases, skin creases represent areas of relative skeletal prominence, where the flexor tendons are normally most prominent to palpation.
- All skin creases represent areas of reduced subcutaneous thickness, where the flexor tendons are more superficial.



Distortion: Creases normally translate proximally with flexion:

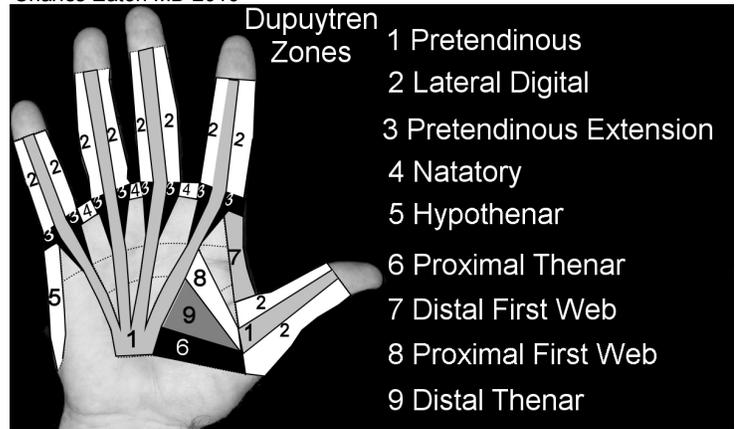


Portals: Normal palmar creases + common Dupuytren Zones = Portal Zones.
The skin portal system relates closely to the skeleton:



Dupuytren Zones

The great majority of needle access sites fall into one of the following nine zones:



1. **Pretendinous.** This zone incorporates areas developing *pretendinous* cords (proximal to the web space) and *central* cords (distal to the web space) Pretendinous portals are not generally used distal to the PIP joint.
2. **Lateral Digital.** Cords in this area may involve pure lateral digital sheet structures (lateral cord) or be associated with the pretendinous extension as a spiral cord. Lateral digital portals may extend into the lateral digital pulp of the distal phalanx.
3. **Pretendinous Extension.** The deep extension of the pretendinous band forms a "Y", joining pretendinous fibers with the lateral digital sheet at the base of the finger. This area may also involve a pure natatory cord or both processes. Pretendinous extensions may be palpable or not, depending on which fibers are under tension.
Palpable fibers are either:
 - a. In continuity with the natatory fibers, or
 - b. Superficial to the transverse metacarpal ligament but deep to the neurovascular bundle (fibers of Legueu and Juvara)Nonpalpable fibers in this zone are deep to both neurovascular bundle and transverse metacarpal ligament, in the interosseous areas lateral to the metacarpal head. This results in a palpable discontinuity between a proximal pretendinous cord and a lateral digital cord despite synchronous tensioning of both zones by fasciodesis.
4. **Natatory.** Natatory cords may simply span web spaces transversely or may bridge obliquely from the pretendinous extension of one finger to the lateral digital area of the adjacent finger.
5. **Hypothenar.** Involvement of the mid-ular aspect of the palm usually forms a thick, broad sheet with prominent dermal involvement, and may extend from the pisiform to the abductor digiti minimi tendon.
6. **Proximal Thenar.** Proximal thenar cords, previously unnamed, but fairly common, arise from the radial longitudinal fibers of the superficial fascia. These are the most functionally impairing cords to affect the thumb because they produce palmar abduction and narrow the palm.
7. **Distal First Web.** Cords arise here from the distal commissural ligament of the first web space - the ligament of Grapow. This is the natatory zone of the first web space.
8. **Proximal First Web.** Cords arise here from the proximal transverse commissural ligament of de Frenne. These cords usually extend from the base of the thumb to the distal palmar crease of the middle finger.
9. **Distal Thenar.** This triangular zone extends from the base of the thumb to the middle of the thenar crease, between the proximal thenar and proximal first web zones. Involvement here takes the form of a diffuse sheet rather than a linear cord, with diffuse dermal attachments. Release is sometimes possible at the distal apex of this portal.

