**RESEARCH PAPER**

# A Prospective Study of Functional Outcome of Percutaneous A1 Pulley Release in Trigger Finger

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**ABSTRACT**
This prospective study evaluates the functional outcomes of percutaneous A1 pulley release in patients with trigger finger unresponsive to conservative treatment. The minimally invasive technique enables effective release of the constricted pulley with minimal tissue trauma. Functional improvement was assessed postoperatively, demonstrating significant relief in pain, restoration of finger movement, and early return to daily activities, supporting the procedure as a safe and efficient treatment option.

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## INTRODUCTION

Trigger finger, or stenosing tenosynovitis, is a common musculoskeletal disorder characterized by the entrapment of the flexor tendon at the A1 pulley. This condition leads to pain, swelling, and limited movement of the affected digit. The underlying cause is the thickening of the A1 pulley, which restricts the smooth gliding of the flexor tendon, resulting in a catching or locking sensation during movement [1]. This disorder primarily affects the middle and ring fingers, with individuals in the age group over 40 being most frequently affected [2].

Conservative treatments such as steroid injections, anti-inflammatory medications, and splinting are often first-line therapies. However, when these methods fail to relieve symptoms, surgical intervention is required. Percutaneous A1 pulley release has become the treatment of choice for patients who do not respond to non-invasive options. This minimally invasive procedure involves the release of the constricted A1 pulley and offers several advantages, such as reduced trauma, faster recovery times, and fewer complications compared to open surgery [3].

Ultrasound-guided percutaneous A1 pulley release, a more recent refinement, allows for greater precision and improved outcomes. This approach reduces the risk of tissue damage, accelerates recovery, and decreases the cost associated with traditional surgery. Given its effectiveness, percutaneous release has become a highly recommended procedure for managing trigger finger, particularly in cases resistant to conservative treatments [4].

## MATERIALS & METHODS

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This prospective study was conducted in the Department of Orthopaedics over a period of 18 months and included patients presenting to the Orthopaedics outpatient department with a clinical diagnosis of trigger finger (stenosing tenosynovitis). Patients aged 18 years or older of either gender with trigger finger affecting the digit and limited preoperative range of motion, assessed using standardized goniometry, were included. Diagnosis was confirmed through clinical examination and/or imaging studies where necessary. Patients with trigger thumb, involvement of pulleys other than the A1 pulley, prior surgery of the affected digit, or active infection were excluded. After obtaining Institutional Research Committee (IRC) and Institutional Ethics Committee (IEC) approval, informed consent was taken from all participants, and patient confidentiality was strictly maintained. Eligible patients were counselled regarding the merits of percutaneous A1 pulley release as well as alternative treatment modalities. Preoperative symptoms and signs were documented, following which percutaneous pulley release was performed. Patients were followed up on the 3rd day, 7th day, 15th day, 1 month, and 3rd month postoperatively. Functional outcomes were assessed using the Visual Analog Scale (VAS) for pain, range of motion measured by goniometer, and the Disabilities of the Arm, Shoulder and Hand (DASH) score. The sample size was calculated based on a previous study, assuming proportions of 23% and 50% for functional outcomes in exposed and non-exposed groups respectively, with 5% level of significance and 80% power; the final sample size was 62, including a 10% non-response rate. Data were entered into MS Excel and analysed using SPSS version 16. Descriptive statistics were applied, and appropriate tests of significance were used with a 95% confidence interval; a p-value of less than 0.05 was considered statistically significant. The study timeline included ethical approval, 18 months of data collection, 2–3 months of manuscript preparation, and subsequent submission. The study was conducted without additional financial burden at SSSMCRI

## .RESULTS

**Table 1.** Demographic profile by age & sex (n = 62)

| Variable | n | % | Complete relief at 3 mo (n) | p-value |
|---|---|---|---|---|
| Age 18–30 | 9 | 14.5 | 8 | 0.42 |
| Age 31–40 | 18 | 29.0 | 16 | |
| Age 41–50 | 22 | 35.5 | 19 | |
| Age >50 | 13 | 21.0 | 10 | |
| Male | 24 | 38.7 | 20 | 0.33 |
| Female | 38 | 61.3 | 33 | 0.33 |

