Non-Ischemic Contractures of the Intrinsic Muscles of the Hand*

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The mobility, strength, and versatility of the fingers depend on the integrated action of the intrinsic muscles with the long flexors and extensors of the fingers. If the intrinsic mechanism becomes contracted or adherent, the digits may stiffen, deform, or dislocate.

Ischemic contracture of the interossei was first described by Finochietto in 1920. Finochietto and later Parkes 96, Bunnell, Doherty, and Curtis 9.10, and others described the intrinsic-plus deformities consisting of metacarpophalangeal joint flexion and interphalangeal joint extension which are typically seen in patients with ischemic contracture of the intrinsic muscles of the hand. The intrinsic tightness test—limited flexion of the proximal interphalangeal joint as the metacarpophalangeal joint is extended—was noted in these injured hands and was also described by these authors.

There are, however, many causes for contracture of the intrinsic mechanism other than ischemia 21,31,51,52 and in this paper these causes will be surveyed, with examples given of each, together with a plan for their diagnosis and treatment. The location and nature of the resulting deformity will depend on the cause of the contracture, its duration, and the integrity of the joints in the affected fingers. The treatment of these contractures will differ depending on these variables.

Types of Intrinsic Contracture

Displacement of the Lateral Band

The lateral bands of the dorsal apparatus (Fig. 1) lie adjacent to the proximal

![Diagram of the intrinsic apparatus of the finger](https://via.placeholder.com/150)

Diagrammatic representation of the intrinsic apparatus of the finger: A, extensor digitorum communis; B, sagittal band of extensor digitorum communis; C, transverse fibers of dorsal apparatus; D, lateral slip; E, central slip; F, terminal tendon; G, oblique retinacular ligament; H, lateral band; I, oblique (spiral) fibers of dorsal apparatus; J, fibrous flexor sheath; K, lumbrical tendon; L, interosseous muscle.


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phalanx. Any projection of bone or soft tissue deep to the lateral band may displace it dorsally or laterally. The extensor apparatus distal to the projection of bone or soft tissue will tighten. Flexion at the proximal interphalangeal joint will be limited when the metacarpophalangeal joint is held in extension. Displacement and tightening of the lateral band has been caused by fractures of the proximal phalanx, tophaceous gout, and deep soft-tissue tumors of the proximal phalanx. To release the contracture the mass is removed. If the intrinsic tightness test remains positive during surgery, after the tumor has been removed, the lateral band must be resected on the side of the tumor.

CASE 1. A thirty-three-year-old police officer sustained a closed oblique fracture of the proximal phalanx of his right ring finger. The finger was splinted for three weeks and healed with a small bone projection radially. The patient complained of limited flexion at the proximal interphalangeal joint. The intrinsic tightness test was positive. Exploration revealed the radial lateral band to be displaced dorsal to the bone spike. The projection was removed and full motion was restored (Fig. 2).

The lateral band of the dorsal apparatus is displaced by projection of bone or soft tissue at the lateral side of the proximal phalanx. The dorsal apparatus distal to this mass is tightened, limiting passive proximal interphalangeal joint flexion.

The Lumbrical-Plus Finger

The flexor digitorum profundus and the lumbrical form an integrated unit structure which bifurcates in the distal part of the palm. The entire unit is pulled proximally as the profundus muscle contracts. Normally when the finger flexes the lumbrical muscle relaxes and elongates as the profundus contracts. The radial lateral band is thereby relaxed, permitting full flexion of the interphalangeal joints. When the finger extends, contraction of the lumbrical tightens the lateral band and simultaneously pulls the profundus tendon distally. Thus, the unique origin of the lumbrical on its own antagonist places it in a superb mechanical position to serve as the "work horse of the extensor apparatus." As Parkes noted, various types of injury to the profundus tendon or to the lumbrical muscle can upset this balance, resulting in limited flexion at the proximal interphalangeal joint.

Lumbrical Retraction

The tendon of the flexor digitorum profundus will retract proximally if the distal phalanx is amputated or if the tendon is avulsed or lacerated within the hand. If the laceration or avulsion of the profundus tendon occurs within the finger and therefore distal to the origin of the lumbrical, the lumbrical muscle will be pulled proximally by the retracted profundus tendon (Fig. 3, A). Retraction of the profundus may be somewhat limited by the vinculae which tether its tendon to the proximal and middle phalanges. Nonetheless, retraction of the lumbrical will increase the tension on the radial lateral band. The intrinsic tightness test will be positive. If the integrity of the profundus is restored promptly by suture, advancement, or graft of the tendon, the lumbrical origin will be drawn distally, allowing it to relax in normal fashion, and digital balance will be regained. Frequently, after many weeks or months following injury, the radial lateral band may become adherent to adjacent tissues and thus it will not loosen even after appropriate surgery to the profundus tendon. In these cases,
the lateral band may be divided to the projection of bone or soft tissue anterior to the mass is tightened. An integrated unit structure. The entire unit is pulled proximally when the finger flexes the interphalangeal joints. The radial lateral band and simultaneous origin of the lumbral muscle position to serve as the ideal for three weeks and healed. Full tensile strength in the finger and of stiffness when he attempted to flex the proximal interphalangeal joint. Tenodesis of the profundus stump was performed at the distal joint. In addition, the radial lateral band was divided at the distal half of the proximal phalanx to restore full passive motion to the proximal interphalangeal joint (Figs. 4-A and 4-B).

A tightened radial lateral band caused by lumbral retraction can occur following: a, flexor profundus laceration, b, loose tendon grafts, or c, tight imbrication of the lumbral muscle tendon suture.

Case 3. A thirty-one-year-old man had had lacerations of the tendons of the flexor digitorum profundus and superficialis of the little finger ten days previously. There was limitation of passive flexion at the proximal interphalangeal joint when the metacarpophalangeal joint was held extended. At surgery, full passive motion was restored to the proximal interphalangeal and when the lacerated flexor profundus tendon was pulled distally (Figs. 5-A and 5-B).

Case 4. Several months following amputation at the neck of the middle phalanx of the index finger, a twenty-one-year-old student complained of limited flexion of the proximal interphalangeal joint. The joint flexed 45 degrees passively when the metacarpophalangeal joint was extended and 100 degrees when it was flexed. At surgery, the radial lateral band was divided, releasing the pull of the retracted lumbral muscle on the proximal interphalangeal joint. Full motion was restored (Figs. 6-A and 6-B).

Lumbral-Plus after a Loosely Inserted Tendon Graft

If a flexor tendon graft is inserted too loosely, the profundus-lumbral unit is imbalanced. When the patient attempts to flex the interphalangeal joints of the injured finger, contraction of the profundus muscle belly will be transmitted to the radial lateral band rather than to the graft (Fig. 3,B). The metacarpophalangeal joint will actively flex; the interphalangeal joints will extend. Either the tendon graft must be shortened or the radial lateral band resected.
Fig. 4-A: Following laceration of the flexor profundus tendon in the finger, there is limitation of passive proximal interphalangeal joint flexion when the metacarpophalangeal joint is hyperextended.

Fig. 4-B: The radial lateral band is transected at the neck of the proximal phalanx allowing full passive proximal interphalangeal joint flexion.

Contracture of the Lumbrical following its Imbrication about a Palmar Tendon Suture Line with Tendon Grafts

In performing a tendon graft, the lumbrical muscle is often imbricated about the palmar tendon suture line so as to prevent adhesions of the graft to the skin and adjacent tendons. However, if the lumbrical muscle belly is sutured too tightly, its fibers may become fibrotic and contracted. If care is not taken to advance the lumbrical distally at the time of its imbrication, there will be increased tension on the radial lateral band (Fig. 3,C). In either case, the radial lateral band may be resected to restore proximal interphalangeal joint flexion.

Intrinsic Contracture following Tendon Transfer and Tenodesis

Many methods of tenodesis and tendon transfer have been recommended for the treatment of the paralytic claw hand. The transferred tendon is passed volar to the deep transverse metacarpal ligament and sutured to a lateral band in each of the clawed fingers. With each of these procedures, there is a potential risk of overcorrecting the deformity and creating an intrinsic-plus hand.

Laceration of flexor digitorum profundus and superficialis. Proximal traction on the extensor profundus, as would occur with active attempts at interphalangeal joint flexion, pulls the lumbrical proximally and limits passive proximal interphalangeal joint flexion.
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FIG. 4-B

In the finger, there is limitation carpophalangeal joint is hypermobile, the proximal phalanx allowing motion about a Palmar Tendon

is often imbricated about of the graft to the skin and is sutured too tightly, it is often to advance the lumbral-based tension on the radial and may be resected to re-imbricated.

FIG. 5-B

When the profundus tendon is pulled distally, relaxing the lumbral, passive proximal interphalangeal joint flexion is increased.

FIG. 6-A

After an amputation through the neck of the middle phalanx of the index finger there is limited proximal interphalangeal joint flexion when the metacarpophalangeal joint is held extended.

FIG. 6-B

When the metacarpophalangeal joint is flexed, relaxing the retracted lumbral, there is full proximal interphalangeal joint flexion.

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A fifteen-year-old boy with Charcot-Marie-Tooth disease had clawing of the index finger due to intrinsic-muscle weakness.

Six months after transfer of flexor superficialis to the lateral band the patient is unable to flex the proximal interphalangeal joint. The clawed finger has been overcorrected.

The incidence of overcorrection and swan-neck deformity is probably greatest following the Bunnell superficialis tendon transfer, particularly in patients with marked laxity of the proximal interphalangeal joints. Overcorrection often may be avoided by transferring one superficialis tendon to several fingers. However, if hyperextension of the proximal interphalangeal joint does develop after tenodesis or tendon transfer for a claw hand, the intrinsic contracture may be corrected by transecting the lateral band just distal to the site of tendon suture and proximal to the proximal interphalangeal joint. The transferred tendon will then act through the transverse fibers of the dorsal apparatus (Fig. 1C) to flex the metacarpophalangeal joint and thus prevent metacarpophalangeal-joint hyperextension. The transferred tendon will serve as an active metacarpophalangeal joint knuckle bender. With hyperextension of the metacarpophalangeal joint prevented, the central slip of the common extensor tendon (Fig. 1E) will be able to extend the proximal interphalangeal joint 2.

Case 5. A fifteen-year-old boy with Charcot-Marie-Tooth disease had severe weakness of the intrinsic muscles of the index finger. The metacarpophalangeal joint hyperextended; the proximal interphalangeal joint had limited active extension. At surgery the superficialis tendon of the index finger was transferred to the radial lateral band after the method of Bunnell. Overcorrection resulted, and he was unable to flex the proximal interphalangeal joint postoperatively. Six months later, under local anesthesia, the lateral band was transected just distal to the site of tendon transfer, restoring flexion of the interphalangeal joint (Figs. 7-A through 7-D).
NON-ISCHEMIC CONTRACTURES OF THE INTRINSIC MUSCLES

The radial lateral band is transected just distal to the site of tendon transfer. Twenty degrees of full extension has been lost.

Flexion now is possible to 80 degrees.

Transfer of the tendon of the first dorsal interosseous muscle to the radial side of the long finger has been recommended to increase the power of pinch following amputation of the index ray. If the transferred tendon is inserted to the base of the proximal phalanx, radial abduction of the long finger is strengthened. However, if the tendon is sutured to the radial lateral band of the long finger, flexion of the proximal interphalangeal joint may be limited. Its motions may be restored either by detaching the transferred tendon or by dividing the radial lateral band distal to the level of the tendon suture.

**Intrinsic Contracture Following Edema of the Hand**

**Intrinsic Contracture without Swan-Neck Deformity Following Edema**

Edema following fractures or blunt trauma about the hand and wrist is among the more common causes of contracture of the intrinsic muscles of the hand. Some restriction of motion of the interphalangeal joints is expected during the early post-traumatic period, due to edema within the joints and para-articular tissues. As the edema subsides, the patient may continue to notice the restriction. The true nature of the intrinsic contracture may be overlooked and the finger stiffness may be misdiag-
nosed as residual synovitis. The nature of the intrinsic contracture may vary, but it is usually the result of fibrosis or adhesions about the interosseus muscles or their tendons. If the extensor apparatus is not adherent to the proximal phalanx, the intrinsic tightness test is positive. The lateral bands and oblique fibers to each side of the involved fingers are excised (Fig. 1, H and I) and passive motion is encouraged immediately postoperatively. In these cases it is unnecessary and probably unwise to transect the transverse fibers of the dorsal apparatus (Fig. 1, C) which serve to flex the metacarpophalangeal joint.

CASE 6. A fifty-four-year-old beautician noted continued stiffness of the proximal interphalangeal joints of all fingers eight months after treatment for a Colles fracture. The intrinsic tightness test was positive. The lateral bands and oblique fibers of the four fingers were resected (Fig. 8). Full motion was restored.

![Intrinsic Contracture with Swan-Neck Deformity Following Edema](image)

Eight months after closed reduction for Colles' fracture, a fifty-four-year-old woman noted continued stiffness of the proximal interphalangeal joints of the fingers. At surgery, the lateral bands and their oblique fibers were excised at both sides of each finger. (As shown here, just the radial side has been operated on). Two months after operation there was excellent joint motion.

Intrinsic Contracture with Swan-Neck Deformity Following Edema

At the metacarpophalangeal joints of the fingers, the collateral ligaments (metacarpophalangeal ligaments) are dorsal to the axes of joint motion. The collateral ligaments are thus stretched with flexion of the joints, and relaxed with extension.
The structure of the proximal interphalangeal joints, however, does not follow the same pattern. The shape of the head of the proximal phalanx is such that the collateral ligaments are stretched to a maximum with mild flexion of the proximal interphalangeal joint. With long-standing contracture of the intrinsic muscles, the middle phalanx gradually assumes a position of hyperextension. In this position the more dorsal fibers of the collateral ligaments adapt to their shortened position and contract. The volar plate is stretched. The intrinsic tightness test frequently cannot be evaluated accurately because secondary contracture of the collateral ligaments does not permit flexion of the proximal interphalangeal joint. In these cases, release of the lateral bands alone will not correct the deformity. After release of the intrinsic tendon, the middle phalanx will snap from hyperextension to acute flexion as it is drawn dorsally and volarly over the head of the proximal phalanx. In addition to release of the insertion of the intrinsic muscle, the collateral ligaments of the proximal interphalangeal joint must be excised.

To prevent recurrent hyperextension deformity after capsulotomy and intrinsic release and to stabilize both the lateral and the volar sides of the proximal interphalangeal joint, Littler has recommended tenodesis of the lateral band volar to the axis of motion of the proximal interphalangeal joint. The lateral band is transected at the proximal third of the proximal phalanx (Fig. 1, C) and is separated medially from the central slip and triangular ligaments to the distal end of the middle phalanx. It is then rerouted volar to the axis of motion of the proximal interphalangeal joint volar to Cleland's ligament (Fig. 9). The tendon is then sutured to the fibrous flexor-
This patient with rheumatoid disease of both hands is attempting to flex all fingers. All four fingers of the right hand and the index finger of the left hand are dislocated at the metacarpophalangeal joints. The dislocation relaxes the interosseus tendons, allowing proximal interphalangeal joint flexion. The ulnar three fingers of the left hand are not dislocated at the metacarpophalangeal joints. The intrinsic mechanism remains tight and she is unable to flex the proximal interphalangeal joints.

tendon sheath opposite the base of the proximal phalanx so as to hold the proximal interphalangeal joint in about 30 degrees of flexion. The transferred and tenodesed lateral band thus has a course and function similar to the oblique retinacular ligament (Fig. 1G). Flexion exercises are begun immediately postoperatively. Full proximal interphalangeal joint extension is prevented by the use of a dorsal splint for four to six weeks.

Case 7. A fifty-one-year-old man twisted his right hand in the steering wheel of a car one year previously. There were neither fractures nor dislocations but the hand became quite swollen and swan-neck deformities gradually developed in the long and ring fingers. All fingers had limited proximal interphalangeal joint flexion when the metacarpophalangeal joints were held extended (positive intrinsic tightness test). There was full metacarpophalangeal joint motion. The lateral bands and oblique fibers (Fig. 1H and I) at each side of the index and little fingers.

Fig. 11-A: There are swan-neck deformities at the proximal interphalangeal joints of each of the fingers in this sixty-two-year-old woman with rheumatoid arthritis.

Fig. 11-B: Flexion occurs only at the metacarpophalangeal and distal interphalangeal joints. There are fixed extension contractures at the proximal interphalangeal joints.

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...flex all fingers. All four fingers were located at the metacarpophalangeal joints; the ring finger was dislocated at the metacarpophalangeal joint; the little finger was unable to flex the proximal interphalangeal joint. Full flexion was restored.

Roentgenograms of both hands reveal the deformities at the proximal interphalangeal joints. There is no metacarpophalangeal-joint subluxation or gross destruction of the joint surfaces.

The index and little fingers were resected. In the long and ring fingers, the collateral ligaments of the proximal and distal interphalangeal joints and the ulnar collateral ligaments of the metacarpophalangeal joint were resected. The radial collateral ligaments were transferred volar to Cleland's ligament and tenodesed to the fibrous flexor sheath. Full flexion was restored.

A 30-degree flexion contracture of the proximal interphalangeal joints of the tenodesed long and ring fingers persisted.

**Intertosseus Spasticity**

Cerebral palsy, cerebrovascular accidents, Parkinson's disease, encephalitis, and various other upper motor neuron lesions all may cause spasticity of the interosseus muscles. The total management of these patients is complex. Complete neurological and medical evaluation of the patient, analysis of his needs, of the sensibility of his hand, and of the status of the extrinsic muscles all must be thoroughly considered prior to any surgery. In properly selected cases, however, correction of the deformities and improved function may be achieved by tenotomy of the lateral bands, tenodesis of the lateral bands, or tenodesis of the superficialis tendon across the proximal interphalangeal joint. If there is deformity at both the proximal interphalangeal and metacarpophalangeal joints, surgical release must be performed proximal to the metacarpophalangeal joint. Intertosseus tenotomy at the metacarpal neck or ulnar neuroectomy may lead to overcorrection and postoperative clawing by completely eliminating interosseus muscle function. Stripping the interosseus muscles from their metacarpal origin and allowing them to slide distally was proposed by Bunnell for interosseus muscles damaged by ischemia but still functioning. This procedure has been found useful in some cases of interosseus muscle spasticity. By recessing the origins of the interosseus muscles distally, the force of these muscles on both the metacarpophalangeal and proximal interphalangeal joints is lessened but not eliminated. The deformity may thus be corrected without total loss of interosseus muscle action.

**Case 8.** A fifty-four-year-old housewife had undergone surgery for a cerebral aneurysm ten years previously. She remained with a left spastic hemiplegia. Sensation to the left hand was good. The fingers were held flexed at the metacarpophalangeal joints and hyperextended at the proximal interphalangeal joints. Function was most awkward in that she was unable to sufficient...
Through an ulnar digital incision the lateral bands are seen to be dislocated dorsally.

The ulnar lateral band is separated from the central slip and triangular ligament, transferred volarward to Cleland's ligament, and sutured to the fibrous sheath.

ly open the hand at the metacarpophalangeal joints to get larger objects within her palm. She also had difficulty in curling her fingers at the interphalangeal joints for grasp, once an object was in her palm. The hand was virtually useless. The intrinsic tightness test was negative. An ulnar nerve block at the wrist resulted in significant but temporary improvement of the deformity. At surgery, the interosseous muscles were dissected from the metacarpal shafts subperiostially. The hand was splinted in a clawed position for two weeks. Postoperatively, both the function and appearance of the hand were improved.

**Rheumatoid Intrinsic Contractures**

Intrinsic muscle tightness has long been noted in many rheumatoid hands. The causes are unclear. Bywaters noted perivascular infiltration within the interossei which suggested inflammatory spasm of these muscles. Kestler noted fibrosis and increased collagenization in the interosseus muscle fibers. Brewerton stated that in those rheumatoid patients with intrinsic-plus deformities, spasm accounts for the interosseus shortening in the first three years of the disease, and thereafter these muscles become fibrotic.

Although Amick and others were unable to find electromyographic
The radial lateral band is transected along with its oblique fibers. The transverse fibers of the ulnar lateral band are also sectioned. The finger immediately adopts a more natural position at both the metacarpophalangeal and interphalangeal joints. The flexion deformity at the distal interphalangeal joints is also corrected by the lateral band tenodesis.

Flexion compared in the right hand (operated on) and the left hand (not operated on). Both hands were symmetrically involved preoperatively.

Evidence of spontaneous activity in the interossei of rheumatoid hands, electromyographic and histological changes have been noted in these muscles by several workers. Boyes had suggested that intrinsic muscle changes in the rheumatoid hand may be secondary to the deformity of the metacarpophalangeal joints. Brewerton noted intrinsic muscle contracture of the hand in 13 per cent of 300 ambulatory patients with rheumatoid disease whom he examined, and in 48 per cent of all those with ulnar deviation.

The location and severity of the intrinsic tightness in the rheumatoid hand is most variable. It may be dependent on the age of the patient, the duration and severity of the disease, the integrity or degree of destruction of the joint capsule and articular surfaces of the involved hand, or on the use of the hand. Atrophy of the interossei, however, appears to bear no relationship to the deformities.

Several points regarding the metacarpophalangeal joints of the fingers in the rheumatoid hand bear emphasis:
1. If there is any imbalance of forces in the sagittal plane of the metacarpophalangeal joint the predominant force is directed volarward. 
2. The proximal phalanx will not dislocate or subluxate dorsally in the normal course of the disease.
3. Synovitis within the metacarpophalangeal joint may weaken the collateral ligaments and decrease their stabilizing effect on the proximal phalanx, thus a volar force at the joint would tend to cause subluxation of the proximal phalanx toward the palm rather than flexion about an axis of rotation.
4. The interosseus muscle to the ulnar side of each finger is usually tighter than that to the radial side of the finger.

Rheumatoid intrinsic contractures of the fingers may be classified as follows:

**Limited Flexion of the Proximal Interphalangeal Joint with Extension of the Metacarpophalangeal Joint; No Deformity**

This is the mildest type of rheumatoid intrinsic contracture and clinically appears similar to the early non-rheumatoid intrinsic contracture. The treatment, however, is somewhat different. The lateral band to the ulnar side of each finger is excised along with the oblique and transverse fibers (Fig. 1, H, I, and C). The transverse fibers are excised in order to decrease the probability of volar subluxation of the metacarpophalangeal joints later in the course of the disease. Riordan and Harris have warned against excising these fibers in the non-rheumatoid hand for fear of subsequent hyperextension deformity at the metacarpophalangeal joints. This precaution appears unnecessary in the rheumatoid hand, since the resultant of forces at this joint is directed volarward.

**Hyperextension Contracture of the Proximal Interphalangeal Joint; No Metacarpophalangeal-Joint Changes**

In the rheumatoid hand, if stability at the metacarpophalangeal joint has been weakened by synovitis and collateral ligament attenuation, the proximal phalanx will respond to a volar-directed force by subluxating rather than flexing about an axis of motion. If the joint dislocates completely, the proximal phalanx will also tend to migrate proximally. With proximal displacement of the finger, the interosseus muscles are relaxed, and proximal interphalangeal joint motion is usually preserved. If, however, the metacarpophalangeal joints remain stable and do not subluxate, the force of any intrinsic-muscle contraction will be transmitted to the proximal interphalangeal joint, which may then gradually hyperextend into a swan-neck deformity (Fig. 10).

In these cases, surgery at the proximal interphalangeal joint requires release of both lateral bands, capsulectomy, and tenodesis as in intrinsic contracture with swan-neck deformity following edema of the hand. At the metacarpophalangeal joints, the transverse fibers of the intrinsic apparatus (Fig. 1, C) should be sectioned to prevent volar subluxation as described in the section immediately previous (Figs. 11-A through 11-G).

**Volar Subluxation of the Metacarpophalangeal Joint Without Ulnar Deviation**

To rebalance the forces about the dislocated metacarpophalangeal joint in the rheumatoid hand, a diminished volar-directed force at the base of the proximal phalanx is required. Generous resection of the metacarpal head in performing arthroplasty will usually relax the interossei and lumbricals by shortening the distances from their origins to their insertions. However, if a prosthesis is inserted after metacarpal-head resection, the width of the prosthesis between the bone ends may sufficiently stretch the contracted intrinsic muscles to require their release.

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ittal plane of the metacarpophalangeal joint. If both lateral bands are resected, extension of the interphalangeal joints is possible only through contraction of the extensor digitorum communis. In the rheumatoid hand, the tendon of the extensor digitorum communis may often be ruptured or dislocated. Reconstruction of the rheumatoid hand may require either repair or relocation of the extensor tendon. Occasionally, the surgeon may tenodese the extensor tendon to the base of the proximal phalanx. Under these circumstances, one lateral band must be allowed to remain intact in order to provide interphalangeal joint extension. Since the ulnar interosseus is usually tighter than the interosseus to the radial side of the finger, the ulnar interosseus tendons are excised proximal to the metacarpophalangeal joint. If the proximal interphalangeal joint is hyperextended, the ulnar lateral band is tenodesed as in hyperextension contracture in the previous section.

**Joint with Extension of the Interphalangeal Joints**

There are type and clinically apparent contracture. The treatment of the ulnar side of each finger is as follows: 1. With ulnar deviation and volar subluxation of the rheumatoid hand, the ulnar interossei are tighter than those to the radial side. 

**Volar Subluxation of the Metacarpophalangeal Joint With Ulnar Deviation**

Volar dislocation of the proximal phalanx in the rheumatoid hand is most frequently accompanied by ulnar deviation. The imbalance of forces about the joint is in both the sagittal and frontal planes. It is unclear whether the intrinsic contractures contribute to, or result from, these deformities. There is no doubt, however, that intrinsic-muscle contractures constitute but one abnormality about a joint which may also exhibit abnormalities of bone, synovium, ligaments, and extrinsic tendons. As previously noted, the proximal interphalangeal joint may not be affected by the intrinsic contracture when the proximal phalanx is dislocated and the interosseous and lumbrical muscles thereby relaxed. With surgical relocation of the proximal phalanx, however, the intrinsic muscles are stretched and limited flexion at the proximal interphalangeal joint ensues.

In an attempt to rebalance the forces about the ulnar-deviated and dislocated metacarpophalangeal joint, a radially directed force (or ulnar force in the infrequent event of radial deviation) can be added by means of the crossed intrinsic transfer. The tendons of the interossei to the ulnar sides of the index, long, and ring fingers are transected at the proximal phalanx and the proximal ends are transferred to the radial side of the base of the proximal phalanx of the adjacent finger.
Fig. 13-A: Preoperative photograph of a rheumatoid hand with ulnar deviation and volar dislocation of the metacarpophalangeal joints and ulnar intrinsic tightness.

Figs. 13-B and 13-C: The crossed intrinsic transfer has been performed at the second and third and fourth webs. Other reconstructive procedures were performed at the metacarpophalangeal joints, including synovectomy, extensor-tendon relocation, and ulnar collateral-ligament resection. The postoperative appearance and function of the hand were greatly improved.

ferred to the radial side of the adjacent finger. Flatt advised that the transferred interosseus tendon should be sutured to the base of the proximal phalanx midway between the volar and dorsal aspects. The tendons of the flexor digiti quinti and abductor digiti quinti are transected but not transferred (Figs. 12-A and 12-B).

It is difficult to be certain that correction of the ulnar deviation in patients undergoing crossed intrinsic transfer (usually with arthroplasty) is due to actively contracting transferred interosseus muscles. In the reconstruction of these deformed hands, arthroplasty, relocation of the extensor tendons, and shortening of the metacarpals may contribute to the correction of the deformity. Postoperatively, however, many patients exhibit strong active radial deviation at the metacarpophalangeal
Fro. 13-B

th ulnar deviation and volar tightness, performed at the second and third metacarpophalangeal joints operatively, however, the metacarpophalangeal ligament is greatly improved.

Fractures or tumors at proximal phalanx

Positive

Proximal interphalangeal

Remove tumor or bone spicules; resect oblique fibers and lateral band on side of mass, if necessary

FLEXOR PROFUNDUS LACERATION

Positive

Proximal interphalangeal

Resect oblique fibers and lateral band on radial side of proximal phalanx

Proximal contraction transmitted through lumbrical

Lumbrical fibrosis

Positive

Proximal interphalangeal

Resect oblique fibers and lateral band on radial side of proximal phalanx or tighten graft

Excessive tightness tendon transfer or tenodesis

Positive

Proximal interphalangeal (occasionally metacarpophalangeal)

Resect oblique fibers and lateral band on radial side of proximal phalanx

FRACTURES, BLUNT TRAUMA OR TIGHT DRESSINGS

Positive

Proximal interphalangeal

Resect oblique fibers and lateral band on radial side of proximal phalanx

Upper motor neuron lesions

May be positive or negative

Proximal interphalangeal

Distal interosseous slide with or without proximal interphalangeal joint tenodesis

RHEUMATOID ARTHRITIS

Positive

Proximal interphalangeal

Resect lateral band, transverse and oblique fibers both sides of finger

RHEUMATOID ARTHRITIS

Usually negative

Proximal interphalangeal

Resect lateral band, transverse and oblique fibers both sides of finger

VOLAR SUBLUXATION, METACARPOPHALANGEAL JOINT; NO ULNAR DEVIATION

Rheumatoid arthritis

Positive

Metacarpophalangeal (proximal interphalangeal)

Resection arthroplasty or prosthetic arthroplasty metacarpophalangeal joint with resection ulnar lateral band at metacarpophalangeal joint (lateral band tenodesis and proximal interphalangeal capsulodectomy with swan neck)

RHEUMATOID ARTHRITIS

Positive (negative if swan-neck deformity at proximal interphalangeal joint)

Metacarpophalangeal (proximal interphalangeal)

CROSSED INTRINSIC TRANSFER (also ulnar lateral band tenodesis and proximal interphalangeal capsulodectomy with swan neck)

Non-ischemic contractures of the intrinsic muscles of the hand

Increased tension on the lateral bands of the fingers may affect the inter-

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phalangeal joints, the metacarpophalangeal joints, or both. The resulting stiffness or deformity of the fingers has been termed intrinsic contracture. Frequently, however, with intrinsic contracture neither the lumbricals nor the interossei exhibit evidence of pathological change. Such imbalance of forces within the fingers may follow displacement of the lateral band, injury to the tendon of the flexor digitorum profundus, spasticity of the interossei, or tendon transfers to the lateral bands. To call these cases examples of intrinsic contracture is thus a misnomer. The term is well established, however, and is justified if it is assumed to describe a clinical entity where the forces of the intrinsic mechanism of the finger overbalance those of the extrinsic muscles.

In the past, ischemia of the interosseus muscle has been noted as a cause of intrinsic-muscle contractures. Many other causes of imbalance have been described. The effects of the imbalance will depend on the integrity of the metacarpophalangeal and interphalangeal joints, the cause of the contracture, and its duration. Restoration of function may involve resection of the ulnar or radial lateral bands, excision of the oblique or transverse fibers of the dorsal apparatus, lateral band tenodesis, interosseous tendon division or transfer, capsulectomy or arthroplasty.

A plan for the diagnosis and the treatment of these deformities has been presented (Table I).

References

The resulting stiffness in the fingers may follow: flexor digitorum profundus; lateral bands; Toor, The term is well known, and the clinical entity is well recognized.

In noting a cause of these have been described: metacarpophalangeal joint duration. Reattachment of several bands, excision of bands, tenodesis, interossei.


AND JOINT SURGERY.