Basic Approach

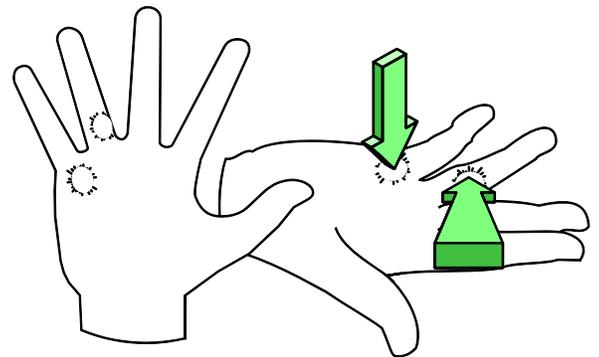
Preparation

Counseling - discussion with the patient

- Definition of Dupuytren's disease, risk factors and natural history
- Noninvasive treatment options
- Open surgery: possible complications, short and long-term care and expectations
- Percutaneous fasciotomy - possible complications, short and long-term care and expectations
- Review use of NA for this patient's specific pathology, including expectations for ROM and recurrence. Based on published studies, fasciectomy has a 50% recurrence rate at about 5 years, needle aponeurotomy 50% recurrence at about 3 years. Average improvement with needle aponeurotomy is 1-2 grades of improvement in the Tubiana system (45 – 90 degrees of composite MCP+PIP contracture) and 50% improvement in PIP contracture.
- Technique, including meaning and importance during the procedure of Reporting paresthesias or numbness to reduce chance of nerve injury
Warn "Don't jerk your hand if it hurts – it's like being at the dentist"
Active finger flexion on request to reduce the chance of nerve injury
- Postop program (see separate sheet)

Examination

- **Palpate** cords
- **Doppler** examination should be performed when there is a question of a spiral cord, based on soft tissue prominence in the distal palm or proximal digit. To best identify tones representing spiral anatomy, Doppler orientation is perpendicular to pretendinous bulges, transverse to lateral bulges as in this diagram. *Listen at potential portal sites for vascular tones where there should be none.*
- **Diagram** cords, nodules, scars, ROM



Preop Photography

Dorsal: palm down, thumb down:



Palmar: palm up, thumb up:



Ulnar: palm pushing down on a table top,



Markings: planned portals, scars or previous surgery :

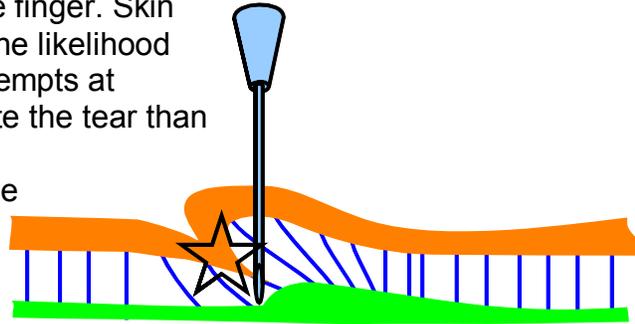


Portal planning

Portals are planned in areas where the skin is soft and untethered and the cord is a discrete linear structure with palpable variation in tightness (fasciodesis) demonstrated with changes of adjacent joint position.

- Portals are usually spaced a minimum of 5 mm apart, except when on adjacent sides of a named palmar crease, in which case they may be spaced more closely.
- If skin creases are curved, portals are planned on the *convex* side of the curve to allow maximum skin release.
- *Skin tears* are most common at the distal palmar crease and adjacent to flexion creases at the PIP and the base of the finger. Skin creases are not used for portals because of the likelihood of skin tear. Once a tear develops, further attempts at passive extension are more likely to propagate the tear than separate a cord at a different portal.

The sensory end organs of the skin are located in the deep dermis. This may be quite distorted deep to the dimple, resulting in unexpected **needle tenderness** in deep areas:



Indications:

Best: isolated MCP contracture with well defined cord

Otherwise: palpable cord with adequate latent skin elasticity

Staged repeat releases: Indicated for

- Severe involvement (Tubiana III, IV)
- Incomplete improvement
- Nodular involvement: steroid injections, return for NA in 4-8 weeks

Repeat NA for recurrence after NA is reasonable if:

- The prior release resulted in significant improvement
- There is adequate skin and a clearly defined cord
- Recurrence occurred a year or more after NA

Contraindications:

Strong:

- Tightness but Stage 0 - can't rupture cord unless it is preventing extension
- Inadequate skin: too diffuse skin involvement, longitudinal scar, skin graft
- No palpable cords

Relative:

- Ulnar palsy with minimal MCP contracture
- Boutonniere with no MCP contracture
- Poor release on previous attempt

Best with additional reconstruction for:

- Boutonniere
- Trigger finger

- MCP Sagittal band rupture

Technique:

Skin preparation

Antimicrobial wash, Betadine solution: Full sterile field / drapes not necessary

Anesthetic technique

30 gauge ½” needle. For least pain: vibrate palmar skin with personal massager before and during injection; touch needle tip lightly to skin for 2 seconds before penetration; verbally warn patient ½ second before penetration.

