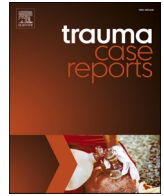




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Case Report

Central slip defect reconstruction utilizing partial ulnar side of flexor digitorum superficialis tendon for chronic boutonniere deformity: A case report

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ABSTRACT

Background: Post-traumatic central slip injuries, resulting in boutonniere deformity, are a complex issue that can significantly impact hand function and quality of life. The deformity should be easily reducible in the acute phase, but if left untreated, it shortens the oblique retinacular ligament, leading to chronic contracture. This is a challenging issue in hand surgery, as chronic central slip defects cannot be sutured like other tendon. Various methods for reconstructing central slips have been discussed, but the best method for subacute or chronic injuries remains unclear. This case presents a case of chronic traumatic boutonniere deformity with central slip defect reconstruction.

Case report: A 65-year-old male patient presented with swelling and boutonniere deformity on the digit III of the right hand. The patient had previously fallen from a motorcycle, and the patient's right middle finger got was by a motorcycle six months ago. After the incident, the patient's right middle finger cannot be fully extended. The patient's right hand showed edema with flexion of the interphalangeal (PIP) joint and hyperextension of the distal interphalangeal (DIP) joint. The Range of Motion (ROM) of the PIP joint right middle finger was 45–110 degrees. The X-ray of the right hand AP/oblique showed no bone involvement in the deformity. The patient underwent central slip defect reconstruction utilizing the partial ulnar side of the flexor digitorum superficialis tendon. A PIP joint extension splint was applied for 2 weeks. Active and passive exercise of the ROM of the PIP joint began after 2 weeks of PIP extension joint splinting. The patient's ROM of the PIP joint (0–90 degrees) significantly improved 1 month after surgery. The patient's ROM of the PIP joint returned to normal after 2 months after surgery. The function of the patient's right hand is evaluated with the DASH score, which improves significantly from 50 to 4.2.

Conclusion: Central slip defect reconstruction utilizing the partial ulnar side of the flexor digitorum superficialis tendon is a reliable method for traumatic chronic boutonniere deformity and results in great functional outcomes after 2 months of follow-up. Central slip defect reconstruction

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utilizing the partial ulnar side of the flexor digitorum superficial tendon is a simple and cost-effective method compared to other methods.

Introduction

Boutonniere Deformity, characterized by flexion at the proximal interphalangeal joint (PIP) and hyperextension at the distal interphalangeal joint (DIP), is a challenging condition often resulting from traumatic injuries to the central slip of the extensor mechanism in the finger. This deformity can significantly impair hand function and diminish the quality of life for affected individuals. This is frequently the result of acute trauma and is caused by a rupture of the PIP central slip. This causes extensor function impairment in the afflicted digit. Laceration injury to the central slip and dorsal capsule can potentially cause a boutonniere deformity [1,2].

Acute injury to the central band of the extensor tendon will result in an acute boutonniere deformity as both lateral bands shift palmarly due to the accompanied disruption of the triangular ligament. The deformity should be easily reducible in the acute phase but if left untreated, it shortens the oblique retinacular ligament, leading to chronic contracture. This ailment has long been acknowledged as one of the most difficult challenges in hand surgery, as chronic central slip defects cannot be sutured like the other tendon [3].

Post-traumatic central slip injuries complicated by boutonniere deformity continue to be a challenge for hand surgeons. It is usually possible to successfully treat closed injuries without surgery by creating a proximal interphalangeal joint (PIP) orthosis in extension and performing active distal interphalangeal joint activities [4]. Untreated injuries that cause the lateral bands to migrate in the volar direction lead to the classically described deformity of PIP joint flexion and DIP joint hyperextension, which can cause discomfort and impairment [5,6]. However, operational intervention may be necessary in cases of postponed therapies, open wounds, or significant bone avulsions [4,7,8]. Despite the fact that a variety of methods for reconstructing the central slip of the extensor mechanism have been discussed, it is unclear from the literature whether method is best for subacute or chronic injuries [9,10]. The most common methods performed in central slip reconstruction: direct repair, lateral band centralization, and distally-based flexor digitorum superficialis (FDS) slip repair [11]. We present a case which chronic traumatic boutonniere disease with central slip defect reconstruction utilizing partial ulnar side of flexor digitorum superficial tendon.

Case report

A 65-year-old male presented with swelling and boutonniere deformity on the right middle finger for six months after a motorcycle accident on January 1st, 2023. Initially, he managed the injury with painkillers and did not seek medical attention. After six months of persistent symptoms, including an inability to fully extend the finger and noticeable edema, he sought treatment.

Clinical findings

The inspection of the right hand showed the presence of deformity with edema. The active range of motion (ROM) was impaired in PIP joint in digiti III of the right hand. The active ROM of PIP joint digiti III of the right hand 45–110 degrees. The passive ROM of PIP joint digiti III of the right hand within normal (Fig. 1).



