12 Post-Traumatic Contracture

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Keywords
Aetiology • Classification • Presentation and assessment • Investigations • Role of therapy • Role of surgery • Outcomes

Introduction

Contracture after injuries to the hand and wrist is not uncommon, affecting particularly the wrist, metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints. Fortunately, in most cases the contracture either resolves or is not clinically significant and can be ignored. In others, however, treatment is required. The nature of a contracture depends very much on the severity of the initial injury, the treatment received and perhaps most importantly the patient's attitude. For the latter, a patients understanding of the nature of the injury, the treatment received and what is expected of them is paramount. Even if treatment is optimal, an unresponsive patient will more than likely have a poor outcome, including an ongoing contracture. With regard to the injury itself, the more severe the trauma; the more likely it is that a patient will develop a contracture. For this reason it is important that the clinician appreciates what particular structures have been damaged; is there any bony injury, has the articular cartilage been damaged, or is there malalignment? For the soft tissues again it is important to ascertain which have been permanently damaged; the dorsal or volar capsule (volar plate), or the collaterals. In addition, have any of the surrounding structures been injured, particularly the tendons including the central slip, but also the neurovascular structures as well as the skin and underlying soft tissues. All of these may need attention if the contracture is to be addressed.

Finally, with regard to treatment, the role of the surgeon can be contentious. Whilst obviously addressing severity and over-seeing treatment, the role of surgical intervention is not always clear cut. It is often too easy to recommend intervention when this is not in a patient's best interest. Surgery itself will inflict further trauma to the injured area and can result in otherwise normal tissues being damaged. In a study by Weeks, et al on 453 PIP joint flexion contractures treated with

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an intensive programme of active, passive and resisted exercises, static and dynamic splinting, 87 % responded to treatment to the extent that surgery was not indicated [1].

The key for the surgeon therefore is to balance the relative benefits and risks of intervention.

Perhaps of greater importance, however, is the pivotal role of the therapist. Any rehabilitation regime must ensure maximum pre-operative improvement, as well as firstly demonstrating to the patient the commitment necessary after any surgical intervention, and secondly indicating to the therapist the likely level of compliance of that patient.

The most important task for the hand therapist is to establish which of the underlying structures is causing the stiffness and the limitation of joint range of motion. A regime can then be planned to target those specific structures; for example, a programme concentrating on tendon glide will have little impact on a stiff joint. In addition, the longer the period of stiffness, the more extensive and intensive the rehabilitation is likely to be. Part of the role of the hand therapist is to continue to motivate the patient to maintain the range of modalities and the time commitment required.

All the modalities discussed in this chapter are relevant either pre-operatively or post-operatively-the differences being the application, duration and specific modalities chosen for each patient and joint. In-depth assessment and clinical reasoning to set up the programme is vital.

Background/Aetiology

Contraction, or at least the potential for contraction, is normal after any injury. In most cases, however, this does not occur as the injury is mild and patients are soon able to mobilize and stretch to prevent any permanent deformity. In more severe cases, however, particularly in cases where surgery has been undertaken and early mobilization impractical, stiffness and contracture may ensue. It is therefore key to identify which structures have been injured, either bony or soft tissue.

Bony injuries can obviously be either extra or intra-articular. Undisplaced or well fixed extra-articular fractures often do well; in so much that patient's can begin mobilizing sooner rather than later. However, displaced intra-articular fractures managed either surgically or conservatively are more likely to result in stiffness and contracture. The basic patho-physiology being the damage to or altered position/alignment of the surrounding soft tissues results in healing with contracture or altered mechanics, which in turn leads to stiffness. Hence the importance of splinting the joint and surrounding soft tissue on full stretch (the MCP joint's at 90° and the PIP's in extension). Intra-articular incongruity can lead to both maltracking of the joint, or act as a direct block to movement. Added to that, extra-articular fractures can also result in adhesions to the overlying flexor and extensor tendons, which again will result in contracture. The more displaced the fracture, the more likely it is to develop adhesions. A comminuted fracture or indeed fractures that undergo surgery also have a higher risk of adhesion formation.

Table 12.1 Classification of injuries

Bony injuries	Intra-articular disruption	
	Extra-articular disruption	
Soft tissue injuries	Intrinsic	Collateral ligament injury
		Capsular injuries
		Volar plate injuries
	Extrinsic	Tendon/flexor sheath
		Neurovascular structure
		Skin/subcutaneous tissue

Of the soft tissue injuries, as can be seen from Table 12.1, these can be either classified as intrinsic or extrinsic, depending on whether the injury is to the tissues immediately surrounding the joint or external to it.

Whilst it is unusual for an individual structure to be injured in isolation, usually one structure is damaged predominantly. For example, a collateral or other restraining ligament, when put under load, will initially elongate. When this occurs during the "elastic phase" (Fig.12.1), if the load is removed the ligament returns to its pre-injury length. Later, however, in the "plastic phase," if the load is removed the ligament will not return

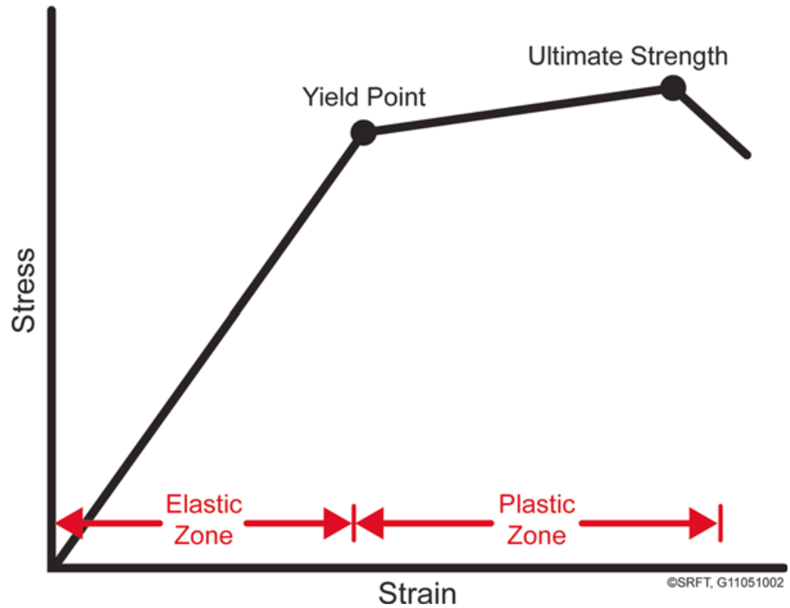

Fig. 12.1 Stress and strain graph

to its previous length, but will heal in an elongated fashion. Clinically this will result in instability, rather than contracture.

Finally, the end result is rupture, either as an intra-ligament tear, or as an avulsion from bone. During this process, other structures, specifically the adjacent capsule, will also be affected, although the principle injury is to the collateral. When the healing process begins collagen is laid down, which eventually leads to scar formation and contracture. If this affects the collateral ligaments predominantly this will lead to a loss of movement, particularly at the extremes, e.g., full extension at the PIP joint or flexion at the MCP joint [2].

At other sites, particularly if the ligament is avulsed from bone, direct healing may not necessarily occur, e.g., ulnar collateral ligament injuries at the metacarpophalangeal joint of the thumb. Again this will result in instability, rather than contracture. Optimal treatment involves allowing the ligament to heal in as normal position and length as possible, yet maintaining motion.

Capsular injuries, particularly to the volar plate, again often result in contracture, usually as a result of the volar plate healing in a contracted fashion. At the PIP joint, this would result in a flexion deformity. Less often, detachment or elongation can occur, which will result in hyper-extension.

Extrinsic injuries to tendon or skin, which in their own right can lead to contracture, can also result in stiffness in associated normal joints. For example, a flexor tendon injury that dehisces after repair, or becomes stuck within the flexor sheath, will result in a flexion deformity of the finger, which will ultimately result in a secondary contracture of the associated joints, either the MCP or PIP, despite them essentially being normal. Similarly, rupture of the extensor central slip off the base of the middle phalanx will result in weakness extending the PIP joint and, again, a tendency to develop a flexion contracture.

Why, therefore, does an erstwhile normal joint develop such a contracture? The current rationale is that normal cartilage nutrition depends on joint loading and motion [3]. If the latter is absent, cartilage degeneration occurs and adhesions develop. These result in the contracture of the joint capsule, volar plate and collateral ligaments, leading to more permanent loss of movement.

Brand and Hollister stated that joint stiffness is on average caused by 90 % elastic factors (collagen and elastin), 9 % viscous oedema and 1 % friction in the joint [4]. The hand therapist, therefore, needs to concentrate on modalities that allow, in particular, elongation of contracted elastic tissues. Collagen fibres Type III (scar) need to be stimulated to alter to Type I (normal extensile tissue). Prolonged stretch with gentle consistent force encourages this. Flowers and LaStayo concluded from a study of total end range time that, if a joint is held at its moderately lengthened position for a significant time, the tissues will lengthen [5].

It is also important to remember that a patient may present with decreased range of movement due to pain. This is not true stiffness and management of the pain will produce a full range of motion.

