Surgical Management for Boutonniere Disease

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ABSTRACT	ARTICLE DETAILS

Boutonniere disease is a hand injury causing extension lag or restriction in the proximal interphalangeal joint and hyperextension in the distal interphalangeal joint. This condition often arises from direct laceration or closure damage to the central tendon, rheumatoid arthritis, osteoarthritis, Dupuytren contracture, pulley injury, burns, and other conditions. Surgical management for Boutonniere deformity relies on the expertise of the attending physician and involves both non-surgical and surgical options. In acute cases, conservative therapy should be pursued, while in chronic cases, conservative management may be advised.

Surgical intervention is used to transform excessive extension force of the distal interphalangeal joint into extension force of the proximal interphalangeal joint. This is necessary to heal an open rupture of the central tendon. Surgical techniques for chronic deformity are complex due to variables and hand surgeons' expertise. There is no definitive surgical therapy for persistent buttonhole deformity, but several approaches have been documented in case studies. These include terminal tenotomy, collateral band surgery, central tendon surgery, tendon transfer and grafting, stepwise extension mechanism readjustment surgery, and arthrodesis. Central tendon surgery addresses the central tendon, where injured tissue transforms into scar tissue, resulting in delayed extension of the proximal interphalangeal joint.

Tendon transfer or grafting have been documented for rotator cuff mechanism rehabilitation, but no definitive guidance exists for these techniques. Curtis treatment introduced a sequential therapy approach for traumatic buttonhole deformity, which involves splinting, excising the transverse reticular ligament, resecting and lengthening the collateral ligament, and repositioning the core tendon. Arthrodesis may be applicable in cases of advanced arthritis, coronal plane deformity, functional impairment, or elderly patients. There are no definitive indications for surgical interventions for persistent buttonhole deformity, and outcomes may be variable or inferior. Understanding the deformity, its progression, and patient's functional constraints is crucial for effective treatment.

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INTRODUCTION

Injuries to the central slip tendon of the hand constitute around 2% of hand trauma necessitating treatment. Should the dorsal base of the middle phalanx, the attachment site of the central tendon, be compromised or injured, the proximal interphalangeal joint may demonstrate extension lag or restriction, while the distal interphalangeal joint may present with hyperextension, referred to as a 'boutonniere or buttonhole deformity.' Initially, only a limitation of extension at the proximal interphalangeal joint is noted; however, over time, the lateral band shifts toward the palmar aspect of the proximal interphalangeal joint, disrupting the length equilibrium between the central tendon and the lateral band. This alteration in the pulling mechanism of the anteriorly displaced collateral ligament induces hyperextension of the distal interphalangeal joint, culminating in a Boutonniere deformity.

These deformations may mostly arise over time after direct laceration or closure damage to the central tendon, as previously reported. Deformations often arise when tendon injuries are neglected at the time of occurrence or when suturing is inadequately executed. Traumatic central tendon injuries may also arise from rheumatoid arthritis, osteoarthritis, Dupuytren contracture, pulley injury, burns, and other conditions.

Buttonhole deformity is a disorder seen by surgeons in rare instances, and there are now no definitive treatment protocols; hence, management often relies on the expertise and experience of the attending physician. This study will examine the aspects to consider when determining the therapy for buttonhole deformity, including both non-surgical and surgical options.

Figure 1. The cause was found to be a section of the central portion of the extensor mechanism, which is ultimately what causes buttoniere.

Figure 2. at rest and the IFP extension is maintained with inability to flex it

Management

The motions of the proximal interphalangeal joint and distal interphalangeal joint are complicated structures that are anatomically and biomechanically interconnected and

mutually influential. The therapy of buttonhole deformity, which seeks to restore the delicate extension of the proximal interphalangeal joint, often has disappointing postoperative outcomes. Consequently, the choice of surgical intervention

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and the specific surgical technique must be meticulously determined.

1. Indications for surgical intervention

Green's 7th edition of Operative Hand Surgery advocates for nonoperative management of acute abnormalities, whereas in chronic instances, conservative therapy should be pursued first; if ineffective, surgical intervention is advised. In acute situations, if an external incision involves a rupture of the central tendon or a displaced fragment on the dorsal aspect of the middle phalanx, surgical suturing of the ruptured tendon or reduction and fixation of the fragment may be pursued. Furthermore, in patients exhibiting acute buttonhole deformity who struggle to utilize an orthosis for conservative management, joint stabilization using a metal pin (Kirschner wire, K-wire) in the extended position may be executed, with range-of-motion exercises commencing 4–6 weeks post-surgery.

Fox and Chang identified four criteria for surgical intervention in chronic deformities: (1) ineffectiveness of conservative treatment, (2) fixed contracture with worsening deformity, (3) potential passive movement of the proximal interphalangeal joint, and (4) incapacity to grasp large objects. Contraindications included (1) severe arthritis of the proximal interphalangeal joint, (2) inadequately treated rheumatoid arthritis, (3) restricted passive mobility of the proximal interphalangeal joint, and (4) potential maximal flexion alongside normal grip strength.

2. Conservative management

The proximal interphalangeal joint is immobilized in full extension during 4–6 weeks to facilitate the spontaneous healing of the central tendon. Currently, bending of the distal interphalangeal joint is permitted to restore the collateral ligament to its natural anatomical location, posterior to the middle phalanx. Furthermore, flexion of the distal interphalangeal joint may elongate the reconstructed collateral ligament, which might subsequently displace the extension mechanism of the proximal interphalangeal joint proximally. Following 4–6 weeks of immobilization in the extended position of the proximal interphalangeal joint, intermittent or nocturnal splinting is then administered for an additional 4–6 weeks.

3. Operative intervention

The principle of surgical intervention is to transform the excessive extension force of the distal interphalangeal joint into extension force of the proximal interphalangeal joint. Currently, extension must be reinstated within a range that does not compromise the flexion capability of the proximal interphalangeal joint. Excessive extension of the proximal interphalangeal joint may restrict its flexion, leading to more significant functional impairment than buttonhole deformity. Surgical intervention is necessary to heal an open rupture of the central tendon. In instances of avulsion fracture of the central tendon, conservative therapy is used for minor or non-displaced bone fragments, whereas surgical fixation with a K-wire is necessary for pieces over 2 mm.

In contrast to the surgical intervention for acute deformity, many surgical techniques are used for chronic deformity. This is due to several variables, including the level of deformity, which complicate the use of a standardized surgical approach even within chronic deformity. Moreover, even among hand surgeons, their expertise with the surgical management of chronic deformities is rather constrained, complicating the execution of comparative research on treatment modalities. Currently, there is no definitive surgical therapy for persistent buttonhole deformity; nevertheless, several surgical approaches have been documented in case studies by skilled hand surgeons. Surgical treatment modalities may be primarily categorized as terminal tenotomy, collateral band surgery, central tendon surgery, tendon transfer and grafting, stepwise extension mechanism readjustment surgery, and arthrodesis, based on the surgical objective and technique used.

Lateral collateral ligament surgery

This approach enhances the extension of the proximal interphalangeal joint by repositioning the anteriorly misplaced collateral ligament dorsally. Littler and Eaton excised the collateral ligament from the adjacent tissue by a dorsal incision, repositioned it dorsally, and then sutured both collateral ligaments at the midpoint of the middle phalanx. This approach efficiently conveys intrinsic and extrinsic extension stresses to both the proximal and distal interphalangeal joints. Nonetheless, a drawback exists in that flexion is constrained owing to excessive extension of the distal interphalangeal joint, and the outcomes are likewise discordant with nonanatomic tendon realignment surgery.

Central tendon surgical procedure

The central tendon surgery addresses the central tendon, where injured tissue transforms into scar tissue, resulting in delayed extension of the proximal interphalangeal joint. Following the resection of the scar tissue using the dorsal technique, the central tendon is advanced and sutured to restore its pre-injury length. Certain writers further reconnect a collateral band to augment the extension force. This operation is an anatomical restoration, in contrast to terminal tendonectomy or collateral band surgery.

The authors also evaluate this procedure mostly in Burton stage I or II, which are criteria for surgical intervention in persistent buttonhole deformity. Access the dorsal portion of the proximal interphalangeal joint and locate the segment of the central tendon that has been elongated and infiltrated with scar tissue as a result of previous damage. The core tendon is longitudinally incised on both sides to detach it from the collateral ligament, followed by the dissection of the collateral ligament. Surgical loupes are used to differentiate between the parenchyma and scar tissue of the central tendon, allowing for maximal resection of scar tissue from the distal region of the central tendon. The resection length is now targeted to provide 0 degrees of proximal interphalangeal joint extension when the remaining proximal and distal segments are sutured post-resection, hence preventing

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hyperextension and flexion limitations. Prior to suturing the distal end of the central tendon, if a flexion contracture exists in the proximal interphalangeal joint, the volar ligament and collateral ligament must be dissected to facilitate passive extension of the proximal interphalangeal joint. Tendon suturing is performed via the loop suture technique. To enhance suture strength and diminish shear strain on the suture region, a suture anchor is implanted in the central tendon contact area, followed by further suturing with the remaining thread. Based on the state of the sutured tendon, a joint fixation metal pin (K-wire) may be introduced at the proximal interphalangeal joint at 0 degrees and then removed in an outpatient setting after 4 weeks. Post-surgery, the proximal interphalangeal joint is immobilized for 4 to 6 weeks, but mobility of the distal interphalangeal joint is permitted after postoperative discomfort subsides.