Tiny skin wheal anesthesia: inject as needle is withdrawn to infiltrate dermis.

Medication – 2 of many choices:

- Buffered 2% Lidocaine (5 cc bicarb + 50 cc 2% Lidocaine): least painful to inject. Diffuses rapidly – greater chance of inadvertent conduction block.
- 0.5% Bupivacaine: burns the most on injection. Diffuses slowly, so less chance of conduction block, but long duration of block if it does occur.

Intradermal only for portal anesthesia.

Inject *dimples adjacent to portals* intradermally to reduce deep tenderness

Intraarticular PIP/DIP anesthetic if contracture > 30°

Careful of back spray of anesthetic when injecting - face shield recommended.

Patient positioning

Patient supine with pillow for head or in reclined chair

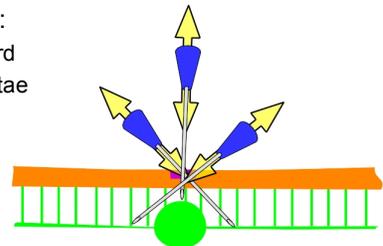
Pad behind the hand to facilitate MCP extension

Needle techniques: 25 gauge 5/8” Needle, bevel perpendicular to cord.

1. In general, these movements are quite small: perforating lengthwise excursion is usually 2-3 mm.
2. Establish a clear zone deep to the dermis.
3. Divide the cord with a combination of stabbing and slicing:

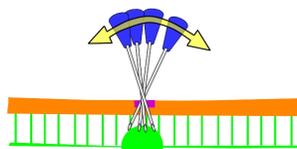
Needle Technique: Clear

- Initial entry:
 - Define cord
 - Clear septae

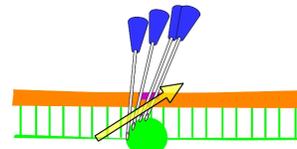


Needle Technique: Slice

- Tip Slice
 - For thick cords

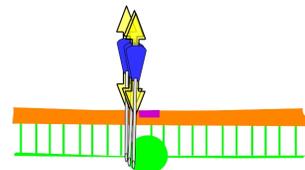
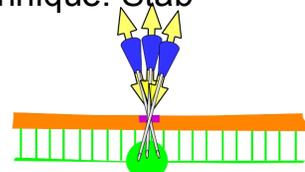


- Side Slice
 - For wide cords



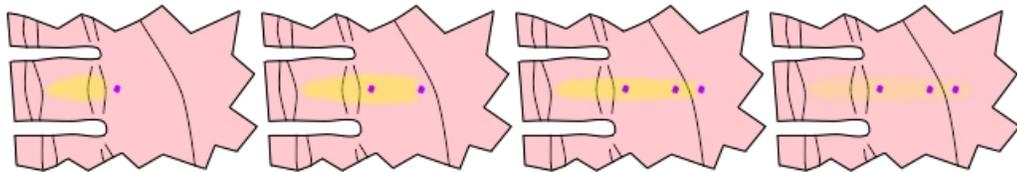
Needle Technique: Stab

- Radial Stab
 - Useful for large cords
- Linear Stab
 - Useful for small incremental progress



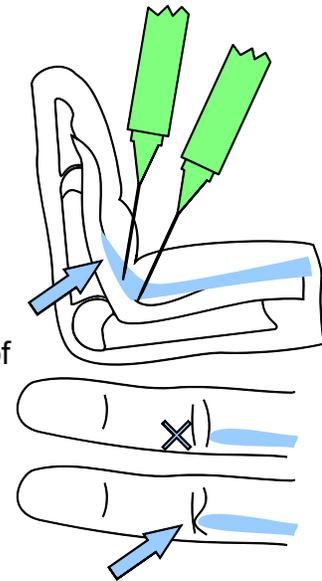
Technical points:

- Hold the needle bevel **perpendicular** to the direction of the cord fibers.
- **Traction/Tension pulls the cord superficial: *Bring the cord to you.***
 - Divide the cord while maintaining steady traction distally.
 - The safest traction is on the *skin* rather than the *skeleton* – slide the skin or pull on a nodule distal to the portal in distal direction.
 - When possible, avoid passive composite extension: don't pull on the fingertips. Try to keep the flexor tendons as slack, reducing the risk of inadvertent tendon injury.
 - Release traction on the skin when reinserting needle to reenter an established plane – you can feel your way much better.
- Release **distal to proximal** when possible, so that if the patient develops a conduction block at the active portal from local bleeding, swelling or anesthetic diffusion, a more proximal portal may still be used, as the nerve will still be sensitive ("live") proximally.
- **Cord palpation:** Use your fingertips. A small round ended probe is helpful to palpate lateral digital cords. Cords should be felt to tension as the finger is passively moved from flexion to extension. Cords can be demonstrated by "trampoline" fingertip bouncing helpful to assess adequacy of cord rupture in areas of diffuse skin involvement or in the thenar/first web space zones. Trampolining may be used to rupture thenar cords without joint motion.
- **Pink skin=portal:** Skin which *doesn't blanch with traction* is stress shielded by tightness of the underlying fascia. Blanching indicates lack of underlying fascial tightness and a less favorable site for a portal. *Blanching will advance across a portal when the underlying fascia has been adequately released, as shown in this progression .*

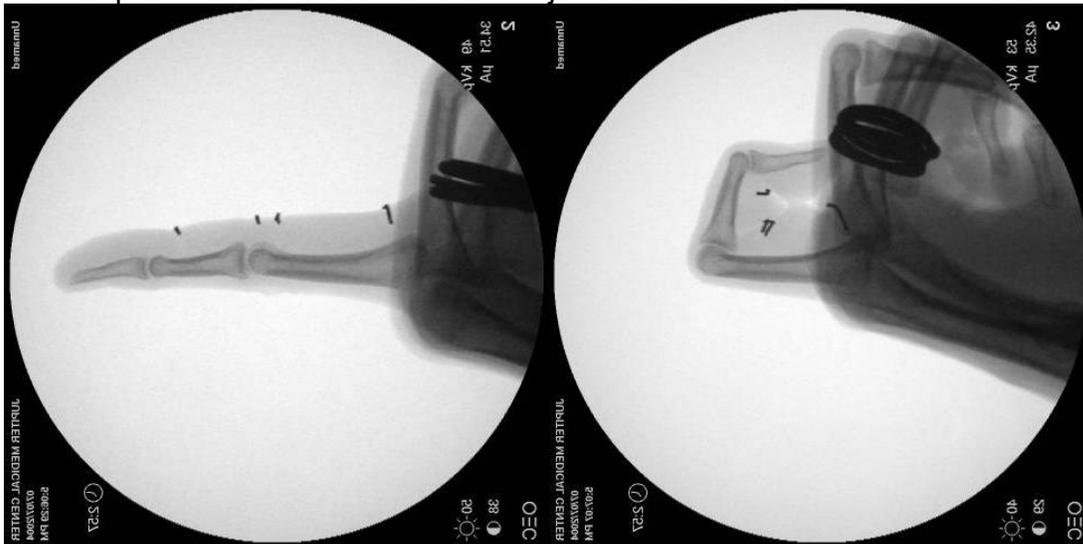


- **Needle feel:** The needle cutting the fascia should feel *crisp* or *crunchy*. When the needle meets rubbery resistance to insertion or withdrawal, it's probably lost its edge. Needle tips must be sharp. A needle which pierced a rubber stopper to withdraw medication will be too dull for NA.
- **Monitor repeatedly:** Tip sensibility (nerve), active flexion with needle inserted (tendon).

- **PIP release:** Portals may be used proximal and distal to the PIP flexion creases. These creases translate proximally with PIP joint flexion, as shown below. If the palpable proximal phalanx pulp cord appears to stop proximal to the PIP flexion crease, a distal portal may still be indicated, depending on the curvature of the PIP flexion crease: If the PIP flexion crease is convex facing *distally*, there is attachment of the proximal cord to the lateral digital sheet or flexor sheath distal the crease even if it is not palpable, as shown by the oblique arrow here. Otherwise, release should not be attempted in the absence of a clearly palpable cord ("X" in the diagram).