With regard to management, obviously both areas have to be addressed if the patient is to achieve better movement; that is not only has the tendon to be addressed, but also the accompanying joint contracture. Fortunately, it is often possible to treat the latter conservatively prior to releasing or reconstructing the tendon.

In addition, injuries to the flexor sheath in their own right can produce adhesions and consequent restriction of movement of the flexor tendon. When deficient it can result in "bow-stringing" of tendons, particularly at the level of the proximal interphalangeal joint. Again, this has the effect of producing a contracture with associated secondary stiffness of the PIP joint. Obviously, again both issues have to be addressed for treatment to be successful.

Finally, if there is significant damage to skin and the subcutaneous tissue, for example as a result of major trauma, burn or a degloving injury, this can also lead to contracture in an underlying joint. Again, any treatment will require release of this contracture and the application of new skin and subcutaneous tissue, ideally using flap cover.

Presentation, Investigation and Treatment Options

History

The clinical presentation of a contracture is usually obvious. Whilst patients may complain of pain, the deformity is often readily seen. Functionally, loss of movement or fixed deformity can lead to specific disability. Examples at the wrist would be an inability to manipulate the hand into a particular position, e.g., handwriting, toileting etc. The lack of finger extension can diminish span, making gripping difficult. As such, taking tops off jars and other twisting actions may be difficult. In addition, patients often make complaint of an inability to open the hand to take change. Finally, contracted fingers can be caught, for example in pockets.

Added to this, grip or pinch strength will normally be diminished, as the wrist or hand cannot be placed in the optimum position for strength. Finally and by no means least, patients often complain about the appearance.

Establishing the Cause of Stiffness

On examination any contracture is usually obvious. It is, however, important firstly to determine whether this deformity is fixed, passively correctable or a combination of both. A fixed contracture usually means that there is a problem with the joint itself, whereas if the contracture is passively correctable, there is usually an extrinsic tendon or muscle component. (The degrees of contracture are quantified by direct measurement using a goniometer.) This is important, as it will provide objective evidence of any improvement or not. Clinical photographs can also be useful.

Assessment of Stiffness (Table 12.2)

1. Assess for chronic oedema that may be restricting range of motion, particularly at the PIPJ. Dorsal oedema will restrict flexion, as the skin has to stretch further. Shin and Amadio showed that 12 mm of skin stretch was necessary for 90° flexion at the PIP joint, although this was increased to 19 mm for an oedematous joint [6]. Oedema may be assessed using various methods e.g. tape measures for individual digits or a volumeter if oedema is present throughout the hand. Be aware that circumferential measurements using tapes show variable inter-rater reliability, though intra-rater reliability is higher [7, 8].

Table 12.2 Algorithm for assessment of structures causing stiffness

DIPJ sits in ext	DIPJ sits in flex	PIPJ sits in flex	PIPJ sits in ext
Limited in flex	Limited in ext	Limited in ext	Limited in flex
↓	↓	↓	↓
Active limitation caused by	**Active limitation caused by**	**Active limitation caused by**	**Active limitation caused by**
Flexor Digitorum Profundus	Terminal extensor tendon	Central slip	Flexor Digitorum Superficialis
		Trigger locking	Early swan neck deformity
		Lateral bands	
Passive limitation caused by	**Passive limitation caused by**	**Passive limitation caused by**	**Passive limitation caused by**
Arthrodesis	Arthrodesis	Volar plate	Intra-articular tightness
Intra-articular tightness	Intra-articular tightness	Dupuytrens	Dorsal capsule
Extrinsic extensor tightness	OA	Trigger finger	Established swan neck
ORL	Extrinsic flex tightness	Intra-articular	Extrinsic extensor tightness
Intrinsic mm tightness		Collateral ligaments	Intrinsic mm tightness
Lateral bands/TRL		Extrinsic flex tightness	Central slip contracture
		Volar joint capsule	
		Lateral bands	
		Transverse retinacular ligament	

When assessing the PIP joint – the following algorithm may be helpful

2. Measure the range of motion – isolated and composite as well as active and passive. This will differentiate between capsular tightness, tendon tethering and extrinsic or intrinsic tightness. Using an appropriate goniometer and a standardised method of measuring increases the reliability of joint measurement in experienced therapists to between 5 and 10° [9].
3. Always look at what is restricting the ROM – tightness or pain. Is it true tissue tightness or muscle guarding due to anticipation of pain? This is not true stiffness and the pain response would need to be managed initially.
4. Manual Muscle testing – assess the strength and action of individual muscles to isolate tethering, shortening or rupture of particular tendon/muscle units. The Medical Research Council (MRC) Scale for Muscle Strength is the most commonly used (1981), with Grade III (movement through range against gravity) being the only objective grading [10].
5. Differentiate between intrinsic and extrinsic tightness of the muscles and possible tendon tethering – for digital intrinsic tightness, the therapist passively extends the MCP joint to neutral and then passively flexes the interphalangeal joints into maximum flexion [11]. If it is not possible to fully flex the IP joints and there is pain or stretch obliquely along the lateral borders of the proximal phalanx, this denotes tightness of the intrinsic muscles (Fig. 12.2a).

   This position places the intrinsic muscle/tendon unit on full stretch, while composite flexion of the digit relaxes the intrinsics (Fig. 12.2b, c).

   For digital extrinsic tightness, the therapist passively flexes the digit at all joints to maximum range of motion. If this is limited, the long extensors are tight or scarred (Fig. 12.2d).

   Extrinsic extensor or flexor muscle/tendon tethering or tightness is tested with passive composite wrist and finger extension or flexion.
6. Assess for intra-capsular tightness or shortening- Joint palpation with ballottement or accessory mobilisation aims to assess for tightness of ligaments or joint capsule and to differentiate between joint tightness or laxity (Table 12.2). Always compare with the contra-lateral side, as there is a wide

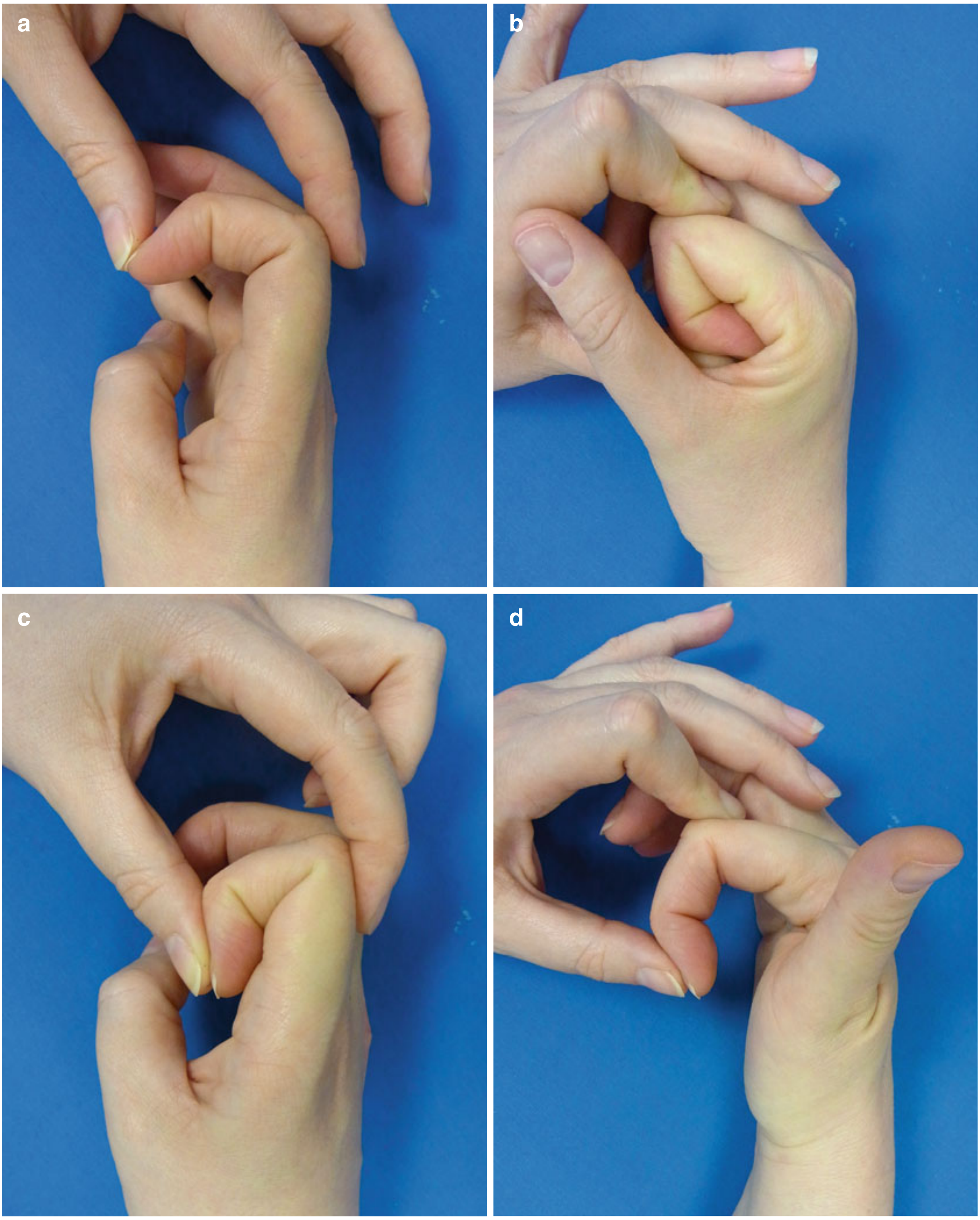

Fig. 12.2 Demonstration of intrinsic and extrinsic tightness. (**a**) Intrinsic tightness. (**b**) Full composite flexion. (**c**) Normal intrinsic stretch. (**d**) Extrinsic tightness

range of ‘normal’. Remember that ligaments may be tight in different positions of movement; for example collateral ligaments at the PIP joint are tight in flexion beyond 60° and accessory collaterals tight between 0 and 20°. Similarly, wrist dorsal and volar radioulnar ligaments tend to be tighter in supination or pronation respectively.

7. Assess grip strength, sensation and function, as these may well alter the patient's motivation to improve and their expectation of the outcome of rehabilitation or surgery.

Clinical Pearl
Assessing the stiff hand requires knowledge of the detailed anatomy, mechanics and specific tests to differentiate between capsular intra-articular or extra-articular tightness.

Investigations

All patients who present with a contracture after an injury should have two views of a **plain x-ray** of the affected area. This is to identify any previous bony injury either malunion or mal-angulation, or indeed if secondary osteoarthritis has supervened. All of these will have an effect on any treatment proposed.

Dynamic Ultra sound scans can also be useful, particularly in identifying tendon damage; either rupture or dehiscence following repair, acute or chronic inflammation or tethering of soft tissue. This would also apply to the flexor sheath where the tendons will be seen to have separated (Fig. 12.3). Other modalities of scanning MRI/CT are currently less useful, but will undoubtedly improve with time. CT may be most relevant when assessing for altered articular surfaces producing a bony block to movement.

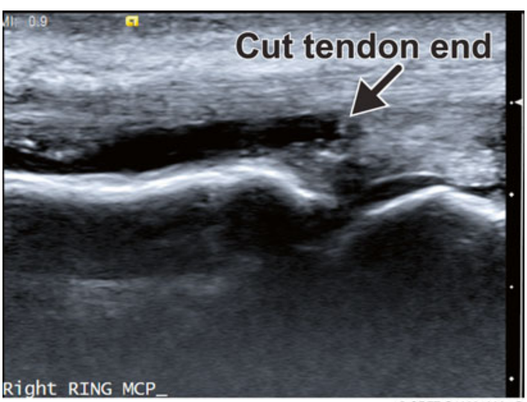

Fig. 12.3 Ultrasound image of divided flexor tendon

Prevention of Stiffness

The optimum treatment for all contractures is prevention. There is a general tendency after injury for joints to assume a position of comfort. The best example of this is at the proximal interphalangeal joint, which is often held at between 30° and 40° of flexion. It is in this position that the capsule has its maximum volume and as a consequence is a position of comfort. Unfortunately, however, if left at this angle any soft tissue injuries will heal in a contracted position resulting in permanent stiffness. As a consequence, it is essential that the joints are splinted with the soft tissues at full stretch. For the wrist this would be neutral, for the MCP joint 90° of flexion and the PIP joint at full extension.

Surgical Treatment Options

Treatment options for contractures in the hand and wrist are numerous and will tax even the most skilled and experienced hand surgeon or hand therapist. Whatever is undertaken, however, will require a team approach. Firstly, the patient should be fully aware of what is proposed, together with the relative advantages and disadvantages combined with the complications. Their participation particularly in any therapy is crucial. It is therefore strongly recommended that the patient is seen by the therapist pre-operatively to allow the post-operative therapy programme to be defined and explained. Indeed in our opinion post-operative therapy input is more important than the surgery itself. If the input of an appropriately qualified hand therapist is not available then this type of surgery should not be attempted.

Table 12.3 shows the treatment options available:

Of the bony operations, **osteotomy** is probably the most rewarding. However, it should be carefully planned, particularly with regard to the site of the osteotomy, the need for bone graft and the placement of any internal fixation. The latter must not be placed over joint capsules or collaterals and preferably give rigid fixation such that early mobilization can begin. With this in mind, plate

Table 12.3 Surgical treatment options

Cause of stiffness	Surgical treatment options
Bony	Osteotomy
	Replacement
	Excision
	Arthroplasty
	Arthrodesis
Soft tissue	
Intra-articular	Capsular release
	Collateral and accessory collateral ligament release
	Volar plate release
Extra-articular	Tendon realignment
	Tendon release, repair, reconstruction
	Pulley reconstruction
	Flap cover

Table 12.4 Rehabilitation treatment options

Cause of stiffness	Rehabilitation options
Bony	Acceptance of limitation of movement and maximising function
	Splinting for pain and support in function
	Muscle strengthening
	Activity modification
Intra-articular tightness or tendon tethering/extrinsic tightness	Heat modalities
	Oedema modalities
	Splinting
	Static, serial, static progressive, dynamic
	Joint mobilisations
	Passive stretches
	Active and resisted exercises
	Tendon glide exercises
	Activity rehabilitation
	Scar, graft or flap management
	Blocking splints to isolate joints or tendon function
	Functional activities

and screws seem preferable to k wires. On the down side there is obviously a risk of non-union or infection. Added to that range of motion may not increase significantly, although it may well be in a more functional plane. Extra-articular osteotomies typically do better than intra-articular; the latter only being required for severe intra-articular incongruity, particularly in younger patients. Results, however, can be unpredictable.

Joint replacement can also be undertaken if there is particularly severe joint disruption, or if secondary arthritis has developed. Indeed, in selected cases this can be the treatment of choice giving more predictable results, including correction of contracture.

Finally, **arthrodesis** should be considered if reconstruction is not possible, but the deformity is causing significant impairment. Effectively the joint is arthrodesed in a more functional position.

Releases around the joint, either of the capsule, collaterals or volar plate, form the basis of most procedures. It is important, however, that the operation is undertaken in a systemic yet limited manner. That only the contracted tissues are released and normal tissues are left untouched. Gentle handling of the tissues is therefore essential, as significant post-operative bruising and swelling will result in difficult mobilization and ultimately little improvement. Arthroscopic release of a joint, particularly of the wrist capsule, has obvious advantages in this regard.

External to the joint, **tendon realignment, tendon release, repair or reconstruction** are all crucial, as without normal or near normal tendon excursion full active mobilization cannot be undertaken. It is essential, therefore, to obtain at least maximal or full passive joint motion prior to tendon reconstruction. A similar situation would apply to any **sheath/pulley reconstruction.**

With regard to skin and subcutaneous tissues, none of the above procedures will be successful if there is a skin contracture. This has to be addressed by the application, preferably of flap cover, or at least a full thickness skin graft. This is usually undertaken prior to any other reconstruction.

Rehabilitation Treatment Options

Management of the stiff digit or wrist relies on the initial assessment and then intensive therapy, using a core of the most appropriate modalities for those structures most affected (Table 12.4).

Clinical reasoning is vital to ensure that treatment targets the appropriate cause of the stiffness. Rehabilitation will take a different form for the stiff joint caused by capsular contracture, rather than that as a result of tendon or other soft tissue tethering. In a chronicly stiff hand there are likely to be elements of both and the therapist will need to prioritise these in relation to the patient expectations and function. Generally, gaining flexion is more beneficial functionally, but patients will often prioritise extension for cosmetic reasons.

In order for stiff joints or tight soft tissues to improve, it is vital that rehabilitation is carried out regularly every day and overnight with splinting. A clear, concise and achievable home rehabilitation programme needs to be taught to the patient as well as attendance at therapy. The therapist should concentrate, in treatment sessions, on modalities that are not possible for the patient to achieve themselves at home, whilst also checking home programme activities and exercises to ensure the patient is using the correct technique.

The hand therapist needs to be realistic about time scales, to use a range of modalities specific to the patient and the problem and evaluate their effectiveness regularly. If a modality is not making a change within a few weeks, a different method or application needs to be tried. The hand therapist needs to know when to advise the patient that further active therapy is unlikely to change the stiffness and that they either need surgery or to learn to adapt to the remaining disability. In choosing the modalities most likely to be effective for an individual patient, aspects such as inflammation and pain must always be considered. Slow prolonged periods of tissue stretch have been shown to produce consistently improved results in elongation and glide of tissue, without micro tissue trauma [5].

Many patients with stiff hands will need to accept a functional range of motion rather than full range and adapt grips to enable maximum function. A study by Hulme et al. (1990) [12] found that flexion postures averaged 61° (range 33°–73°) at MCPJ, 60° (range 36°–86°) at PIPJ and 39° (range 20°–61°) at DIPJ in a range of ADL tasks [12]. A further study by Woodworth et al. (2006) [13] showed that PIPJ's held at 40° (the most common fixed flexion position for post trauma contracture) showed an increase in MCPJ flexion required and an increase in the MCPJ hyperextension used [13]. They also noted that precision tasks, which would normally rely on dynamic PIPJ movement, showed the most significant change in MCPJ movement. Wrist functional range requires 40° of extension and flexion, a total range of 40° of ulnar and radial deviation with 75 % rotation range [14].

It is not in the remit of this chapter to give details of how to carry out each of these modalites, but to encourage clinical reasoning in choosing the most appropriate therapy for each patient. In order to improve clinical reasoning, the discussion will be split into common modalities and then those for intra-articular tightness and soft tissue glide.

Common Rehabilitation Modalities

Heat Treatment

Mild heating of tissues increases blood flow and metabolic rate and allows more tissue extensibility as well as reducing pain [15, 16]. Soaking the hand in warm water, or immersing in wax prior to passive stretching can be of great benefit. Heat packs can be used if immersion in water is contraindicated e.g. in the presence of K-wires. Hot paraffin wax gives a well insulated, low temperature method of heating the tissues [17]. Therapists should incorporate heat and stretch by applying tape (e.g. micropore) to maintain the digits in flexion and then dipping the hand in the paraffin wax.

Oedema Management

Oedema is a normal part of the inflammatory healing process, but the majority of this oedema should be eliminated within 6 weeks to reduce developing stiffness [18]. Oedema remaining after this time is likely to disperse very slowly and residual swelling may remain for many months. The following modalities will have decreasing effectiveness, as the oedema becomes more chronic.

Elevation

Elevation is most effective in acute oedema [19]. Gravity will aid the flow of the lymphatics. Active exercises carried out in elevation will further aid reduction of oedema by creating muscle pumping and movement of soft tissues [20, 21].

External Compression

Compression should not be used during the first 3–5 days of the inflammatory stage, as oedema is necessary for healing [22]. Gentle external compression increases the capillary volume and speeds vessel filling, oedema therefore reduces as the blood flow and lymphatic drainage improves. Compression needs to be only sufficient to stimulate the lymphatic drainage and not to overload the system [18]. Compression is provided by using some form of elastic wrapping, such as elasticated wrap, lycra digisleeves, compression gloves or string wrapping. External compression is contraindicated in the presence of infection. Always wrap from distal to proximal, ideally leaving the finger tips free to assess capillary return. The patient must be warned to watch for signs of the wrapping being too tight.

Cooling Temperatures

Cold induced vasoconstriction may help to minimise inflammatory swelling, by decreasing blood flow to the area [23]. Cryotherapy has also been shown to be effective in pain management [24, 25]. Chronic oedema is less likely to benefit from cryotherapy. Cryotherapy may be provided by ice or cool packs, or contrast bathing. Ice packs have been shown to be more effective than contrast bathing, but be aware that in the early stages local vasodilatation does not inhibit lymphatic drainage [26]. Contrast bathing may also be an effective method of reducing oedema with alternating hot and cold producing a pumping action and aiding lymphatic drainage. Combining cold, compression and elevation has been found to be most effective for decreasing oedema [16].

Active Exercise

Active exercise increases blood flow, facilitating venous return and pushing the fluid along more quickly [27]. Exercises may improve lymph flow up to ten times [28]. Active movement encourages tendon excursion through the oedema and maintains joint mobility and increases range of motion as the oedema reduces. To be most effective for oedema control, active exercise must also include full range of arm and shoulder motion to keep the fluid moving through the lymphatic system at elbow and axilla.

Electrotherapy

Pulsed shortwave diathermy (PSWD) has been advocated to decrease oedema. There are clinical claims as to the effectiveness of PSWD, with the suggestion that it helps to increase the number of white cells, histocytes & fibroblasts in a wound, which in turn improves the rate of oedema dispersion with a reduction in the inflammatory process [29, 30]. However, there is no conclusive evidence to date.

Lymphatic Massage

MEM (Manual Edema Mobilization) is a method of gently stimulating the lymphatics to facilitate the flow of excessive tissue fluid and proteins from an oedematous area. It involves light proximal to distal then distal to proximal massage of the skin carried out in segments [18]. It is applicable to people suffering persistent high protein oedema, with intact, but overwhelmed, nodes and lymphatic system. It is important that following massage any improvement is maintained by elevation, pressure garments and exercise [25–27].

Elastic Taping

Kase et al. (2003) [31] proposed that Kinesiotape, placed in a direction that may lift the skin and increase the interstitial spaces, encourages natural lymphatic drainage and reducing pressure on underlying tissues. The drainage must always start proximally to clear those nodes and allow the fluid to move freely from the distal hand and arm region.

Kinesio-Taping is most commonly done as a series of fan shapes, with tape stretch of 15 % only, started at proximal axilla lymph nodes, elbow nodes and then into wrist, hand and fingers. Patients and relatives may be taught to do this at home. Most evidence is anecdotal at

Fig. 12.4 Example of kinesiotaping for lymphatic drainage

present, but is supported by the theory of lymphatic drainage (Fig. 12.4) [31].

Scar Management

Scar Massage

Massage techniques can help eliminate tethering and invigorate the blood supply to the area of the scar, increasing range of motion, but having less effect on skin mobility [32]. The massage should be firm and distract the skin from other soft tissue. A greasy cream should be used to ensure that many minutes of massage can be done before the cream is absorbed. The patient must understand that it is the massage that is therapeutic, not the cream.

Ultrasound

Used in the stiff hand and wrist to help with the softening of thick scar tissue, but with limited evidence base for effectiveness in musculoskeletal injuries [33]. Continuous ultrasound used for at least 6 min may encourage scar tissue to become more elastic and extensible and may be beneficial when used prior to scar massage. (www.electrotherapy.org).

Silicone Gel

There are many silicone gel sheets and topical gel treatments available for scar care. There is still controversy about how they work, but they may be effective in flattening raised scars, hastening the maturation process, decreasing colour and some gels keep the scars moist [34]. The selection of the gel is important, as they have differing abilities to contour or adhere to the skin and have different life spans. A study by Chernoff et al. (2007) [35] showed most effective management of scars with topical gel (Kelocote) in the day and a silicon gel sheet overnight or twice daily application of the topical gel [35]. Patients preferred the ease of application of the topical gel.

Pressure Garments

Pressure garments are used most regularly with scars following burn, extensive soft tissue injuries, skin grafts or in the case of web creep [36]. They form a 'second skin' by exerting the pressures on the deep skin layers as the original outer layers of skin would have done. This helps to prevent the new skin from being formed in spiral bundles (producing hypertrophic scars).

Elastomers

Elastomers can be moulded to produce an imprint on any skin which has an awkward or concave shape. This can then be worn to increase pressure on the skin. Some elastomers are infused with silicone. They should be replaced every few months in order to maintain a good imprint. Increased compression can be gained with a splint or pressure garments.

Specific Rehabilitation for Capsular Tightness or Tendon Tethering

The following factors will help the therapist to prioritise the most appropriate modality: the stage of tissue repair, the degree of pre treatment stiffness or tethering, the time since diagnosis or

Fig. 12.5 Passive composite finger flexion

injury, the patient's age, work, lifestyle and compliance and the therapist's knowledge and resources.

Rehabilitation to Gain Capsular Tissue Elongation for Intra-Articular Tightness

All rehabilitation for capsular tightness should concentrate on achieving end of range stretch or placing a prolonged stretch on the tight tissues.

Gaining Range of Motion

Passive Exercises/Stretches

Passive stretches should be done for a prolonged period of time, with a low to moderate amount of tension [16]. The patient needs to understand the difference between the sensations of stretch and pain. Forced manipulations are contraindicated because they result in pain, micro trauma to tissues and increase swelling (Fig. 12.5) [37].

Following a low load prolonged stretch into flexion carried out by the therapist, it is possible to tape the finger into the improved flexed position. This way, the patient can experience an effective and safe stretch for longer (without having to hold on to the finger). Begin with suggesting 10–15 min of taping and gradually build it up. This stretch can also be achieved using a variety of splints or straps (often using velstretch, Lycra or neoprene) (Fig. 12.6a–c).

Joint Mobilisations

Specific manual joint accessory movements are very effective for capsular tightness [8]. These may be passive oscillatory movements, two or three per second of small or large amplitude, applied anywhere in the range; or sustained stretch with or without tiny amplitude oscillations at the limit of range [38]. When stretching a stiff joint to regain range, treatment movements include spin, roll and slide which are normal for that particular joint. They may be used for assessment or for treatment of stiffness. These techniques require knowledge of surface anatomy, training and practice.

Exercises

These are less effective for capsular tightness than for tendon glide, but will build muscle power and maintain soft tissue glide. Isotonic exercises will work on core muscle strength without requiring active or full ROM. Active exercises may be most effective following heat and taping and then targeted exercises.

Activity

Activity rehabilitation chooses games, activities or functional tasks that will target the joints involved. These joints can be further isolated by using blocking splints that only allow the stiffer joints to move, or using a sustained grip on an object which will improve the elastic stretch on tissues.

Lycra or Neoprene Sleeves

Cylindrical sleeves with reinforcement dorsally may be effective in reducing fixed flexion deformities in the digit, by producing a prolonged stretch with compression [39, 40] (Fig. 12.7a, b).

Splintage

Flowers and LaStayo (1994) [5] concluded, from a study of total end range time, that, if a joint is held at its moderately lengthened position for a significant time, the tissues will lengthen [5]. They also proved that the amount of lengthening is directly proportional to the time spent at total end range (TERT). Such growth of the dense

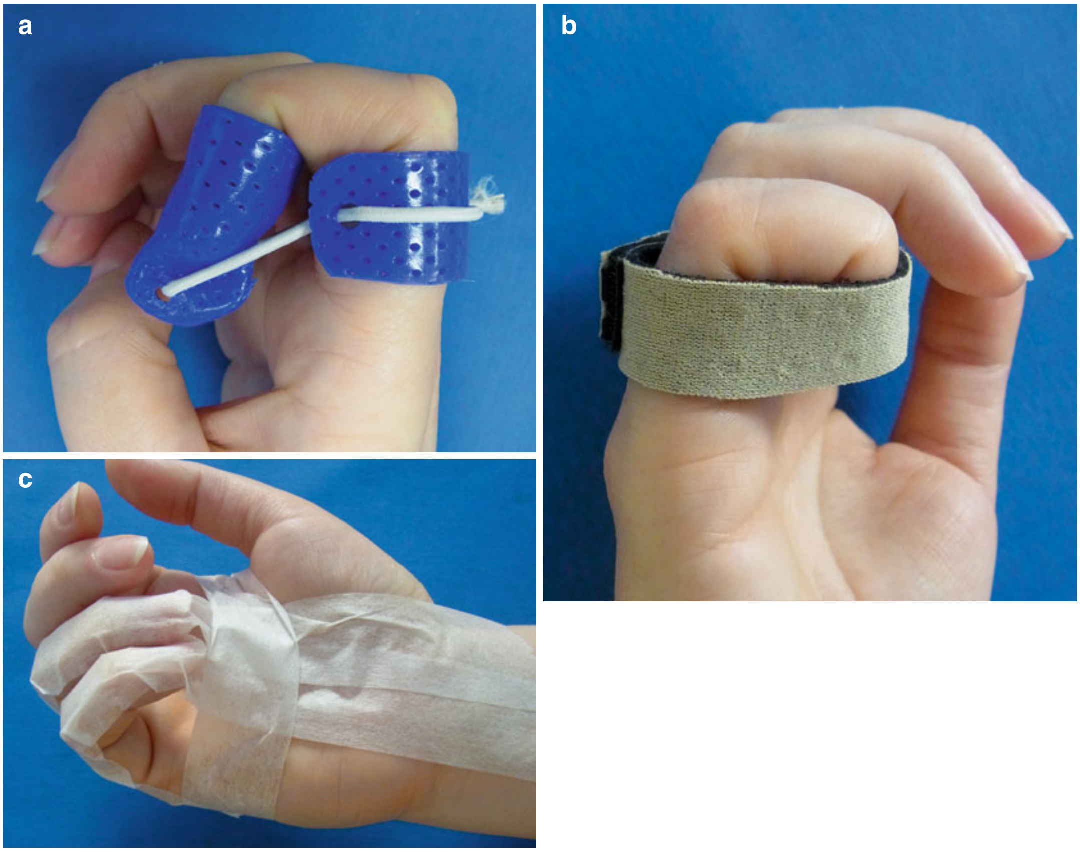

Fig. 12.6 Techniques of improving finger flexion. (**a**) Dynamic IPJ flexion splint. (**b**) Elastic IPJ flexion strap. (**c**) Micropore taping into flexion

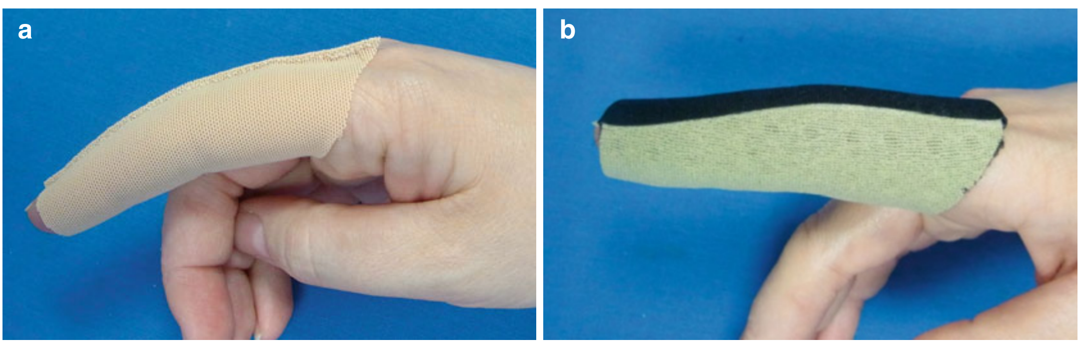

Fig. 12.7 Lycra finger digisleeve and neoprene tube. (**a**) Lycra digisleeve. (**b**) Neoprene finger tube

connective tissue around the joint allows for increased movement. Splints must be removed regularly to allow range of movement exercises and must always work within the clinically safe range of force [41].

The duration of splinting must be considered. Prosser (1996) reports the average splint wearing time for 20 patients with PIP joint contractures to be 6–14 h a day for 3–5 months [42]. This is because collagen turnover

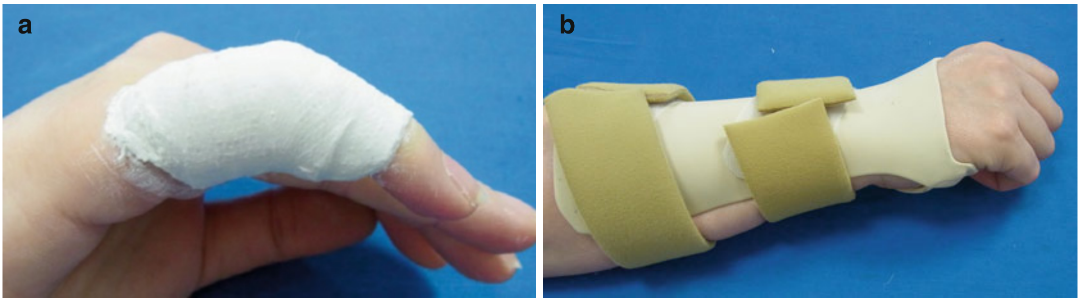

Fig. 12.8 Thermoplastic wrist serial static splint and POP PIP joint cast. (**a**) Plaster of Paris PIPJ serial cast. (**b**) Dorsal leverage extension wrist splint

is approximately 6 weeks and an acceptable clinical improvement may take several cycles of collagen turnover. Clinically, 3–6 months of splinting is recommended.

Static Splintage

A hand which is oedematous or being rested for a prolonged period can be rested in a thermoplastic splint. The position of safe immobilisation is the intrinsic plus position (wrist extension, MCPJ flexion and IPJ extension), as this prevents the collateral ligaments tightening. In the presence of oedema, strapping on the splint should be in a figure of eight pattern or a wrap, so that pressure is distributed over a large area. Individual joints can be splinted to prevent contractures forming, or where contractures have already formed, serial splinting can be used, periodically altering to gradually reduce the contracture.

Serial Static Splinting

Serial static splints are those that hold a specific position with prolonged gentle stretch for a length of time (3–5 days) and are then exchanged for another identical splint as tissue changes but held at a slightly improved angle. They are particularly effective in joint or tissue contractures as tissue is encouraged to "grow" and rearrange patterns of collagen rather than stretch, producing a long term effect and improved tissue length. Plaster of Paris is often used in this manner to gain composite extension in the hand and wrist (Tribuzi 1995) [43] or specifically at the PIPJ [43, 44]. Circumferential, dorsal leverage and volar thermoplastic splints may also be effective (Fig. 12.8a, b)

Static Progressive Splinting

This differs from static splinting, as a force is applied to the joint, rather than in static splinting where a joint is held in a particular position. The torque can be applied to the joint using a variety of materials including Velcro straps or an inelastic static line [45].

Glasgow et al. (2008) [46] proposed that static progressive splinting may not be the most effective splinting type for elongation of collagen in stiff joints. They suggest that this may be due to reliance on the patient to make the adjustments which may not be continually made in accordance to the viscous response and no adjustments over night are possible.

Dynamic Splinting

Dynamic splinting is an effective way of applying low to moderate amounts of tension to a stiff joint over a prolonged period of time. Dynamic splints use elastic methods to place torque on to the joint. Glasgow et al. (2008) [46] concluded that dynamic splints are able to respond to increases and decreases of viscous resistance and, therefore, may be most appropriate in contracture [46]. Menzes and Buck Willis (2011) confirmed substantial gains in ROM, with prolonged end range time in treating wrist and elbow contractures (Fig. 12.9) [47].

Casting Motion to Mobilise Stiffness (CMMS)

Judy Colditz (2011) suggests that the stiff hand develops poor habits of movement and substitutes patterns of movement promoting the loosest joints [8]. For example, if there is restricted movement

Fig. 12.9 Dynamic supination splint

at the IP joints, the MCPJ will often flex using the lumbrical muscles more than the long finger flexors. This encourages imbalance. The exact opposite is also seen. If there is tightness into flexion at the MCP joint, patients are often seen using increased long finger flexor movement to produce IP flexion and therefore reduce the amount of use of the lumbricals. CMMS promotes movement in the stiffest joints, by immobilising joints that have good range. This forces the patient to use their power to move stiff joints and encourages the motor patterning of this movement. Midgley (2010) [48] confirmed that CMMS was beneficial in managing patients post Dupuytren's release contracture [48].

Clinical Pearl
Most capsular contractures will need a combination of many modalities over a prolonged time. A systematic review of treatment for upper limb contractures showed that active exercises, joint mobilisations and splinting were most effective [49].

Rehabilitation to Gain Tendon Glide

Tissue glide occurs within structures themselves, such as ligaments and tendons, but also between these structures at fascial interfaces, with tendon or synovial sheaths or between bone and tendon. Disruption and scarring of any aspect will reduce the available glide. Fractures with scarring of the periosteum may tether to all surrounding tissue; for example, a proximal phalanx fracture may tether all circumferential tissue involving flexors, extensors, ligaments, intrinsic and extrinsic tendons and fascial gliding layers. Tendon glide of >5 mm or PIPJ ROM of 0–40° gained in the first 4 weeks post injury or surgery has been shown to be a positive prognostic sign for reduced tethering [50].

Gaining Tendon Glide

Active Exercises

Active exercises can be aided by heating the tissues prior to movement to improve the potential for elongation. Methods for this have been discussed earlier in the chapter.

Tendon gliding exercises, which encourage full tendon excursion, should be performed. Consider methods of gaining maximum glide for the finger and thumb flexors and extensors in isolation from each other, as well as differential glide of the intrinsic and extrinsic muscles. For example, holding the interphalangeal joints in flexion and slowly extending the metacarpophalangeal joints to hyperextension will maximise active glide of Flexor Digitorum Profundus with passive glide of the interossei and lumbricals (Fig. 12.10a, b).

Maintaining a power grip and moving the wrist through flexion and extension will maximise extrinsic tendon glide.

Exercises must be carried out regularly throughout the day and need to be repeated slowly. Graded exercises, such as foam sponges or putty, can be started, as long as they do not cause an increase in pain or swelling. Active exercise must also include full range of motion of all upper limb joints. Muscle strength must not be forgotten. Joint movement cannot be maintained if muscles cannot put them through the available range. A graded exercise programme is recommended, incorporating resisted activity and function. Consider using the position of the wrist and/or MCP joints to increase tendon glide, to alter glide to inner or outer range of pull. Exercises such as "place and hold" will produce a strong contraction in inner range. FDP glide with the wrist in full extension is likely to gain a further 2–3 cm of glide [51]. Exercises may be composite or isolated to work individual muscles in isolation or a combination of muscles to produce movement. Muscles may be worked in a concentric manner to

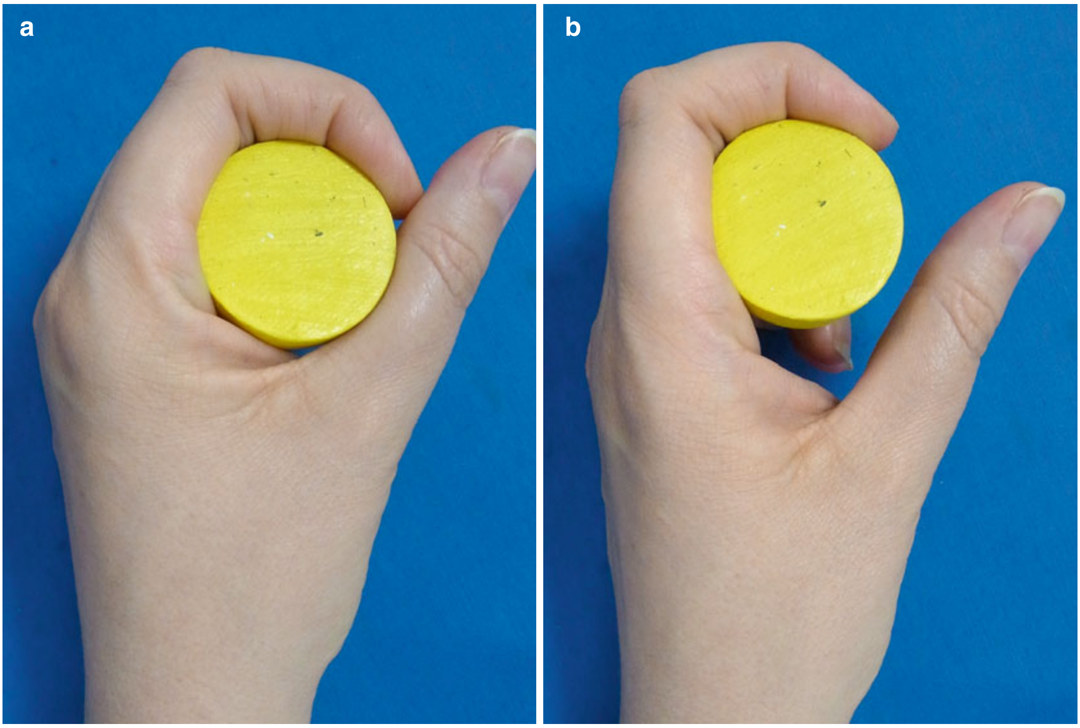

Fig. 12.10 Techniques of gaining tendon glide. (**a**) Composite flexion around an object. (**b**) Intrinsic minus increasing intrinsic passive stretch

produce a shortening of the muscle tendon unit in contraction or in eccentric to produce a lengthening of the unit, as the muscle controls the position of the wrist, hand or finger.

Resisted exercises will increase the force of the muscle pull and therefore the pull of the tendon on adhesions. These may include exercises such as Velcro rollers, thera-band and elastic resistance, thera-putty and splints. Repetitive movements will again produce a shearing force of the tendon or gliding tissues on adhesions.

Activity

Using the hand in a wide range of functional and/or rehabilitation activities will gain soft tissue glide, often with decreased pain, as the patient is distracted by the activity. Activities may be chosen and graded specifically for individual or composite tissue glide. These may be rehabilitation activities or incorporated in functional or leisure activities. Blocking splints again may be necessary to isolate the movements required (Fig. 12.11a–c).

Surgical Techniques

1. Arthroscopic release at the wrist.
2. Dorsal release of the metacarpophalangeal joint (MCP).
3. Volar plate release of the proximal interphalangeal joint (PIP).
4. Tenolysis – flexors and extensors

Whilst these procedures can be undertaken as described in isolation, it is important to remember that they are often undertaken in conjunction with some form of reconstruction, e.g. extensor tendon realignment at the metacarpophalangeal joint and central slip reconstruction at the proximal interphalangeal joint.

Arthroscopic Release of Capsular Contracture at the Wrist

With informed consent and usually under general anaesthetic, a patient's arm is suspended in finger traps with 5 lb (2kg) of counter traction. A tourniquet is also in situ. Under strict asepsis, using a

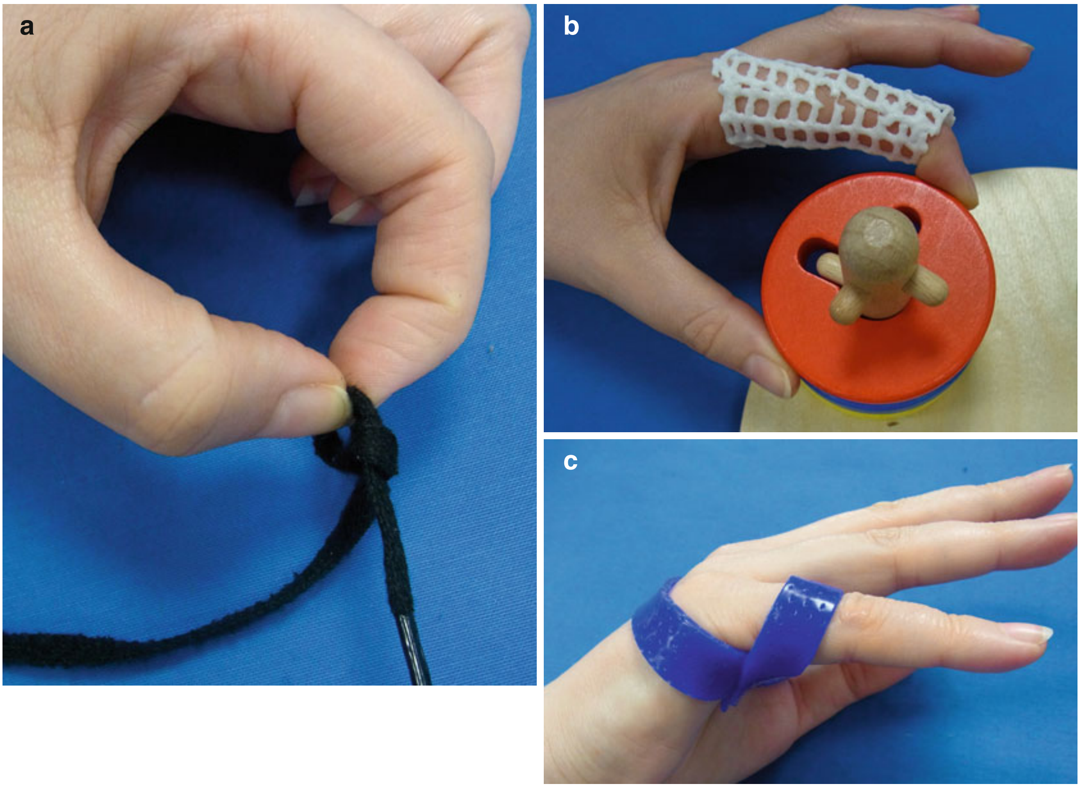

Fig. 12.11 Active techniques of regaining finger flexion. (**a**) Undoing a knot encourages FDP function. (**b**) A splint to block the PIPJ isolates FDP action. (**c**) A splint to prevent MCPJ hyperextension isolates IPJ extension

2.7 scope, both radio carpal and mid-carpal arthroscopies are undertaken. Generally these are undertaken through 3/4 and 6R portals plus a standard mid-carpal portal. A complete intra-articular examination of this joint is performed. Once this is complete, it is possible to proceed to the capsular release. Generally this will involve a capsular release at the radio-carpal joint. Again the two portals utilized are the 3/4 and 6R. In many incidences, particularly with a tight contracture, we also will use an additional 6U portal. With the arthroscope in the 3,4 portal, a soft tissue resector (2.9 mm full radius blade) can be inserted in the 6R or 6U and an ulnar capsule release undertaken. This can be undertaken on both the volar and dorsal surfaces. Switching the resector and the scope allows the release to continue on the radial side (Fig. 12.12). The author would also recommend the use of a fluid management system set at low pressure. To aid the release,

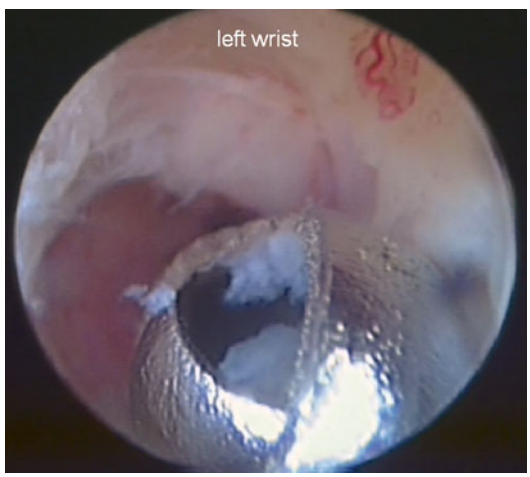

Fig. 12.12 Arthroscopic view of anterior capsular release

manipulations of the wrist can be undertaken at the pertinent stages, the counterweight having been removed to allow this to be undertaken. On the dorsal side, the release tends to be somewhat easier and less hazardous. Specifically as only the extensor tendons are at risk. On the volar side, however, there are more important neurovascular structures which could theoretically be damaged. Generally, however, using small resectors and occasionally arthroscopic scissors, it should be possible to protect any extrinsic tendons, nerves or blood vessels. It is important, however, that the procedure should not continue for too long, and certainly no more than 60 min, to prevent excessive saline extravasation.

Hand Therapy Post Capsular Release

Following the procedure, local anaesthetic is injected into the wrist joint and active and passive mobilisation begun immediately to maintain the range gained in the operation. A static, serial static or dynamic wrist/forearm splint may be necessary to maximise range, particularly if the contracture is long term. Light function may be begun immediately and return to all activities graded as pain and range of motion allows. All other modalities for capsular tightness management need to be considered.

Outcome

In 1988 Hanson et al. reported a number of cases of adhesive capsulitis affecting the wrist joint [52]. He also described various clinical and radiological features. Treatment took the form of closed manipulation under general anaesthetic in four patients with some improvement in range of motion. In one case there was a fracture of the ulna.

Reports on the outcome after arthroscopic capsular release at the wrist are few and far between. Dorsal capsular release was described by Bain et al. (2000) and, subsequently, in a further report in 2008 with results in 12 patients [53, 54]. In 9 of the 12 patients there was a 75 % increase in range of motion and grip strength. The other 3 patients reported between 25 and 50 % improvement. It is of note that rehabilitation that is active early mobilization began in the immediate post-operative period. In this study the authors reported no significant complications. Hattori et al. (2006) [55] reported their results in 11 patients and reported a significant improvement in all cases with a 22° increase in arc of motion [55].

With regard to the distal radio-ulna joint, while incongruity after distal radial fracture remains the commonest cause of loss of forearm rotation, scarring and contracture of the distal radio-ulna joint capsule can also lead to a reduction in this movement. Kleiman and Graham (1998) recommended, in patients who had restored osseous-anatomy after trauma, a DRUJ capsulotomy to improve forearm rotation [56].

Dorsal Release of the Metacarpophalangeal Joint (MCP)

Again with informed consent, either under a general anaesthetic or regional block, the patient's arm is prepped and draped. The operation is undertaken with a tourniquet in situ. Through a longitudinal incision overlying the MCP joint, the long extensor tendon is identified. This is then released along both its radial and ulna aspects and freed from the underlying capsule. However, the tendon is often adherent and may have to be released by sharp dissection. Once free, the tendon is retracted and the dorsal capsule exposed. This is then released in a transverse fashion; the release being undertaken whilst the joint is manipulated into flexion (Fig. 12.13). At this stage, the articular surfaces of the MCP joint can be inspected. If there is significant damage, then joint replacement should be considered. The capsular release then continues down the radial and ulna aspects of the metacarpal head, including the collateral ligaments, until full flexion of the joint is obtained. At this stage it is important that the articular surfaces glide into flexion rather than hinges. For the latter, it may be that an additional volar plate release is required. Finally, if there is intrinsic tightness, the intrinsics should also be released.

For closure, the extensor tendon is realigned over the centre of the metacarpophalangeal joint and the capsule is left open. The skin is closed and the hand splinted in the safe position that is with the metacarpophalangeal joints flexed to 70–90°. Local anaesthetic infiltration into the wound and operative site is recommended.

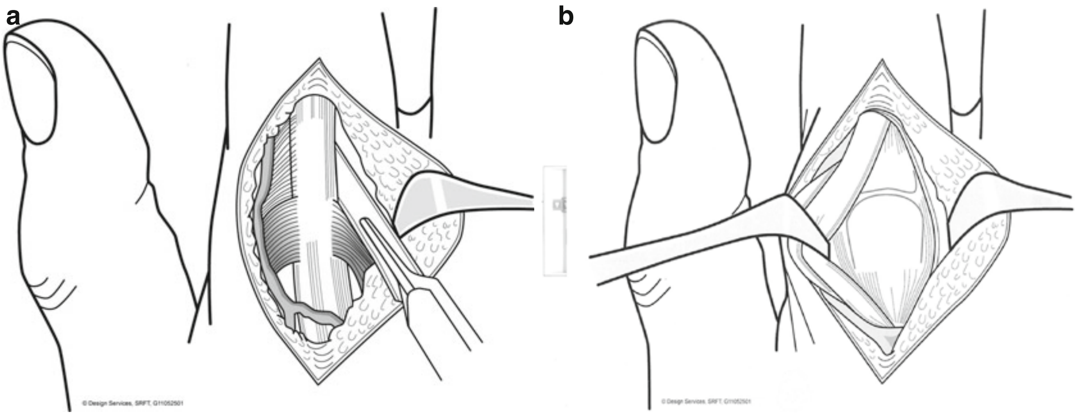

Fig. 12.13 Dorsal capsular release of the metacarpophalangeal joint

Hand Therapy Following MCP Dorsal Capsular Release

The patient should then begin gentle therapy at 1–2 days, with increased intensity after 5 days once the inflammatory reaction has settled. Tendon glide is vital, particularly for the extensors and intrinsic muscles, with differential glide of each tendon/muscle. The splint should be worn 24 h for the first 2–3 weeks with removal every 1–2 h for active and passive exercises, tendon glide and activity rehabilitation. Exercises carried out 10–15 min every 2 h are effective [57]. Intensive oedema and scar management is important. Early gains in ROM and tendon glide often reduce after 3–4 weeks as the scar tissue thickens and intensive rehabilitation in the hand therapy department and at home is needed. Resisted activities and exercises are incorporated as the wound heals and inflammation reduces after 3–4 weeks. Functional activities need to also be part of rehabilitation with blocking splints maximising the tissue and joint movement. A balance between maintaining flexion at the MCP joints and decreasing extensor lag needs to managed with stretch overnight and active tendon and tissue glide in the day.

Outcome

In 1974 Buch reported his results of MCP capsulotomy and on occasions supplemented by a skin graft [58]. Following a course of therapy he noted that a significant number of patients gained between 30 and 80° of flexion. Leroy Young et al., in a large series published in 1978, found that in the majority of patients the stiffness was due to collateral ligament tightness [59]. Following release and an intense course of therapy, they reported long term improvement with an average flexion of 48°; the best results being obtained in patients who sustained a closed fracture or a laceration.

More recently Rozmaryn and Wei (1999) [60] advocated that these releases could be undertaken arthroscopically [60].

Volar Release of the Proximal Interphalangeal Joint (PIP)

Again under either general or regional anaesthesia and with strict asepsis and a tourniquet in situ, the PIP joint is approached from the volar side. The usual skin incision would be a Brunner or zig-zag incorporating the flexor crease. Flaps are elevated and the flexor sheath identified. Both neurovascular bundles are identified and retracted. The flexor sheath is then incised transversally at the level of the PIP joint. This is between the A3 and A4 pulleys. The flexor tendons are then identified and inspected. If they are found to be in a satisfactory condition they are retracted, allowing the volar plate to be visualised. This is then released from the proximal phalanx at its insertion. This allows the plate to slide distally (Fig. 12.14).

If this is insufficient to correct the contracture then collateral ligament releases can be undertaken. Again these structures are released from

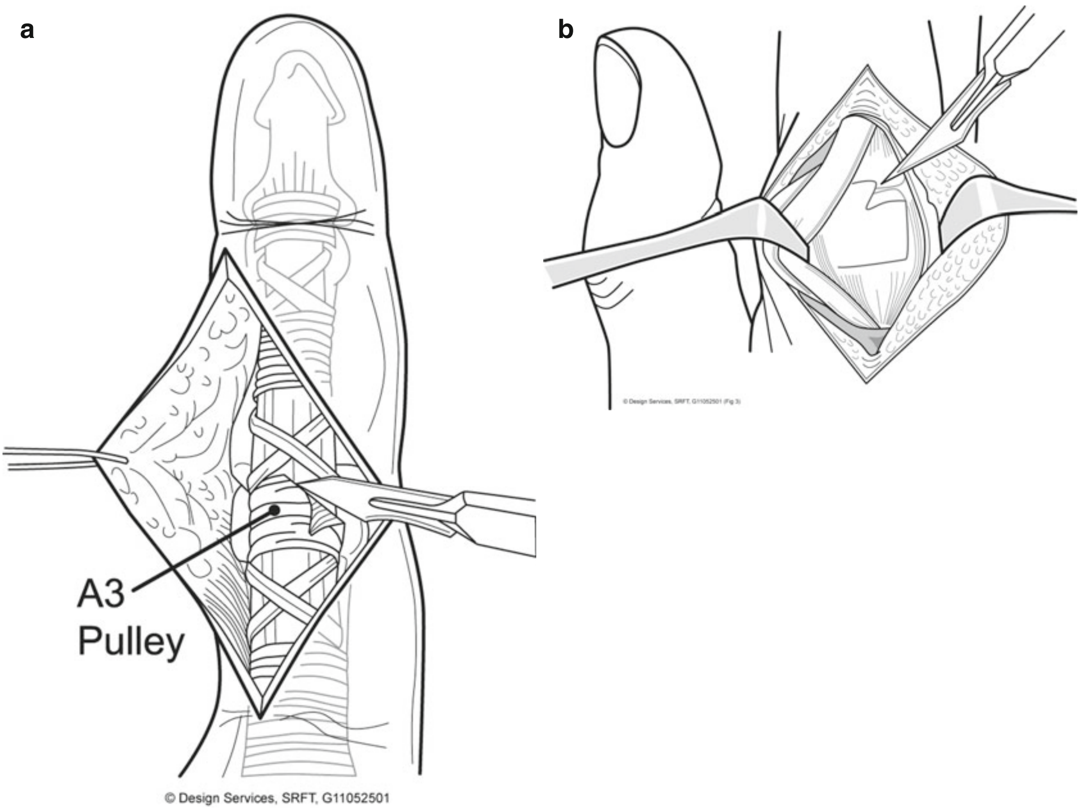

Fig. 12.14 Release of volar plate of proximal interphalangeal joint

their attachment to bone, usually at the proximal phalanx. The releases are aided by gentle manipulation. At this time it is usually possible to inspect the articular surfaces. Again, and as at the MCP joint, if they are badly damaged arthroplasty should be considered. Returning to the flexor tendons, if they are adherent they should also be released. Indeed, the flexor digitorum superificalis tendon can, if necessary, be excised. In addition it may be that following the correction the distal interphalangeal joint assumes a hyper-extended position, due to tightness of the lateral bands. If this is the case, these bands can be released through a separate dorsal incision over the middle phalanx.

At the end of this procedure, once haemostasis has been obtained, the wounds are closed and then infiltrated with a local anaesthetic. Usually it is possible to directly close the skin, however, if not, then an advancement flap can be utilized. For small defects however, it is perfectly acceptable to allow them to heal by primary intention. With the dressing in place, the hand is splinted with the PIP joint in extension.

Hand Therapy Following Volar Release of the PIP Joint

Therapy starts between 3 and 5 days, unless flexor tenolysis has been performed at the same time. Evans et al. (2002) [61] showed that wound tension and overly aggressive early therapy following PIPJ release post Dupuytren's faciectomy produced an increase in scar tissue and inflammatory response [61].

As for any capsular or joint release, splintage needs to be 24 h initially to maintain ROM gains, but removed 1–2 h for active and passive exercises, tendon glide and activity rehabilitation [57]. Saar and Grothaus (2000) [62] and Crowley and Tonkin (1999) [63] showed that longer periods of splinting PIPJ was more beneficial and that 3–6 months of serial or dynamic PIPJ splinting could gain extension beyond surgical gains [62, 63]. Clinical reasoning needs to balance flexion and tendon glide with joint extension gains and all modalities considered for capsular tightness.

Outcome

The results of surgery to release contractures of the proximal interphalangeal joint can be quite variable. It is for this reason that more often than not conservative treatment is recommended at least in the first instance. Published results also vary, both with regard to the exact technique undertaken but also the range of pathology. As a consequence, the scope of recommended procedures ranges from isolated percutaneous release of the accessory collateral ligament, (Stanley et al. 1986) [64], flexor tenolysis, extensive open excision of all supporting soft tissues and proximal skin release with grafting or flap cover [64]. Generally, however, a sequential approach, preferably under local anaesthetic, is advised, allowing the patient to actively move the finger during the procedure to assess progress. In most series a volar approach is utilized, although many authors have used a mid-lateral. Post-operatively, many surgeons also use a K-wire to fix a joint in extension for a short period of perhaps 2–3 weeks.

In 1979 Watson et al. reported successful results in a large series of 115 fingers with contractures of various aetiologies [65]. Around the same time, Young et al. (1978) [59], again in a large series, reported an average 42° improvement in movement following a sequential release of structures [59]. Gould et al. at the same time in a similar study also showed some improvement although not as marked [66]. More recently Ghidella et al. (2002) [67], in a longer term follow up, showed a more modest improvement, added to that 30 % of patients actually lost motion [67]. Finally, Manset and Delprat in 1992, in a series of 135 post-traumatic causes of PIP contracture, reported no significant improvement, indeed 14 % again had worsened [68].

In 1993 Diao and Eaton reported their results following the complete excision of scarred collateral ligaments for the treatment of contracture [69]. Added to this they also undertook distal palmar plate releases, extensor tenolysis and flexor sheath release. Following a course of therapy the average range of motion increased from 38 to 78°, with no instances of instability. They felt this more radical approach was justified. Brüser et al. in (1999) [70] compared mid-lateral to palmar approaches. Results were better in the former [70].

Finally Inoue (1991) [71] reported his results of lateral band release for an extension contracture of the proximal interphalangeal joint [71] Following surgical release of the lateral band from the central slip, flexion improved significantly.

In summary, whilst open release can lead to improved extension of the proximal interphalangeal joint, this can be at the cost of flexion. If, however, this shift in flexion/extension arc results in a more functional range, then obviously this will be beneficial to the patient.

External Fixators

As with splinting and serial casting, external fixation can be used to correct contractures across the proximal interphalangeal joint. At this time, there are a number of commercial devices in use, although unfortunately there are few independent published reports on their efficacy. A number of case series have reported favourable results although numbers are small.

Conclusions/Personal View

Normal motion of any joint requires normal bony alignment, intact articular surfaces, unimpeded tendon gliding and integrity of the surrounding soft tissues, particularly the collateral ligaments and the volar plate. A deficiency in any one or all of these can lead to contracture and/or deformity. In most cases this can be prevented by appropriate splintage, surgery and early mobilization. In established cases, however, initial treatment should be non-operative, using intensive therapy incorporating a wide range of modalities related to the specific tissues involved, often over many months. Many patients will gain an acceptance of functional range and return to maximal functional activities. Only if this is unsuccessful should surgery be considered.

For those who do not gain sufficient functional range, therapy will include careful pre-operative patient assessment and education regarding prognosis and benefits to ensure realistic patient expectations. Patient satisfaction often relates more to achieving an expectation than to a specific ROM or outcome measure. An intensive therapy and home programme, over 4–6 months, will maximise outcomes, with ongoing motivation being vital. In most instances results indicate that it is possible to improve range of motion or at the very least make the hand more functional.

Clinical Pearl

While all patients with contracture benefit from the attention of therapy, the role of surgical intervention is not always clear. The surgery itself may inflict further trauma to an injured area and can result in otherwise normal tissues being damaged. As a consequence, therefore, the surgeon must balance the relative benefits and risks of intervention.

Acknowledgements NES Hand Therapy Training for hand therapy input

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