**Table 2.** Education, occupation & Kuppuswamy SES (detailed sociodemographic)

| Variable | n | % | Complete relief (n) | p-value |
|---|---|---|---|---|
| Illiterate | 6 | 9.7 | 4 | 0.08 |
| Primary | 12 | 19.4 | 10 | |
| Secondary | 20 | 32.3 | 17 | |
| Graduate | 18 | 29.0 | 16 | |
| Postgraduate | 6 | 9.7 | 6 | |
| Occupation — Housewife/unemployed | 20 | 32.3 | 16 | 0.12 |
| Skilled worker | 18 | 29.0 | 16 | |
| Unskilled worker | 8 | 12.9 | 6 | |
| Professional | 16 | 25.8 | 15 | |
| Kuppuswamy I (Upper) | 6 | 9.7 | 6 | 0.06 |
| Kuppuswamy II (Upper middle) | 12 | 19.4 | 11 | |
| Kuppuswamy III (Middle) | 20 | 32.3 | 18 | |
| Kuppuswamy IV (Lower middle) | 16 | 25.8 | 13 | |
| Kuppuswamy V (Lower) | 8 | 12.9 | 5 | |

**Table 3.** Clinical presentation (affected digit, side, complaints, duration)

| Variable | n | % | Complete relief (n) | p-value |
|---|---|---|---|---|
| Index finger | 10 | 16.1 | 8 | 0.04 |
| Middle finger | 18 | 29.0 | 16 | |
| Ring finger | 22 | 35.5 | 19 | |
| Little finger | 12 | 19.4 | 10 | |
| Right side | 38 | 61.3 | 34 | 0.21 |
| Left side | 24 | 38.7 | 19 | |
| Presenting complaint — Pain | 58 | 93.5 | 49 | — |
| Locking | 42 | 67.7 | 36 | — |
| Stiffness | 30 | 48.4 | 26 | — |
| Duration of symptoms | — | — | — | **6.4 ± 3.2** |

| | | | | |
|---|---|---|---|---|
| (months) — Mean ± SD | | | | (min 1, max 18) |

**Table 4.** Baseline pre-operative functional scores (linked to primary objective)

| Parameter | Mean ± SD | Minimum | Maximum | p-value (vs pre) |
|---|---|---|---|---|
| VAS pain score (0–10) | **6.8 ± 1.2** | 4.0 | 9.0 | — |
| Range of motion (active arc, degrees) | **95.6 ± 12.4** | 60 | 120 | — |
| DASH score (0–100) | **42.5 ± 8.6** | 23 | 62 | — |

## DISCUSSION

**Table 5.** Intra-operative details & safety (procedure uniformity)

| Variable | n | % | Complete relief (n) | p-value |
|---|---|---|---|---|
| Percutaneous A1 release performed | 62 | 100.0 | 53 | — |
| Local anaesthesia used (field block) | 59 | 95.2 | 50 | 0.28 |
| Ultrasound-guided release | 12 | 19.4 | 11 | 0.67 |
| Intra-op complications — Yes | 2 | 3.2 | 1 | 0.44 |
| Intra-op complications — No | 60 | 96.8 | 52 | 0.44 |

**Table 6.** Pain (VAS) — pre vs post (mean ± SD) — primary outcome

| Time point | Mean ± SD | p-value (paired vs pre-op) |
|---|---|---|
| Pre-operative | **6.80 ± 1.20** | — |
| Day 3 | **3.40 ± 1.00** | <0.001 |
| Day 7 | **2.10 ± 0.90** | <0.001 |
| Day 15 | **1.30 ± 0.60** | <0.001 |
| 1 month | **0.80 ± 0.50** | <0.001 |
| 3 months | **0.30 ± 0.50** | <0.001 |

**Table 7.** Range of motion (degrees) — pre vs post

| Time point | Mean ROM ± SD | p-value (vs pre) |
|---|---|---|
| Pre-operative | **95.6 ± 12.4** | — |
| Day 15 | **105.2 ± 10.8** | <0.001 |
| 1 month | **110.3 ± 9.6** | <0.001 |
| 3 months | **113.6 ± 7.8** | <0.001 |

**Table 8.** DASH score — functional gain (linked to objectives)

| Time point | Mean ± SD | p-value (vs pre) |
|---|---|---|
| Pre-operative | **42.5 ± 8.6** | — |
| 1 month | **18.2 ± 6.3** | <0.001 |
| 3 months | **8.5 ± 4.1** | <0.001 |

**Table 9.** Post-operative complications & safety outcomes

| Complication | n | % | Complete relief (n) | p-value |
|---|---|---|---|---|
| Surgical site infection | 1 | 1.6 | 0 | 0.12 |
| Neurovascular injury | 0 | 0.0 | 0 | 0.99 |
| Superficial bleeding | 2 | 3.2 | 1 | 0.44 |
| Tendon injury/rupture | 0 | 0.0 | 0 | 0.99 |
| No complications | 58 | 93.5 | 52 | 0.02 |

**Table 10.** Recurrence & re-intervention

| Outcome | n | % | p-value |
|---|---|---|---|
| Recurrence of triggering (by 3 mo) | 3 | 4.8 | 0.08 |
| Reoperation (open release) | 2 | 3.2 | 0.09 |
| Persistent symptoms without recurrence | 4 | 6.5 | 0.11 |

**Table 11.** Overall functional outcome at 3 months (linked to secondary objective)

| Outcome | n | % | p-value |
|---|---|---|---|
| Complete symptom relief | **53** | **85.5** | — |
| Partial symptom relief | 6 | 9.7 | — |
| No improvement | 3 | 4.8 | — |

**Table 12.** Subgroup: Diabetics vs Non-diabetics — outcome comparison

| Variable | Diabetics (n=12) | Non-diabetics (n=50) | p-value |
|---|---|---|---|
| Complete relief at 3 mo — n (%) | 8 (66.7%) | 45 (90.0%) | **0.01** |
| Mean VAS reduction (pre → 3 mo) | 6.7 → 0.9 (Δ 5.8) | 6.9 → 0.1 (Δ 6.8) | 0.02 |
| Recurrence (%) | 2 (16.7%) | 1 (2.0%) | 0.03 |

## DISSCUSSION

### Previous Studies

**Wen et al. (2025)** conducted a systematic review to assess the outcomes of combining percutaneous A1 pulley (PAP) release with corticosteroid injection (CI) for trigger finger release (TFR). The review included seven studies with a total of 685 patients, with a mean age of 52 years (range: 38 to 58.9 years) and a mean follow-up period of 22 weeks (range: 1 to 52 weeks). The studies reported outcomes across various fingers, including 243 thumbs, 115 index fingers, 189 middle fingers, 138 ring fingers, and 10 small fingers. The review focused on pre- and post-operative patient-reported outcomes (PROs), patient satisfaction, return to activity, and complications.

The results demonstrated that combining PAP and CI led to high patient satisfaction, with 96.2% of patients reporting pain resolution and a return to normal activities, including sports and work. The procedure was well-tolerated, with a low rate of complications. The systematic review concluded that concurrent PAP and CI significantly improved clinical outcomes and PROs, making it an effective and safe approach for treating trigger finger [9].

**Öner et al. (2025)** conducted a prospective, randomized controlled trial to compare the clinical effectiveness and safety of ultrasound-guided percutaneous needle release (UGPR) and open A1 pulley release for the treatment of trigger finger. A total of 146 patients with Green stage 2–4 trigger finger were randomly assigned to either the UGPR group (n = 75) or the open release group (n = 71). Pain, functional status, and symptom severity were assessed preoperatively and at postoperative day 3, 1, 6, and 12 months. Additionally, grip strength was measured using a digital pinchmeter, and ultrasonographic evaluation of the A1 pulley and flexor tendon thickness was performed at both baseline and the 12-month follow-up.

The results indicated significant postoperative improvements in pain, functional status, and symptom severity for both groups, with no significant differences in outcomes at the 12-month follow-up. However, the UGPR group showed significantly greater grip strength compared to the open release group. While ultrasonographic evaluation showed increased MCP tendon thickness in the UGPR group, this did not have any clinical impact. Notably, four revisions occurred in the UGPR group due to complications such as incomplete release and tendon rupture, whereas no revisions were needed in the open surgery group. Overall, the study concluded that UGPR and open release provided comparable long-term outcomes, with UGPR offering a minimally invasive alternative with the advantage of preserved grip strength, although it carries a small risk of procedure-related complications [7].

**Al-Mwuad'a (2025)** conducted a prospective study to evaluate the functional outcomes and complications of percutaneous A1 pulley release in treating trigger finger. The study involved 49 patients (57 fingers) who underwent the procedure at Amran General Hospital between September 2021 and September 2023. The patients, categorized as Grade ≥2 according to Quinnell's classification, were treated with local anesthesia and a 19-gauge needle for A1 pulley release. Follow-up assessments at 1, 6, and 12 weeks were performed to assess pain relief, range of motion, and complications.

The results indicated that the procedure was successful in 54 of 57 digits (94.7%). Most patients (68.4%) achieved complete resolution of symptoms (Grade 0), with 26.3% experiencing occasional pain (Grade 1). Only three patients required open surgery due to incomplete release. No infections, nerve damage, or other complications were reported, and the average recovery time was 1.5 ± 0.5 days. The study concluded that percutaneous A1 pulley release is a safe and effective treatment for trigger finger, with minimal complications and rapid recovery, providing a reliable alternative to open surgery [1].

**Bezirgan et al. (2024)** aimed to investigate the factors influencing the prognosis of open A1 pulley release surgery for trigger finger, focusing on the frequency of recurrence and prolonged postoperative symptoms. The study retrospectively analyzed 72 patients (30 males, 42 females; mean age: 58.0 ± 11.6 years) who underwent trigger finger surgery between October 2021 and December 2023, with a minimum follow-up period of six months. The analysis included various parameters such as demographics, comorbidities, clinical grades, Quinnell scores, Disabilities of the Arm, Shoulder, and Hand (DASH) scores, grip strength, and surgeon experience.

The results revealed that comorbidities like carpal tunnel syndrome, De Quervain's tenosynovitis, and diabetes were common in the study population. Among the key findings, the use of loupe magnification in 32 surgeries significantly reduced the occurrence of prolonged postoperative symptoms, from 35% in the non-loupe group to 12.5% in the loupe group ($p=0.028$). Additionally, the mean DASH scores showed significant improvement after surgery, particularly in the loupe group ($p<0.0001$), although grip strength was weaker on the surgical side in the non-loupe group ($p=0.0067$). The study concluded that loupe magnification significantly improved functional outcomes and reduced the risk of prolonged symptoms, suggesting that its use should be considered in trigger finger surgeries [6].

**Qiu et al. (2022)** aimed to assess the efficacy and safety of ultrasound-guided percutaneous A1 pulley release using a needle knife. The study was conducted on 84 cadaveric hands, which were divided into three groups: group U (ultrasound-guided needle knife pushing), group N (non-ultrasound-guided needle knife pushing), and group T (classical needle knife operation puncture). The cadaveric hands were fixed with 10% formalin, and percutaneous A1 pulley release was performed. The anatomical data, including soft tissue dissection, were measured to evaluate the effectiveness of each technique.

The results showed that there were no significant differences in tissue injury between the three techniques, with injury rates of 20.7% for group U, 25.7% for group N, and 20.0% for group T. However, when assessing the percentage of released A1 pulleys, group U showed the highest success rate at 71.4% ± 30.7%, followed by group N at 66.0% ± 20.3%, and group T at 61.0% ± 30.4%. Group U also had the highest full release rate at 31.4%, significantly outperforming both group N (15.7%) and group T (13.6%). The study concluded that ultrasound-guided percutaneous A1 pulley release using a needle knife results in longer and more complete releases of the A1 pulley, with no statistical difference in injury rates between the techniques [48].

**Rohilla et al. (2024)** conducted a systematic review and meta-analysis to compare the efficacy and safety of ultrasound-guided (USG) percutaneous A1 pulley release (PR) versus blind PR for the treatment of trigger finger. The study performed a comprehensive search of PubMed, Embase, Scopus, and Cochrane Library databases to identify all relevant studies, and the extracted data were analyzed using Review Manager Software (RevMan) 5.4.1. Forest plots and 95% confidence intervals were used to present the results.

The results showed that the primary efficacy outcome, residual triggering, was significantly lower in the USG-guided PR group compared to the blind PR group, with a risk ratio of 0.16 (95% CI 0.03–0.87), p = 0.03. Regarding safety, the percentage of complications was lower in the USG-guided procedure group, though the result was not statistically significant (risk ratio = 0.25, 95% CI 0.05–1.16, p = 0.08). The operation time for USG-guided PR was longer than for the blind procedure, but the difference was not statistically significant (mean difference = 5.36, p = 0.25). Additionally, the postoperative Visual Analog Scale (VAS) score at 4 weeks was significantly lower in the USG-guided group (mean difference = −0.40, p = 0.004).

The study concluded that ultrasound-guided A1 pulley release for trigger finger is safer and more economical compared to blind PR, offering improved efficacy and lower complication rates [61].

**Rodríguez-Maruri et al. (2023)** conducted a randomized clinical trial to compare the efficacy of ultrasound-guided percutaneous A1 pulley release with classic open surgery for trigger digit. The trial included 84 patients diagnosed with primary grade III trigger digit, randomly assigned to either the ultrasound-guided or open surgery group. Blinded data collectors assessed various outcomes using the Quick-Disabilities of the Arm, Shoulder, and Hand (Quick-DASH) questionnaire as the primary variable. Additional measures included two-point discrimination, grip strength, time until stopping analgesics, achieving full digital range of motion, and resumption of daily activities, all evaluated at several time points post-procedure.

The results revealed that the ultrasound-guided percutaneous release significantly outperformed the open surgery in terms of functional recovery, particularly within the first three months. Quick-DASH scores were significantly lower in the percutaneous group (7.6 ± 1.2) compared to the open surgery group (15.3 ± 2.4). Additionally, the percutaneous group demonstrated faster recovery in terms of stopping analgesics, achieving full range of motion, and returning to everyday activities. Grip strength was notably better in the percutaneous group during the first week. Although both groups had minimal complications, with one case of transient nerve numbness in each, the open surgery group experienced five cases of moderate local pain.

The study concluded that ultrasound-guided A1 pulley release was clinically superior to open surgery, offering better functional outcomes with fewer complications [64].

**Atthakomol et al. (2023)** conducted a 12-year retrospective observational study to identify the factors associated with the recurrence of trigger finger after open A1 pulley release surgery. The study included 723 patients with 841 trigger fingers who underwent the procedure. The patients were divided into two groups: those with recurrent trigger finger post-surgery and those without. Various potential predictors, such as age, sex, symptom duration, occupation status, smoking habits, number of steroid injections before surgery, and comorbidities, were analyzed through univariable and multivariable analyses. The results were presented using hazard ratios (HR) with a 95% confidence interval (CI).

The findings indicated a recurrence rate of 2.39% (20 of 841 fingers) after surgery. After adjusting for confounding factors, the study identified two independent predictors of recurrence: more than three steroid injections before surgery (HR = 4.87, 95% CI = 1.06–22.35) and manual labor occupation (HR = 3.43, 95% CI = 1.15–10.23). The study concluded that administering more than three steroid injections before surgery and having a manual labor occupation increased the risk of recurrent trigger finger following open A1 pulley release. The authors suggested that additional steroid injections beyond the third may offer limited benefit in preventing recurrence [32].

**Wu et al. (2023)** conducted a prospective, randomized clinical trial to assess the role of the A0 pulley in the pathology of trigger finger. The study aimed to investigate whether releasing the A0 pulley, in addition to the A1 pulley, improves clinical outcomes for patients undergoing trigger finger release. The trial included patients with

symptomatic trigger finger, who were randomized using a coin toss to receive either an initial A0 or A1 pulley release. After the initial release, active flexion and extension of the affected digit were observed, and the remaining pulley was subsequently released. Clinical trigger status was recorded to assess symptom resolution.

The results indicated that 30 fingers from 24 patients were treated, with 17 fingers receiving A0 release first and 13 receiving A1 release first. Following A0 release, 47% of fingers showed complete resolution of symptoms, while 24% showed improvement, and 29.4% showed no improvement. For A1 release first, 46% showed complete resolution, 23% showed improvement, and 31% showed no improvement. After both pulleys were released, all patients experienced complete symptom resolution. The study concluded that the A0 pulley may be a primary factor in trigger finger pathology, suggesting that releasing both the A0 and A1 pulleys could result in better symptom resolution than releasing only the A1 pulley [8].

**Zan et al. (2023)** aimed to compare the efficacy of ultrasound-guided percutaneous A1 pulley release combined with intra-tendon sheath injection (PR-ITSI) versus percutaneous release only (PR-ONLY) in the treatment of adult trigger finger (TF) patients. A total of 48 patients were randomly assigned to either the PR-ITSI or PR-ONLY group. The study measured the thickness of the A1 pulley before surgery and one year after surgery, and evaluated pain levels using the Visual Analog Scale (VAS) and the Patient Global Impression of Improvement (PGI-I) scale at 1 day, 1 month, and 1 year post-surgery.

The results showed a statistically significant difference in the VAS scores between the two groups immediately after surgery and at one month ($p<0.001$), with the PR-ITSI group reporting lower pain levels at these time points. At the one-year follow-up, the VAS scores were similar between the two groups ($p=0.055$). Both groups showed a decrease in A1 pulley thickness, with no significant difference between them ($p=0.095$). The PGI-I scale also revealed that the PR-ITSI group had significantly greater improvement in global health at all time points, with a 15.322 times higher likelihood of improvement at 1 day, 14.807 times at 1 month, and 15.557 times at 1 year, compared to the PR-ONLY group.

The study concluded that ultrasound-guided PR-ITSI is superior to PR-ONLY in improving both pain relief and overall patient satisfaction for adult trigger finger patients [5].

**Sutter et al. (2023)** presented a case series to evaluate the safety and effectiveness of sonographically controlled minimally-invasive A1 pulley release using a newly developed guide instrument. The study included 106 procedures performed on 64 patients between 2018 and 2021. The initial technique involved a commercially available hook knife, but due to complications observed early in the clinical series, a new guide instrument was developed and tested in 16 cadaveric hands. Following revisions to the guide design in November 2019, the modified technique was employed in clinical practice, resulting in improved safety and performance.

The results indicated a success rate of 97.3% following the guide revision. However, complications included two cases of incomplete pulley release and one case of inadvertent skin laceration. Most patients returned to all strenuous activities within two weeks, although four patients experienced prolonged postoperative discomfort. The study concluded that sonographically controlled minimally-invasive A1 pulley release, when performed with the newly designed guide instrument, is a safe and effective procedure. The results suggest that such techniques, when appropriately implemented, can offer a high success rate with minimal complications [50].

**Chopin et al. (2022)** aimed to evaluate the efficacy and tolerance of ultrasound-guided A1 pulley release using the needle technique in patients with symptomatic trigger finger. The study involved 84 patients (105 treated digits), with a mean age of 63.3 ± 10.7 years. Patients underwent A1 pulley release using a 21-gauge needle under ultrasound guidance. The Quinnell grade, Quick Disabilities of Arm, Shoulder & Hand (QuickDASH) score, and pain level on the Visual Analog Scale (VAS) were recorded before the procedure, with the primary endpoint being complete resolution of symptoms at 6 months.

The results showed that at 6 months, 93.4% of treated digits (85 of 91 digits with follow-up) experienced symptom resolution, and 85.7% of patients maintained symptom relief at 12 months. Significant improvements were noted in both VAS pain scores (reduction of 4.1 ± 3.1) and QuickDASH scores (reduction of 36.1 ± 20.7) at 6 months ($p < 0.001$). Additionally, 90% of patients reported being satisfied or very satisfied with the treatment at 6 months. The study also found that longer symptom duration was associated with persistent trigger finger. Complications were minimal, with tenosynovitis occurring in 5.7% of cases, which was effectively managed with corticosteroid injections.

The study concluded that ultrasound-guided needle release of the A1 pulley is a minimally invasive technique that provides rapid and effective symptom resolution with excellent long-term outcomes and good patient tolerance [13].

**Koopman et al. (2022)** aimed to identify the risk factors for postoperative complications following open A1 pulley release for trigger finger or thumb. The study included 3,428 patients who completed baseline questionnaires regarding patient and clinical characteristics, as well as the Michigan Hand Outcomes Questionnaire. Medical records were retrospectively reviewed to identify complications, which were classified using the International Consortium for Health Outcome Measurement Complications in Hand and Wrist Conditions tool. The complications were categorized into grades 1 (mild), 2 (moderate), and 3 (severe), with subtypes including minor and major surgical

treatments, as well as complex regional pain syndrome (CRPS).

The results revealed that 16% of patients experienced complications, with the majority being grade 1 (6%) and grade 2 (7%) complications. More severe complications (grades 3A, 3B, and 3C) occurred less frequently. Logistic regression analyses identified several factors associated with higher complication rates, including longer symptom duration (standardized odds ratio [SOR], 1.09), three or more preoperative steroid injections (SOR, 3.22), a steroid injection within 3 months before surgery (SOR, 2.02), and treatment of the dominant hand or certain finger types, such as the index (SOR, 1.65) or middle finger (SOR, 2.01).

The study concluded that preoperative steroid injections, particularly three or more injections, and injections within three months before surgery were the most significant risk factors for complications. These findings suggest that clinicians should consider avoiding steroid injections within three months of surgery and limit the number of injections to no more than two to reduce the risk of postoperative complications [4].

**Kastanis et al. (2021)** conducted a study comparing the long-term functional outcomes and complication rates of open versus percutaneous A1 pulley release in diabetic patients with recurrent trigger finger. The study included 114 diabetic patients with a mean age of 48 years (range 28-64 years). The patients were randomly divided into two groups: Group A (52 patients) who underwent open release and Group B (62 patients) who underwent percutaneous release using an 18-gauge needle or an ophthalmic corneal/scleral knife. The modified Quinnell grading system was used for classification, and the outcomes were assessed using the Visual Analog Scale (VAS), QuickDASH, and the Gilberts & Wereldasma Questionnaire.

The results showed that at 3 months, Group B (percutaneous release) had better outcomes compared to Group A (open release), with significantly improved pain relief and functional recovery. However, at 6 months and 1 year, there were no significant differences between the two groups. The study concluded that while both surgical methods were equally effective in the long term, percutaneous release had distinct advantages in the short term, including lower costs, fewer complications, and faster functional recovery. These findings suggest that percutaneous release may be the preferred method for treating recurrent trigger finger in diabetic patients, particularly for its short-term benefits [33].

**Panghate et al. (2021)** conducted a prospective cohort study to evaluate the outcomes and efficacy of percutaneous A1 pulley release for trigger finger using a 20-gauge hypodermic needle. The study involved 80 trigger fingers from 67 patients, with the severity of triggering assessed using Quinnell's grading system and pain levels measured via the Visual Analog Scale (VAS) before and after the procedure. Patients were followed up periodically, with the final outcome assessed after one year.

The results revealed that most patients were in the 40–50 year age group (39.07%), with the most common grades of trigger finger being Grade 3 (60%) and Grade 4 (30%). Preoperative VAS scores were predominantly 8 (46%) and 7 (24%), indicating significant pain and functional limitation. At the one-year follow-up, 95% of patients showed complete resolution of symptoms (Grade 0), with a mean VAS score of 0.44, demonstrating significant improvement in pain and finger mobility. The study also noted that three patients developed mild scar tenderness, which resolved with analgesics and physiotherapy. No major complications were reported.

The study concluded that percutaneous A1 pulley release using a 20-gauge needle is a safe, effective, and cost-efficient method for treating trigger finger. The procedure, which can be performed as an outpatient, has a short learning curve and is well-accepted by patients, making it a practical option for managing the condition [41].

**Wu et al. (2020)** conducted a retrospective study to compare the clinical effectiveness of ultrasound-guided corticosteroid injection with and without needle release of the A1 pulley in treating trigger finger. The study included 60 patients, with 30 patients in each group: Group A received ultrasound-guided needle release of the A1 pulley along with corticosteroid injection, while Group B received only the corticosteroid injection. Various clinical parameters were evaluated, including pain degree, joint function, tendon function, postoperative satisfaction, and ultrasound measurements of the A1 pulley thickness.

The results demonstrated that both treatment methods led to significant improvements in pain and functional outcomes. The postoperative Visual Analog Scale (VAS) and Quinnell scores were significantly lower in both groups compared to preoperative values ($p < 0.05$). However, Group A, which received the needle release along with corticosteroid injection, had a significantly lower Quinnell score compared to Group B ($p < 0.05$). Additionally, Group A showed a higher rate of excellent and good outcomes in the total active motion (TAM) results ($p < 0.05$). Ultrasound imaging also revealed that both groups had a reduction in A1 pulley thickness postoperatively, with Group A showing a greater reduction. Both groups reported over 80% satisfaction with the treatment, and no adverse effects or complications were observed.

The study concluded that both treatment approaches are beneficial, but ultrasound-guided needle release of the A1 pulley with corticosteroid injection provides better outcomes in improving tendon and joint function compared to corticosteroid injection alone [42].

**Colberg et al. (2020)** conducted a retrospective chart review and cross-sectional study to evaluate the outcomes of a microinvasive ultrasound-guided trigger finger release technique using an 18-blade. The study aimed to assess the

effectiveness of this technique in achieving a complete release and to introduce three confirmatory tests to ensure successful outcomes. A total of 46 trigger finger releases were performed in 28 patients at a private sports medicine clinic, meeting the required power criteria.

The results showed that a complete release was achieved in all patients, with no recurrence of mechanical catching or locking during the first year ($p < 0.0001$). Additionally, 98% of patients experienced significant improvements in pain and function, as measured by the Visual Analog Scale (VAS) for pain and the modified Nirschl scale ($p < 0.0001$). There were no perioperative or postoperative complications reported. The study introduced three confirmatory tests to ensure that the A1 pulley release was complete, further validating the effectiveness of the technique.

The study concluded that the ultrasound-guided microinvasive release technique, combined with the confirmatory tests, provided full resolution of triggering and resulted in statistically significant reductions in pain and improvements in function, making it a highly effective and safe method for treating trigger finger [43].

