Treating the Proximal Interphalangeal Joint in Swan Neck and Boutonniere Deformities

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KEYWORDS

• Boutonniere • Swan neck • RA • Central slip • Lateral bands

KEY POINTS

- Proper preoperative assessment of active and passive distal interphalangeal (DIP), proximal interphalangeal (PIP), and metacarpophalangeal (MP) joint motion is critical to treatment of PIP joint injuries.
- Radiographs are important to identify underlying arthritis.
- Multiple soft tissue procedures exist for the treatment of swan neck and boutonniere deformities.
- Soft tissue procedures will not be successful in restoring active joint motion if passive joint motion is not present.
- Before surgery, patients should be counseled on the likelihood of incomplete correction and recurrence of PIP joint deformities.

The proximal interphalangeal (PIP) joint is a hinge joint stabilized by collateral ligaments on its radial and ulnar aspect, the volar plate on its ventral surface, and the central slip and lateral bands of the extensor mechanism dorsally.[1] The multiple stabilizing structures of the joint allow for flexion and extension only, without radial or ulnar deviation or circumduction about the joint. In most patients, there is minimal hyperextension at the PIP joint but flexion to approximately 100°. Disruption of the delicate balance of flexion and extension forces on the PIP joint can result in deformity over time. Although flexion and extension at the PIP and distal interphalangeal (DIP) joints are closely linked, here the authors focus on management of the PIP joint in swan neck and boutonniere deformities.

SWAN NECK DEFORMITIES

Introduction: Nature of the Problem

A swan neck deformity refers to a DIP joint in flexion with a PIP joint in hyperextension (**Fig. 1**). There are 3 primary causes of swan neck deformities: trauma, rheumatoid arthritis (RA), and cerebral palsy (CP). The deformity can originate at the metacarpophalangeal (MP) joint, the PIP joint, or the DIP joint. Swan neck deformities can be aesthetically unpleasing, but, more importantly, they can lead to difficulty initiating functional grasp as the patient attempts to overcome hyperextension at the PIP joint.

In 1979, Zancolli[2] classified traumatic swan neck deformities into 3 categories: extrinsic,

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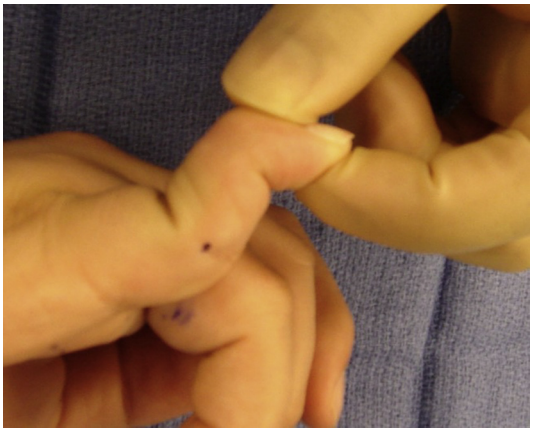

Fig. 1. Small finger swan neck deformity. A hyperextension deformity at the PIP joint and flexion deformity at the DIP joint are seen.

intrinsic, and articular. Extrinsic causes include disruption of the terminal tendon (mallet deformity) and wrist or MP flexion contractures. Intrinsic causes are chronic MP joint volar subluxation, ischemic contracture, and tendon adhesions. Articular causes include disruption of the flexor digitorum superficialis (FDS) or a volar plate/capsule injury.

Extrinsic causes result in a swan neck deformity due to extension forces on the middle phalanx. For example, a mallet finger injury results in disruption of the terminal tendon and flexion of the DIP joint. The flexion allows the lateral bands to migrate proximally and, in doing so, extend the middle phalanx, resulting in PIP joint hyperextension. In contrast, an MP or wrist flexion contracture causes increased tension on the extensor digitorum communis (EDC), which inserts as the central slip on the dorsal aspect of the middle phalanx. As tension on the EDC increases, the middle phalanx is pulled into an extended position and PIP joint hyperextension occurs.

Intrinsic causes refer to those resulting from tightness of the intrinsic muscles, such as occur after an ischemic insult to the hand because of a compartment syndrome or crush injury. Chronic volar subluxation of the MP joint can also lead to intrinsic tightness. The Bunnell test can be valuable to assess for intrinsic tightness. The examiner places the MP joint in mild hyperextension and assesses maximal PIP joint flexion. The examiner then moves the MP joint to a flexed position, putting the intrinsics in a more relaxed position. If PIP joint flexion improves (increases), intrinsic tightness is contributing. If the PIP joint flexion does not improve, dorsal capsule or extensor tendon contracture may be the cause.

Articular causes refer to those that originate on the volar surface of the PIP joint. A volar dislocation of the PIP joint can lead to volar plate laxity, allowing for PIP joint hyperextension. The FDS acts as a volar stabilizer of the PIP joint. If this tendon insertion is disrupted owing to trauma or in a tendon transfer procedure, a swan neck deformity can occur.

In RA, swan neck deformities can occur because of chronic volar subluxation of the MP joints, resulting in extension of the middle phalanx, as discussed above. In addition, a swan neck can occur because of periarticular inflammation at the PIP joint, leading to volar plate and capsule laxity. The terminal tendon can become stretched and lax over the DIP joint, resulting in a mallet deformity, which can initiate a swan neck deformity if left untreated. As for CP, swan neck deformities can be caused by tension on the EDC due to wrist flexion contractures or to spasticity of the intrinsic muscles of the hand.[3]

Treatment options depend not only on the cause of the deformity but also on the duration of symptoms, disability, and condition of the joint. Nalebuff classified swan neck deformities into 4 types (**Table 1**).[4] Classification can help guide surgical management. Nonsurgical options include figure-of-8 ring splints or custom splints that block PIP joint hyperextension (**Fig. 2**). These options are good for patients with full active range of motion (ROM) of the PIP joint but resting hyperextension. Before considering surgical intervention, the surgeon should obtain radiographs of the finger to assess the DIP and PIP joints. Severe arthritis at the PIP joint will limit results from a soft tissue procedure, and an arthroplasty or arthrodesis may be indicated, whereas a DIP fracture may warrant fixation to rebalance the extensor mechanism.

INDICATIONS/CONTRAINDICATIONS

The indications and contraindications to surgical soft tissue procedures to limit hyperextension of the PIP joint are shown in **Table 2**.

SURGICAL TECHNIQUE/PROCEDURE

Multiple techniques have been described for soft tissue rebalancing of the PIP in the setting of swan neck deformity. One option, the FDS tenodesis or FDS sling, is addressed in later

Table 1
Classification and management of swan neck deformities

		Joint Management		
Type	**Characteristics**	**MP**	**PIP**	**DIP**
I	Full ROM, no functional limitations	None	Splint or soft tissue procedure to limit hyperextension (considering cause)	Nonsurgical management vs arthrodesis
II	Intrinsic tightness	Intrinsic release, reconstruction if required	Soft tissue procedure to limit hyperextension	Nonsurgical management vs arthrodesis
III	Limited PIP motion in all positions of MP, joint preserved	Intrinsic release, reconstruction if required	Stepwise approach to restore joint motion + soft tissue procedure	Nonsurgical management vs arthrodesis
IV	Severe arthritic changes	Intrinsic release, reconstruction if required	Arthroplasty + soft tissue procedure OR arthrodesis	Nonsurgical management vs arthrodesis

Data from Strauch RJ. Extensor Tendon Injury. In: Wolfe SW, Hotchkiss RN, Pederson WC, et al., eds. Green's Operative Hand Surgery, 6th edition. Philadelphia: Elsevier; 2011.

discussion. The goal of the procedure is to establish a restraint against hyperextension and rebalance the forced on the joint. MP and DIP joint procedures are beyond the scope of this article.

Preoperative Planning

- Preoperative radiographs of the affected digit or digits
- Medication review, which is especially important for RA patients, whose immunosuppressive medications should be optimized for surgery by working with the patient's rheumatologist
- AROM and PROM of DIP, PIP, and MP joints measured
- Bunnell test performed to assess intrinsic tightness
- Plan for staged or simultaneous procedures on the DIP and MP joints
- Assess for the presence of an FDS in the digit of interest (especially important in the small finger). Assess for a functioning FDP tendon that will remain.

Preparation and Patient Positioning

The patient is placed supine on the operating table with the operative extremity on the hand table. Ideally, the shoulder is placed at 90° and centered on the hand table. However, some patients, especially RA patients, may have limited ROM of the shoulder and elbow, making positioning more difficult. A nonsterile biceps level tourniquet is padded and placed. The patient's hand and arm are prepared in a standard fashion up to the elbow.

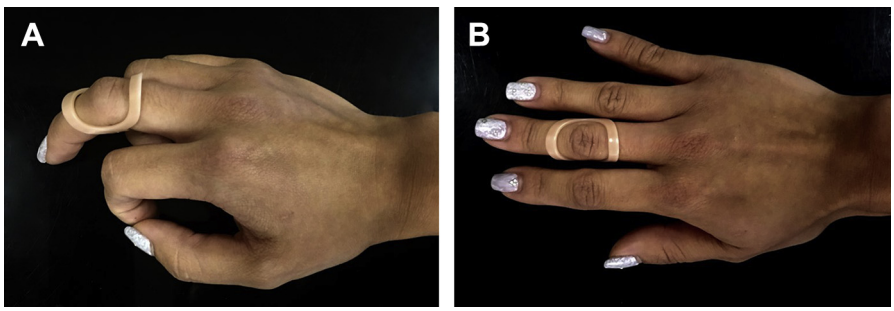

Fig. 2. Figure-of-8 splint. Splint (*A*) Lateral view allows for PIP joint flexion while (*B*) Dorsal view limiting joint hyperextension (*A*) Lateral view. (*B*) Dorsal view.

Table 2
Indications and contraindications to soft tissue procedures to treat swan neck deformities

Indications	Contraindications
Difficulty initiating grasp	Severe arthritis of the PIP joint
Pain due to snapping of the lateral bands	Poorly optimized medical management of RA
Progressive hyperextension deformity	No PROM of PIP joint[a]
Limited AROM of PIP joint with full PROM	Unstable proximal joints (RA)

Abbreviations: AROM, active range of motion; PROM, passive range of motion. RA, rheumatoid arthritis.
[a] PROM of the joint must be restored before soft tissue procedures.

Surgical Approach

The PIP joint can be approached volarly through a variety of incisions, including a standard Bruner, a half-Bruner, or a midlateral approach.[5] The surgeon will need access to the FDS tendon at the location of division and planned inset. As multiple insertions can be used for tenodesis, the surgeon may need to make an additional incision for fixation. If using the A1 pulley for FDS attachment, an incision in the palm can be used and an incision on the digit can be avoided. The authors' preferred technique of tenodesis to the A2 pulley is addressed in later discussion.

Surgical Procedure

1. Design a Bruner style incision over the proximal phalanx, extending from the metacarpal head to the PIP joint (Fig. 3)

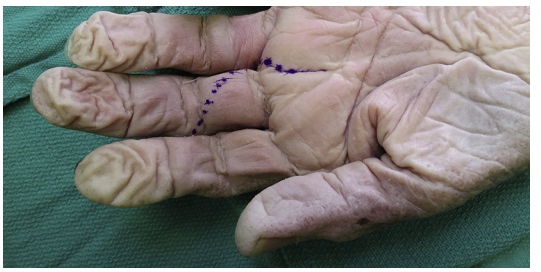

Fig. 3. Volar Bruner incision. An incision that allows clear visualization of the A2 pulley and access to the FDS distal to the A2 pulley is designed.

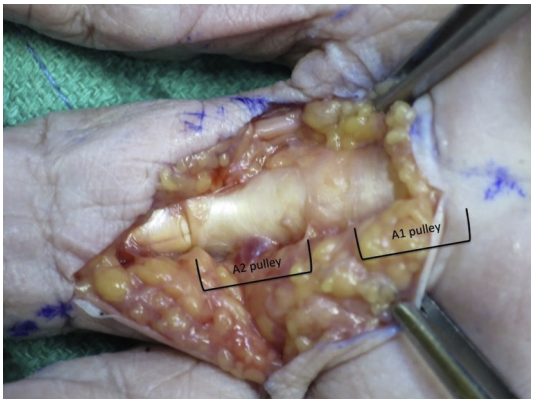

Fig. 4. A2 pulley. The A2 pulley can be seen at the central portion of the dissection with the distal aspect of the A1 pulley visible at the far right of the image.

2. Exsanguinate the hand and inflate the tourniquet
3. Secure the digits in a lead hand
4. Incise the skin and dissect down to expose the flexor tendon sheath, protecting the neurovascular bundles
5. Identify the A2 pulley (Fig. 4)
6. Identify both slips of the FDS and choose one for tenodesis
7. The A3 pulley can be incised laterally and lifted to allow better access to the FDS
8. Pull the slip of FDS distally and cut as proximal as possible just distal to the A2 pulley. This creates a distally based slip of FDS of the length needed for securing around the A2 pulley
9. Identify the center of the A2 pulley from proximal to distal (Fig. 5)

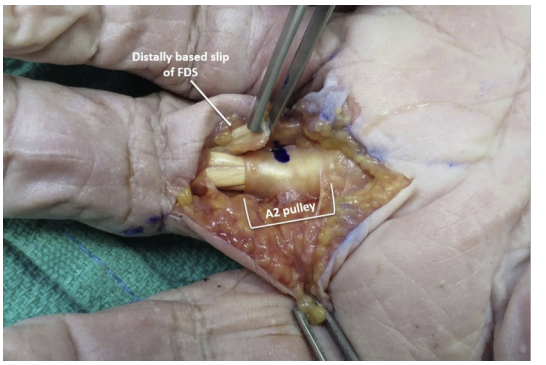

Fig. 5. FDS tenodesis. The FDS has been pulled distally and cut proximally. A purple line marks the midpoint of the A2 pulley. The FDS can be passed through a slip in the pulley and secured to itself, fixated to the lateral aspect of the pulley, or a bone anchor can be used.

10. Make a small slit in the pulley to allow for tendon passage through the pulley
11. The cut end of the slip of the FDS is then passed from distal to proximal and deep to superficial through the slit in A2
12. Secure the tendon on to itself using several nonabsorbable sutures holding the PIP joint in 20° to 30° of flexion
13. Alternatively, the FDS slips can be sutured to the lateral edges of the tendon sheath, with care not to block the passage of the remaining FDP tendon
14. Assess passive flexion and extension of the joint (Fig. 6)
15. Pin the PIP joint temporarily in 20° of flexion for 2 weeks
16. Deflate the tourniquet and obtain hemostasis
17. Close the skin
18. Place the patient in a well-padded dorsal blocking splint

COMPLICATIONS AND MANAGEMENT

There are 2 primary complications after the above procedure:

- Recurrent hyperextension deformity: This can be due to undertensioning the initial tenodesis or stretching over time. The repair can be revised. An alternative tenodesis location can be considered into bone if A2 pulley stretch was responsible.
- Creation of a flexion contracture greater than desired at the PIP joint: This can result from poor compliance with rehabilitation postoperatively or overtensioning of the initial repair. Repairs tend to stretch over time, so this can be monitored or surgically adjusted depending on the time since surgery.

Fig. 6. Resting digit position after securing the FDS slip. The FDS has been secured around the distal half of the A2 pulley creating flexion of the PIP joint at rest.

Postoperative Care

- *At 10 to 14 days postoperatively:* Remove sutures, remove pin, and inspect incision. Place into a custom dorsal blocking splint that maintains desired PIP flexion. Patients are taught active flexion and extension while in the confines of the splint. The splint can be hand or finger based depending on the number of digits involved.
- *6 weeks postoperatively:* Patient is weaned from the splint.
- *Special considerations:* For CP patients, some investigators recommend temporarily pinning the PIP joint in flexion for 4 weeks after swan neck deformity correction.[3]

Outcomes

Outcomes after swan neck deformity are difficult to generalize because of limited studies, a variety of causes, and the diversity of treatment options. Based on the data presented in Table 3, results are stable for 2 years postoperatively. However, they may be less stable in CP patients because of ongoing deforming forces after surgical correction.[9] In addition, surgery does not improve the overall ROM of the joint, but it improves the resting position of the joint for initiation of grasp making the joint more functional.[7,10]

BOUTONNIERE DEFORMITIES

Introduction: Nature of the Problem

A boutonniere deformity is defined as a flexion deformity at the PIP joint with a hyperextension deformity at the DIP joint. The deformity results from disruption or attenuation of the central slip and triangular ligament of the extensor mechanism. The central slip is the termination and insertion of the EDC on the middle phalanx. The triangular ligament is formed between the distal aspect of the central slip proximally, the terminal tendon distally, and the lateral bands laterally. The central slip acts to extend the PIP joint, whereas the triangular ligament prevents volar subluxation of the lateral bands. When both are disrupted or significantly attenuated, the PIP joint moves into flexion and the lateral bands sublux volarly and proximally, causing DIP joint hyperextension. Initially, this deformity will be passively correctable but, over time, the deformity becomes fixed.

A true boutonniere deformity must be distinguished from a pseudo–boutonniere deformity. The Elson test for central slip integrity can be used to distinguish between the 2. A digital block

Table 3
Outcomes after correction of swan neck deformity

First Author, y	Cause	Technique	Outcome
Brulard et al,[6] 2012	RA	FDS tenodesis (A2 pulley)	23 digits at 61 mo Avg postoperative arc −4° to 65° 1 patient (4 digits) with unsatisfactory results
Carlson et al,[3] 2007	CP	Central slip tenotomy	Avg 32° improvement in PIP position at 23 mo postoperatively
Kiefhaber and Strickland,[7] 1993	RA	Dorsal capsulotomy + lateral band mobilization	Preoperative arc of motion 32 (−16° to 16°) Postoperative arc of motion 53° (21°–74°) 11 of 92 digits required revision 15 digits at 54 mo avg arc 15°–54°
Charruau et al,[8] 2016	All	Lateral band mobilization (secured in volar plate/FDS pulley)	41 fingers at 8 y: Avg active flexion of 86° Avg loss of extension of 15° Avg patient satisfaction 7.5/10
de Bruin et al,[9] 2010	CP	Lateral band mobilization (secured to flexor tendon sheath)	69 fingers, avg age 21 No recurrent HE in 84% at 1 y No recurrent HE in 60% at 5 y
Sirotakova et al,[10] 2008	RA	Same as Charruau but lateral band fixed to PP with bone anchor	101 digits No recurrence of deformity 20 mo Avg preoperative PIP arc −13° to 40° Avg postoperative PIP arc 13°–62°

Abbreviations: avg, average; CP, cerebral palsy; HE, hyperextension; RA, rheumatoid arthritis.

may be necessary if the joint is tender. The examiner will place the finger in 90° of flexion at the PIP joint and ask the patient to extend the PIP joint against resistance. If the DIP joint remains in a neutral position and is lax, the central slip is intact. If the DIP joint moves into a hyperextended position with attempted extension of the PIP joint, the central slip is not intact and the patient is pulling though the lateral bands in an attempt to extend the PIP joint. In a true boutonniere deformity, the central slip is not intact. In a pseudo–boutonniere deformity, the inability to extend the PIP joint is due to scarring between the volar plate and flexor tendons. The treatment of this entity is mobilization, serial casting or splinting, and hand therapy.[4]

It is important to determine the duration of deformity and prior trauma to the joint. In addition to a thorough history and physical examination, plain radiographs of the digit are useful to assess for bony central slip avulsions in acute injuries as well as joint space narrowing and arthritis in the chronic setting. The DIP joint should also be examined.

Acute central slip injuries are treated with splinting or pinning the PIP joint in full extension for 6 weeks. DIP joint exercises are performed throughout immobilization to move the lateral bands into their proper dorsal position. Night splinting is continued for an additional 4 to 6 weeks.

Chronic boutonniere deformities are usually secondary to missed traumatic injuries, failed acute traumatic treatment, RA, or volar contractures (eg, Dupuytren contractures, burn scars). Burton classified chronic boutonniere deformities into multiple stages, as summarized in **Table 4**.[11] The stages can be used to help guide treatment.

Table 4
Burton classification of chronic boutonniere deformities

Stage	Description
I	Supple, passively correctable deformity
II	Fixed contracture + contracted lateral bands
III	Fixed contracture + joint fibrosis + collateral and volar plate contractures
IV	Stage III + PIP joint arthritis

Data from Burton RI. Extensor Tendons - late reconstruction. In: Green DP, ed. Operative Hand Surgery. 2nd ed. New York: Churchill Livingstone; 1988.

Stage I deformities can be treated with hand therapy and are managed similar to acute central slip injuries. The patient is started in a PIP joint extension splint for approximately 6 weeks with DIP joint exercises. PIP joint flexion exercises are then initiated with additional night splinting of the PIP joint in extension. Stage II treatment is also nonsurgical with serial casting or splinting to achieve PIP joint extension while exercising the DIP joint. Once achieved, the stage I pathway is adopted.

Stage III deformities often require surgical intervention, which may need to be staged. The PIP joint contracture may need to be addressed first to restore PROM of the joint. The surgeon can then proceed with soft tissue rebalancing. For stage IV disease, arthrodesis or arthroplasty is indicated.

Indications/Contraindications

The indications and contraindications to surgical soft tissue procedures to improve PIP joint extension through tendon rebalancing are shown in Table 5.

Surgical Technique/Procedure

If the patient's primary limitation is due to DIP joint hyperextension limiting grasp of small objects, a terminal tendon release (distal Fowler or Dolphin tenotomy) alone may be sufficient. The terminal tendon is divided over the middle phalanx proximal to the insertion of the oblique retinacular ligament. A mallet deformity may occur but is usually well tolerated.[12,13]

Multiple soft tissue procedures have been described for PIP joint contractures caused by both traumatic insults and RA.[12,14,15] In 1983, Curtis and colleagues[16] described a staged technique for the repair of traumatic boutonniere deformities. Stage I is tenolysis of the extensor tendon over the dorsal capsule of the PIP joint and transverse retinacular ligament (TRL), which tethers the lateral bands volarly. Stage II is sectioning of the TRL. Stage III is step-cut lengthening of the lateral bands, and stage IV is scar excision from the central tendon and readvancement. Stages I and II are performed in a stepwise fashion assessing the patient's progress after each procedure to see of the next is required. The surgeon then chooses between stages III and IV. If the patient has an extensor lag of greater than 20°, the surgeon will proceed to stage IV. If the lag is <20°, the surgeon will proceed with stage III.

Here, the authors discuss central slip reattachment and lateral band mobilization in detail. The goal of the procedure is to restore the appropriate length of the central slip and free the lateral bands from their volarly subluxed position. A terminal tenotomy is performed to correct DIP joint hyperextension.

Table 5
Indications and contraindications to tendon rebalancing to treat chronic boutonniere deformities

Indications	Contraindications
Failed conservative management	Severe arthritis of the PIP joint
Progressive fixed flexion deformity	Poorly optimized medical management of RA
Able to achieve good PROM at the PIP joint	No PROM of PIP joint[a]
Limited grasp of large objects	Full flexion and normal grip strength

[a] PROM of the joint must be restored or arthroplasty/arthrodesis of the joint performed before soft tissue procedures.

Preoperative Planning

- Preoperative radiographs of the affected digit or digits
- Medication review, which is especially important for RA patients, whose immunosuppressive medications should be optimized for surgery by working with the patient's rheumatologist
- Measure active and passive ROM of DIP, PIP, and MP joints
- Plan for staged or simultaneous procedures on the DIP joint

Preparation and Patient Positioning

The patient is placed supine on the operating table with the operative extremity on the hand table. Ideally, the shoulder is placed at 90° and centered on the hand table. A nonsterile biceps level tourniquet is padded and placed. The patient's hand and arm are prepared in a standard fashion up to the elbow.

Surgical Approach

A dorsal approach to the PIP and DIP joints is used. A curvilinear incision is designed over the dorsal aspect of the PIP joint extending

Fig. 7. Dorsal incision over PIP. A curvilinear incision over the PIP joint is shown. The midline is intentionally avoided to prevent the central slip and lateral band repairs from occurring deep to the incision.

proximally to the middle of the proximal phalanx and distally to the distal aspect of the middle phalanx.

Surgical Procedure

1. Design a curvilinear incision over the dorsal aspect of the PIP joint (Fig. 7)
2. Exsanguinate the hand and inflate the tourniquet
3. Rest the digits on a rolled towel
4. Incise the skin and dissect down to the extensor mechanism
5. Identify the central slip, lateral bands, TRL, and terminal tendon (Fig. 8)
6. Incise the TRL radially and ulnarly to allow dorsal subluxation of the lateral bands
7. Identify the stretched or scarred segment of the central slip and excise (Fig. 9)
8. Primarily repair the central slip. If limited distal tendon is available, use a bone anchor in the middle phalanx to secure the tendon
9. Check the DIP joint. If it remains hyperextended or cannot be passively flexed beyond 15°, perform a terminal tenotomy proximal to the DIP joint

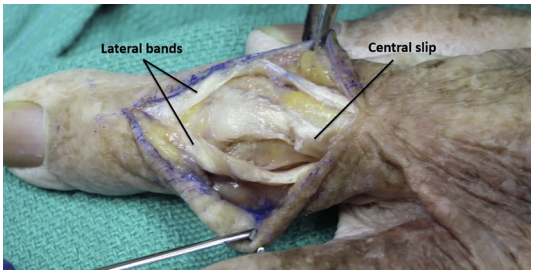

Fig. 9. The central slip and lateral bands are separated. The redundant central slip can be excised. The central slip can then be repaired or reinserted into the middle phalanx with a bone anchor.

10. Assess PIP joint position. If position is acceptable, no fixation of the lateral bands is required. However, if reinforcement is needed, the lateral bands are sutured together dorsally over the central slip (Fig. 10)
11. Use a 0.045 K-wire to pin the PIP joint in extension
12. Deflate the tourniquet and obtain hemostasis
13. Close the skin
14. Place the patient in a well-padded volar splint with the PIP and DIP in neutral and the MP joints in slight flexion

Complications and Management

There are 3 primary complications after soft tissue rebalancing:

- Recurrent flexion deformity: This can be due to underlying joint damage or stretch of the rebalancing. Arthrodesis is indicated if underlying joint damage is suspected. The lateral bands can be used to reinforce the repair if not previously used. The central slip can be readvanced if inadequate correction was obtained.
- Limited flexion of the PIP joint: This can result from poor compliance with rehabilitation postoperatively or overtensioning of the initial repair. Repairs tend to stretch over time, so

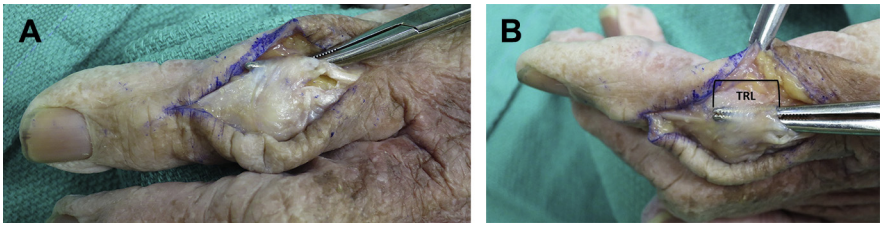

Fig. 8. TRL. (*A*) From a dorsal view, the clamp is passed deep to the TRL, which is located volar to the lateral bands at the PIP joint. (*B*) From a lateral view, the TRL can be seen overlying the clamp.

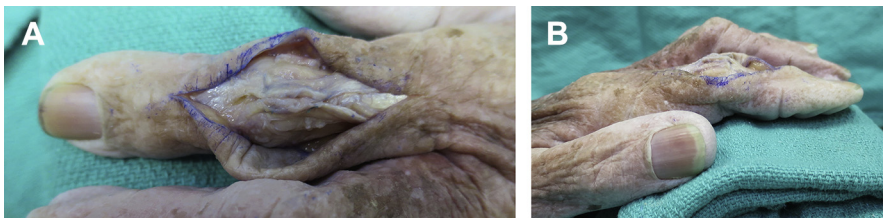

Fig. 10. Centralizing the lateral bands. (*A*) If more extension of the PIP is needed, the lateral bands can be sutured together in the midline. (*B*) Resting extension of the PIP joint is obtained.

this can be monitored or surgically adjusted depending on the time since surgery. If the lateral bands were sutured centrally, this can be released.

- Mallet deformity of the DIP joint: If a greater than 15° extensor lag is noted after terminal tenotomy, postoperative splinting is indicated. If not improved, DIP joint arthrodesis should be considered.

Postoperative Care

- *0 to 2 weeks postoperatively*: Bulky volar resting splint preventing PIP joint flexion and keep the DIP joint at neutral.
- *At 10 to 14 days postoperatively:* Remove sutures and inspect incision. Place into a custom splint that maintains PIP joint extension. Inspect the DIP joint for an extensor lag greater than 15°. If seen, consider a DIP joint extension splint. Otherwise, the DIP joint can remain free and the patient can begin active flexion and extension.
- *4 weeks postoperatively:* Pin is removed and PIP joint exercises are begun. Dynamic extension splint is maintained when not exercising during the day and a static splint is used at night.[13]
- *8 weeks postoperatively:* Patient is weaned from the splint.

Outcomes

The ability to determine predictable outcomes is limited. The authors have listed a few case series in **Table 6**. However, the large variety of techniques used in these cases and the very small number of patients in each series make generalizations difficult. The Dolphin tenotomy is reliable.[19] Results at the PIP joint are less reliable, and incomplete correction is common. Recurrence was common in Kiefhaber and Strickland's[7]

Table 6
Outcomes after correction of boutonniere deformity

First Author, y	Cause	Technique	Outcome
Kiefhaber and Strickland,[7] 1993	RA	Central tendon reconstruction (2 different techniques with similar results)	19 digits, avg FU 22 mo Avg ext lag 67° pre to 39° post 4 digits with recurrent lag ≥ 70° Avg 12° loss of flexion
Caroli et al,[17] 1990	Trauma	Central slip excision and repair	18 pts, avg age 29, avg FU 26 mo 72% with excellent results (≤10° ext lag and ≥80° flexion)
Curtis et al,[16] 1983	Trauma	Curtis procedure	23 pts followed up to 1 y 17 pts avg ext lag 41° pre to 10° post (stages I-III) 6 pts avg ext lag 55° pre to 17° post (stages I-IV)
El-Sallakh et al,[18] 2012	Trauma	Lateral band mobilized, secured centrally and Dolphin tenotomy	12 digits, avg age 32, avg FU 33 mo PIP: Avg ext lag 60° pre to 7° post DIP: Avg 10°HE pre to 75° active flexion post

Abbreviations: avg, average; ext, extension; FU, follow-up; HE, hyperextension; pre, preoperative; post, postoperative; Pts, patients.

experience but less common in the series by El-Sallakh and colleagues[18] and Caroli and colleagues.[17]

SUMMARY

Treating swan neck and boutonniere deformities of the PIP joint is a difficult challenge. Understanding the cause of the deformity, the associated biomechanical changes of the adjacent joints, the functional limitations of the patient, and the articular status of the joint will improve decision making and outcomes. It is important to properly counsel the patient on expected continued limited ROM at the PIP joint and the possibility of repeat procedures in the future.

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