Fig. 1. Preoperative clinical view of right hand ulnar view.

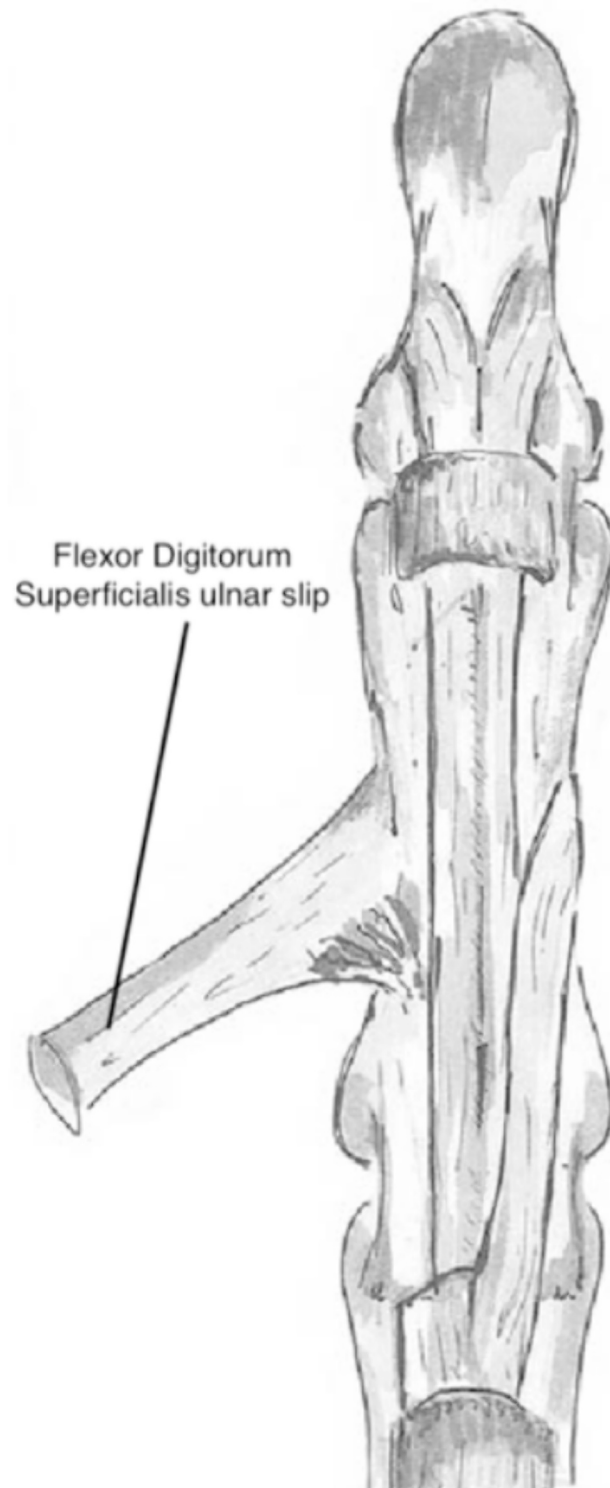


Fig. 2. Illustration of the ulnar slip of the flexor digitorum superficialis tendon (image: A. Odobescu (2010), Modified flexor digitorum superficialis slip technique for A4 pulley reconstruction. DOI:<https://doi.org/10.1177/1753193410371031>).

Diagnostic assessment

We performed X-ray of the right hand AP/Lateral which showed there are no abnormality in the bone and we diagnosed the deformity from soft tissue which is central slip injury.

Surgical technique

A central slip defect reconstruction utilizing partial ulnar side of flexor digitorum superficialis tendon was performed. Under anesthesia, the patient was positioned supine with a tourniquet applied to the upper arm. A midlateral incision was made on the ulnar aspect of the right middle phalanx, centered at the PIP joint. The incision extended dorsally in an oblique manner. A transverse incision was made over the MCP joint flexion crease, just proximal to the A1 pulley. The procedure involves identifying and protecting the ulnar digital neurovascular bundle, exposing the central slip and extensor tendon to the PIPJ, full-thickness dorsal flaps are elevated. Scar tissue and pseudotendinous tissue is identified and excised. The central slip cannot be repaired primarily, so the ulnar slip of the FDS tendon is used for reconstruction. The ulnar neurovascular bundle is mobilized to visualize the periosteal insertion of the A3 pulley.

The extensor tendon is mobilized and tenolyzed, followed by incision of the dorsal capsule of the PIP joint and removal of interposed tissue. The A3 pulley's periosteal insertion is incised longitudinally, and the PIP joint's volar capsule is incised longitudinally. The ulnar slip of the FDS tendon is identified and a 2-0 non-absorbable, monofilament suture is placed around it. A transverse incision is made at the MCP joint flexion crease, proximal to the A1 pulley revealing the flexor tendon sheath. The tendon sheath and A1 pulley are incised longitudinally. The FDS tendon is identified. The ulnar slip of the FDS tendon is isolated and transected to release the ulnar slip, avoiding entrapment or catching of the radial slip. The 2-0 suture that was placed around the ulnar slip at the level of the PIP joint is used to release distally based FDS tendon slip and deliver the ulnar slip of the FDS tendon distally (Figs. 2 and 3).

A 2.8-mm drill is used to create a vertically oriented bone tunnel dorsal to volar. An elevator is placed between the flexor digitorum profundus tendon, volar plate, and volar aspect of the base of the middle phalanx protecting the volar anatomic structures (Figs. 4 and 5). The FDS tendon slip passes through the tunnel while maintaining the PIP joint in extension and reduced position (Fig. 6). The FDS tendon slip passed through the intact proximal section of the central slip and extensor tendon. A tendon weaver completes a Pulvertaft weave, confirming the appropriate tension with the PIPJ in the reduced, full extension position. A 3-0 non-absorbable suture secures the pulvertaft weave. The margins of the capsule and central slip reconstruction are approximated across the PIP joint, and adhesions are released and the lateral bands mobilized (Figs. 7 and 8).

The overall posture, stability, and motion with tenodesis assessed. All the incisions are copiously irrigated. The tourniquet is deflated and hemostasis is obtained. Capillary refill of all fingers is assessed. The skin is closed using horizontal mattress stitches. A sterile dressing is applied with an appropriately padded PIP joint extension splint to allow for early DIP joint and MCP joint motion.

Follow-up and outcomes

First follow-up was done 4 days after for wound treatment. The patient was given oral meloxicam 7,5 mg twice a day and doxycycline 100 mg twice a day for 3 days. The second follow-up was done 3 days after for wound treatment. After 2 weeks, we remove the back slab, remove the external suture and begin the active and passive ROM exercise. After 3 weeks, the wound was healed, and we found the ROM of PIP joint 0 to 90 degrees. And after a month, the patient came with improved ROM of PIP joint 0 to 100 degrees, and improved functional outcome. After 7 weeks of physical rehabilitation, patients already back to work with improve ROM of PIP joint 0 to 110 degrees. The function of the patient's right hand is evaluated with DASH score, which improves significantly from 50 to 4.2.



Fig. 3. The ulnar slip of the flexor digitorum superficialis tendon is isolated.

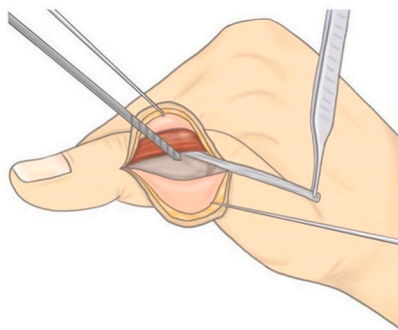


Fig. 4. Illustration of 2.8-mm drill is used to make the vertically oriented bone tunnel dorsal to volar with the elevator protecting the volar anatomic structures.



Fig. 5. A 2.8-mm drill is used to make the vertically oriented bone tunnel.

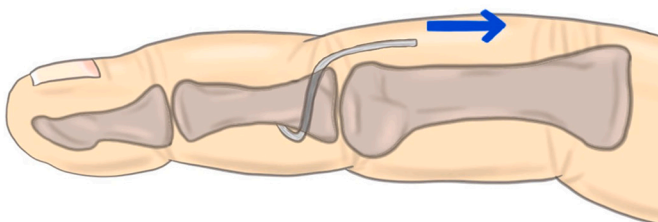


Fig. 6. (A) 2-0 nylon suture is used to pass the flexor digitorum superficialis tendon slip from volar to dorsal through the vertically oriented bone tunnel (B) Illustration of ulnar slip of the flexor digitorum superficialis passed through the bone tunnel.

Discussion

A boutonniere deformity results when the triangular ligament and the central slip of the extensor tendon of a digiti are disrupted. Boutonniere deformity occurred because the lateral bands tend to displace volarly when the ligament and tendon disrupted. As a result, the finger is pressed into flexion, which reduces the range of motion of DIP joints. Over time, the oblique retinacular ligament gradually becomes tighter. The joint's hyperextension deformity will eventually get worse as a result of this ligament contracture [12].



Fig. 7. The Pulvertaft weave is secured with 3-0 nonabsorbable suture.

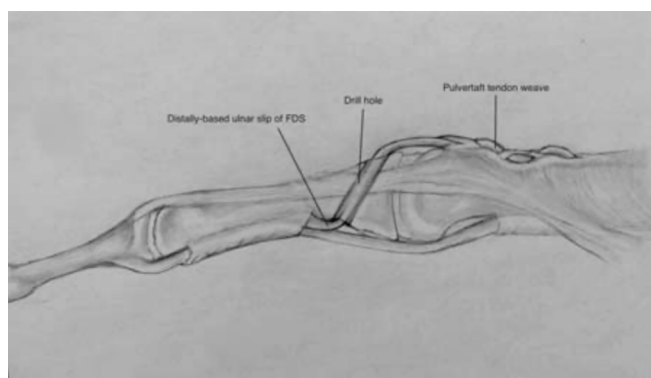


Fig. 8. Illustration of final central slip reconstruction using a slip of the FDS tendon. FDS indicates flexor digitorum superficialis with pulvertaft weave technique.

A boutonniere deformity can be corrected using a variety of repair methods. There are five different ways to treat a boutonniere deformity: Lateral band reconstruction, central slip reattachment, extensor tenotomy, central slip reconstruction using a triangular flap and local tissue, and tendon and transverse retinacular reconstruction [13]. To and Watson [10] compared various reconstruction techniques for boutonniere deformity. The majority of cases in case series have satisfactory results by improved functional range of motion. However, most of these techniques require immobilization of the PIPJ in extension for at least 3 weeks, which can result in stiffness and decreased range of motion. To and Watson concluded there are a few uncontrolled, small case series with inconsistent outcome measurements. Studies comparing various surgical methods or operational versus nonoperative care were lacking. As a result, they were unable to determine which reconstruction method produced the greatest results.

A new technique that reconstructs the central slip through a bone tunnel using a distally based slip of the FDS tendon was introduced by Ahmad [14]. Ahmad primarily used the technique in rheumatoid patients with chronic, nontraumatic central slip injuries. While Ahmad's technique is beneficial for rheumatoid patients, our method's application in chronic traumatic cases offers distinct advantages. Chronic trauma often leads to significant fibrosis and scarring, complicating direct repair of the central slip. The use of the ulnar slip of the FDS tendon provides a reliable and robust reconstruction in these cases. The FDS tendon's function is unaffected since just one tendon slip is utilized. Additionally, the technique's allowance for early mobilization is particularly beneficial for trauma patients, as it helps prevent joint stiffness and promotes better functional recovery. The specific indications for our method include chronic traumatic boutonniere deformities where other direct repair methods may not be feasible or effective. The indications as follows: (1) Full passive range of motion of the PIPJ should be obtained before tendon reconstruction. (2) The flexor tendon function should not be compromised in order to obtain full extension [13].

Unlike most other reconstruction techniques that require at least three weeks of immobilization [2]. Thien and Becker, requires a balance between keeping the repair safe from external forces and avoiding adhesions between the repair site and the paratendinous area. Early mobilization has been demonstrated to restoring gliding function, raise tensile strength, improve tendon excursion, and stimulate morphological restoration of the injured tendon. Unfortunately, there is also an increased risk for complete rupture of the

tendon after repair [15]. The shorter immobilization period of two weeks, compared to the standard three weeks, is an essential factor in our study. This reduction allows for earlier mobilization, which helps maintain the range of motion and prevents stiffness in the PIP joint. The secure tendon repair using the Pulvertaft weave supports early movement without compromising the stability of the reconstruction. Early mobilization is crucial for improving functional outcomes and enhancing the overall rehabilitation process. Post-operative care for flexor tendon injuries in zone II of the hand according to Georgescu known as no-man's land because the risk of adhesions [16].

Following the surgical procedure, the patient demonstrated significant improvement in range of motion (ROM) at the PIP joint, enhancing functional outcomes. The follow-up period indicated a notable improvement in ROM and functional outcomes, as evidenced by a significant reduction in the DASH score after 9 weeks following the surgical procedure (50 to 4.2), signifying improved hand function.

Conclusion

Central slip defect reconstruction utilizing partial ulnar side of flexor digitorum superficialis tendon is a reliable method for traumatic chronic boutonniere deformity and results in great functional outcomes after 2 months of follow-up. Central slip defect reconstruction utilizing partial ulnar side of flexor digitorum superficialis tendon is a simple and cost-effective method compared to other method.

CRedit authorship contribution statement

Andriessanto Ceelvin Lengkong: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Albertus Djarot Noersasongko:** Validation, Supervision, Methodology, Funding acquisition, Formal analysis. **Haryanto Sunaryo:** Validation, Supervision, Methodology, Funding acquisition. **R. Tommy Suharso:** Validation, Supervision, Funding acquisition. **Rangga B.V. Rawung:** Validation, Supervision, Funding acquisition, Formal analysis, Data curation. **Stefan A.G.P. Kambey:** Visualization, Validation, Supervision, Methodology, Investigation, Funding acquisition. **Alfons Datui:** Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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