**Stirling et al. (2020)** conducted a study to compare the functional outcomes, health-related quality of life, and patient satisfaction in diabetic and non-diabetic patients undergoing A1 pulley release for trigger finger. The study included 192 patients, with 143 non-diabetic patients (143 trigger fingers) and 49 diabetic patients (49 trigger fingers). Preoperative and postoperative assessments were made using the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire, EuroQol-5 dimensions, and patient satisfaction scores. The mean follow-up period was 14 months, with a range of 11–40 months.

The study found that the improvement in QuickDASH scores was similar in both groups, with a decrease of 4.5 points in both diabetic and non-diabetic patients. Patient satisfaction rates were high and comparable between the two groups, at 90% for the diabetic group and 96% for the non-diabetic group. Additionally, there was no significant difference in postoperative health-related quality of life between the two groups. Importantly, no complications were reported in either group during the follow-up period.

The study concluded that A1 pulley release for trigger finger leads to similar functional improvements and high patient satisfaction in both diabetic and non-diabetic patients, suggesting that diabetes does not negatively affect the surgical outcomes of trigger finger release [15].

**Stirling et al. (2020)** conducted a cost-utility analysis to assess the economic effectiveness of open A1 pulley release for trigger finger treatment. The study, conducted over six years, included 192 patients who underwent the procedure, with pre- and postoperative quality of life measured using the EuroQol 5 Dimensions 5 Likert scores. The results showed a significant improvement in quality of life, with the median preoperative and postoperative indices being 0.77 and 0.80, respectively. The analysis utilized the cost per quality-adjusted life year (QALY) methodology, considering the United Kingdom National Institute for Health and Care Excellence's threshold for cost-effectiveness, set between £20,000–£30,000 (€22,600–33,900; US$24,600–$36,900).

The findings revealed that the mean number of QALYs gained per patient was 1, with an initial mean cost-utility ratio of £32,308 (€36,508; US$39,730) per patient at 1 year and £16,154 (€18,254; US$19,869) at 2 years. If the benefits of surgery were maintained for the patient's expected life span, the cost-utility ratio decreased significantly to £1,537 (€1,737; US$1,891). The study concluded that A1 pulley release is cost-effective when the benefits are sustained for at least two years and is associated with a statistically significant improvement in quality of life [10].

**Brozovich et al. (2019)** conducted a critical appraisal of adult trigger finger (TF), focusing on its pathophysiology, treatment options, and the future outlook for managing the condition. TF is a common referral to hand surgeons, with patients with diabetes being particularly at risk due to abnormal thickening, scarring, and inflammation at the A1 pulley and flexor tendon. Histological changes in the tendon correlate with the severity of TF, and corticosteroid injections are considered a first-line treatment. While corticosteroids can reduce A1 pulley thickness, their effectiveness is moderate, particularly in diabetic patients. When nonoperative treatments fail, patients may opt for surgical release, either open or percutaneous. The open release approach is associated with a higher risk of infection and scar tissue formation but offers superior long-term outcomes compared to the percutaneous technique.

The study critically reviewed the efficacy and cost-effectiveness of various treatment methods for TF through a comprehensive review of the PubMed database from 2003 to 2019. It highlighted the importance of considering patient subpopulations and their specific needs, such as the desire to return to work quickly, which may influence the choice of treatment. The authors concluded that there is no universal treatment algorithm for TF. From a financial perspective, women without diabetes with a single triggering thumb should attempt two corticosteroid trials before opting for percutaneous release. For all other subpopulations, immediate percutaneous release is the most cost-effective option [45].

**Strigelli et al. (2019)** conducted a retrospective study to evaluate the outcomes of open surgery for idiopathic trigger finger in 1,305 cases performed by four senior hand surgeons between 2014 and 2016. The study aimed to identify the recurrence rate of triggering and other complications following surgery. Medical records and follow-up interviews (with a minimum follow-up of one year) were used to assess these outcomes.

The results showed that 13% of the fingers (169 cases) required a simultaneous release of both the A1 and A2

pulleys because sectioning of the A1 pulley alone did not allow for complete tendon mobility. Importantly, no cases of bowstringing were observed, which the authors attributed to both the surgical technique and proper bandaging methods. The overall complication rate was 11.8%, with recurrence of triggering and permanent proximal interphalangeal joint flexion (PPIJF) being the primary issues. These complications were notably more common in patients where the A2 pulley was not sectioned.

The study concluded that performing a combined A1-A2 pulley release reduces the risk of recurrence of triggering and PPIJF, making it a more effective approach than a single A1 pulley release for managing trigger finger [20].

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