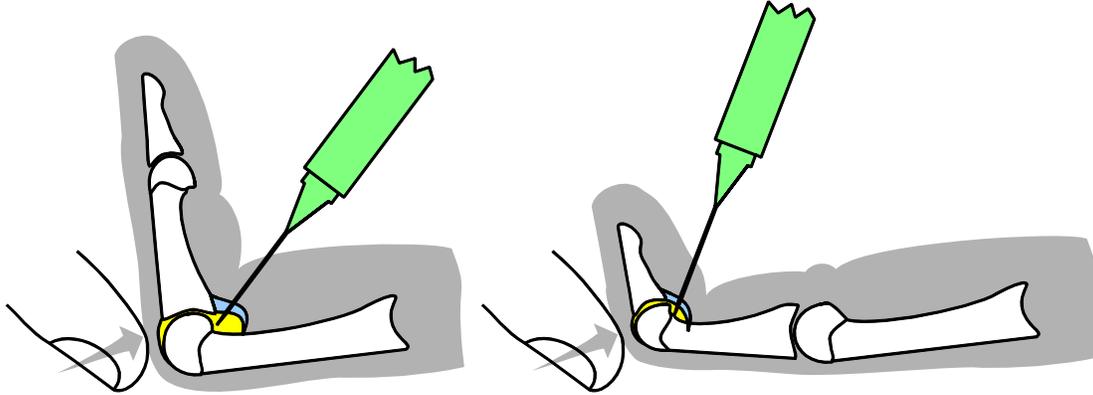
Normal proximal translation of the PIP joint flexion creases is shown here:



Steroid Injections

Steroid "mix": 1:1 10 mg/ml Kenalog with either of the anesthetics described above. Similar medications may be substituted, but depot steroid is recommended. Interphalangeal joint injection with steroid/anesthetic mix makes passive manipulation relatively painless. This should be considered for interphalangeal contractures greater than 30 degrees. It should be done before complete interphalangeal cord sectioning and manipulation – otherwise, if the volar plate has been disrupted, this may result in an inadvertent conduction block of the digital nerves.

A simple and predictable approach is midpalmar through the flexor tendon and volar plate, confirming capsular distention with a fingertip on the dorsum. Needle entry is proximal to the flexion crease for the PIP, distal to the flexion crease for the DIP:



In contrast, anesthetic injection of the MCP joints is most reliably accomplished through a dorsal entry after clearly palpating the joint line.

Manipulation technique

- Passive stretching may be done at the finish of each individual portal. If a portal looks suspicious for tearing, it is helpful to defer a definitive pull on the finger until several proximal portal have been released to reduce the peak force at the questionable site and reduce the chance of a skin tear.
- Flex the wrist while extending fingers to take tension off of the flexor tendons.

Steps to prevent skin tears and reduce pain when manipulating:

- Flex the wrist to put slack in the finger flexors
- Shield with gauze to prevent blood spray during pull, but keep an eye on areas which may tear to minimize the size of a potential skin tear.
- Ask the patient to *actively extend as you stretch*: makes it less painful.
- *First*, extend the PIP with the MCP flexed and then vice versa
- Then, composite MCP/PIP extension after isolated joint stretches
- Pull skin distal to portal in a proximal direction to avoid skin tear

After the definitive final composite stretch,

- Palpate all portals while maintaining light tension to confirm releases
- Explore proximal palmar portals with a needle one last time, as there may be soft tissue shift allowing additional release.

Optional final manipulation under wrist anesthetic block.

Final soft tissue injections are given after releases and final manipulations. Needle sites which have neither skin tear nor tendon contact are injected with anesthetic/steroid mixture, and each nodular area is injected with 5 to 40 mg of Kenalog or its equivalent. Needles must be sharp to allow injection of firm nodules: it may be impossible to inject a firm nodule unless the needle tip is sharp enough to cut into the deep tissue to allow infiltration. Needles which have perforated rubber stoppers to draw up medications are too dull to inject nodules.