This anatomical central tendon repair technique has been documented by several authors before, albeit discrepancies exist in the specifics. Pardini et al. excised scar tissue from the proximal 1 cm distal to the central tendon in Burton stage I buttonhole deformity, approximated both stumps, and sutured the collateral limbs lateral to the core tendon. Following fixation with a K-wire in the proximal interphalangeal joint for an average of 33 days at maximal extension, joint mobility was assessed to evaluate the functional result post-surgery. Per Souter's criterion, 59% of instances had excellent or fair outcomes, whereas 41% resulted in bad outcomes.

Grundberg used a similar procedure; however, he aimed to excise an equivalent length of scar tissue by adjusting the central tendon to 3 mm. Post-surgery, the range of motion of the proximal interphalangeal joint enhanced from 7 to 89 degrees, while that of the distal interphalangeal joint increased from 7 to 51 degrees.

Tendon transfer or tendon grafting

Certain writers have documented tendon transfer or grafting using the flexor tendon of the digiti minimi or the longus tendon for the rehabilitation of the rotator cuff mechanism. These case studies were conducted on cases authored by multiple individuals using diverse methodologies, with a range of reported outcomes. Prior research has not provided definitive guidance on tendon transfer or grafting, making it challenging to see these techniques as primary options in comparison to previously established tendon realignment surgery, especially for skilled surgeons. Chung et al. indicated that surgical intervention on the central tendon resulted in superior joint mobility compared to tendon transfer or grafting, and was favored due to its reduced wound need.

Gradual temple realignment (Curtis treatment)

In 1983, Curtis et al. introduced a sequential therapy approach for traumatic buttonhole deformity. They executed a methodical procedure following the alleviation of passive extension limitation via splinting or, if required, proactive surgical intervention when passive extension of the proximal interphalangeal joint was impeded due to the contracture of

the volar capsule. The procedure was conducted under local anesthetic to verify the patient's vigorous movement; nevertheless, general anesthesia or axillary plexus anesthesia was also prepared in anticipation of advancing to the fourth step. In the first phase, the patient received extensor tendon release across the dorsal capsule of the proximal interphalangeal joint and the transverse reticular ligament, resulting in anterior displacement of the collateral ligament. During the second step, the transverse reticular ligament was excised from the volar aspect. In the third stage, Fowler's approach was revised to systematically resect and lengthen the collateral ligament at the level of the middle phalanx. In the fourth step, the scar tissue of the core tendon was excised and repositioned. The decision to go to the second step of surgery is made after the first procedure by loosening the compression band and instructing the patient to stretch the afflicted limb. If maximal extension is achieved, surgical intervention is discontinued; otherwise, the subsequent surgery is conducted. Following the second step of surgery, the compression band is removed, and active extension is assessed. If the active extension angle of the proximal interphalangeal joint is less than 20 degrees, fourth-stage surgery is conducted immediately; if it is less than 20 degrees, third-stage surgery is undertaken. This process allows for the selection of whether to continue with further interventions by using a straightforward method and assessing the extent of repair achieved.

Arthrodesis

It may be applicable in instances of arthritis that have advanced to Burton stage IV, in the presence of coronal plane deformity, in cases of substantial functional impairment due to extension limitation resulting from proximal interphalangeal joint flexion contracture, or in elderly patients.

In conclusion, there are no definitive indications for surgical interventions for persistent buttonhole deformity, and no therapy ensures optimal outcomes. Kaplan characterized the surgical restoration of the extension mechanism in established buttonhole deformity as the most challenging procedure in hand surgery, while Burton contended that such surgery should be conducted by a surgeon with considerable expertise in hand surgery. Even with a skilled hand surgeon, the outcomes may be variable or inferior to the preoperative condition. Steichen et al. indicated that surgical outcomes were inferior in instances where passive extension of the proximal interphalangeal joint was unattainable, in cases of closed rupture lasting several months or longer, in instances of reoperation, and in patients aged 45 years or older compared to those under 45 years.

CONCLUSION

The treatment of the proximal interphalangeal joint with buttonhole deformity is a significant challenge. Comprehending the etiology of the deformity, its temporal progression, its developmental stage, its correlation with the

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biomechanical alterations of adjacent joints, the patient's functional constraints, and the joint's condition will enhance treatment decisions and outcomes. Considering these factors, the suitable method should be chosen between non-surgical and surgical intervention. Consequently, a comprehensive knowledge of the deformity, together with adequate consultation and collaboration with the patient about the treatment procedure, outcomes, and rehabilitation, is essential.

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