Documentation

Procedure documentation sheet (see other sheet)

Photography

Bandage

Post procedure instructions

Bandages / wash and dry same day

Adhesive bandages on skin tears until healed

36 hr Ice / Elevation

Avoid submerging underwater 48h or until all wounds healed

Minimum of 1 week to avoid inflammatory flare:

- No strenuous hand activities, no heavy soiling
- *No cylindrical grip activities*: golf, tennis, bike, fishing, free weights

Postop pain is uncommon; narcotics are unnecessary

Postop paresthesias are common – few days, more so with bupivacaine.

Expect nodules to soften for 3 weeks

Local Histamine type flare common at 6-8 wks

Rx Topical Benadryl, Hydrocortisone, or prescription steroid cream

3 month static night splint if PROM>>AROM or isolated PIP joint contractures

Problems limiting the procedure

- **Nerve**: paresthesias; numbness preventing more distal releases
- **Deep Dimples**: unexpected sensitivity, potential for buttonhole perforation
- **Tendon Injury**, including late rupture: no steroid injection if tendon contact
- **Skin Tear**: preventing further manipulation
- **Bleeding**: generally not a problem, even in anticoagulated patients
- **Tight skin, Tethered skin, Scar**
- **Joint Contracture**, especially PIP capsule/ligament/flexor sheath
- **Lack of Palpable Cords** due to deep location or nodular involvement
- **Nodules** preventing cord palpation: consider preliminary steroid injection as the first part of a staged procedure, returning 4-8 weeks later for needle procedure
- Established **boutonniere** deformity or **sagittal band rupture** with extensor subluxation

Common Questions:

1. What do you do if the patient develops fingertip numbness?
 - a. Did this immediately follow a paresthesia? If so, go to #2ii
 - b. Tap on the portal to try to elicit a Tinel. If no Tinel, and if there was no antecedent paresthesia, the most likely explanation is conduction block from anesthetic seepage. If there is a Tinel, explain the implications to the patient and continue work proximally.
 - c. Did this follow a joint injection? If so, check both digital nerves. If both radial and ulnar nerves are out, assume a sheath block and continue only proximal to the base of the digit. If only the ipsilateral nerve is numb, avoid further work at or distal to the current portal, and continue proximally.
 - d. An option is to stop work, allow anesthetic to pass and reassess before continuing.
2. What do you do when the patient has a paresthesia from the needle?
 - a. Check to confirm that there is still distal sensibility:
 - i. Yes: Resume release at the same level, avoiding the needle location responsible for the paresthesia.
 - ii. No: Tap on the portal to attempt to produce a Tinel:
 1. No Tinel: move to next, more proximal portal
 2. Yes Tinel: explain the implications to the patient and continue work proximally.
3. How do you avoid the digital nerves that should be right in harm's way when releasing lateral digital cords in the fingers? The digital nerves in Dupuytren's are often more dorsal than would be expected. The anatomic relationships of neurovascular and other structures are different in the closed state compared to what is seen with distortion of surgical dissection. As long as the patient has distal sensibility and no paresthesias, the digital nerves are safe.
4. What about percutaneous PIP collateral ligament release? There is not yet a consistently reliable, safe and effective technique described for this.
5. What about using a needle larger than 25 gauge? An 18 gauge needle is a good option both for percutaneous Fowler tenotomy and for very thick cords in the lateral ulnar palm. Used in the vicinity of nerves and tendons, larger diameter needles have greater potential for collateral damage than smaller needles, although there is no literature to document differences in risk or efficacy.
6. What's the best time to perform NA? The best window of opportunity for the least painful, most significant release is up to about 60 degrees of composite contracture.
7. What if there is a big, deep, full thickness tear, with flexor sheath and neurovascular structures visible in the depths? Treat as you would a McCash – it will heal with little inflammation over the course of one to five weeks, depending on its size. The final scar may be somewhat retracted, unlike that of a McCash.

5 most common mistakes on the learning curve:

1. Not emphasizing enough to avoid strenuous gripping / golf / tennis / gardening / fishing / weight training etc. for a full week post release - even if they feel fine.
2. Not clearly warning patients preoperatively that they may have a skin tear which may require bandaging for a few weeks if it is full thickness.
3. Not repeatedly checking for distal anesthesia when near a nerve or checking active flexion when near a tendon.
4. Inadvertently slicing the skin while trying to slice a very superficial cord.
5. Not changing to a fresh needle when the entry feels rubbery or the cord just won't cut.

Notes: