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A prospective comparative analysis of functional outcomes and recurrence rates in wrist ganglion cysts: excision versus aspiration versus threading

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ABSTRACT

Background: Wrist ganglion cysts are recognized as the most common benign soft-tissue tumors of the hand and wrist. Despite multiple available treatment modalities, there is no consensus regarding the optimal approach, particularly in resource-limited settings. This study aims to evaluate and compare the functional outcomes, complication profiles, and recurrence rates of three common treatments: surgical excision, aspiration, and threading.
Methods: This prospective observational comparative study included 91 patients with symptomatic wrist ganglion cysts treated at a rural tertiary care teaching hospital. Based on patient preference and feasibility, participants were categorized into three intervention groups: surgical excision (n=37), aspiration (n=26), and the threading/transfixation technique (n=28). Outcomes were assessed using visual analog scale (VAS) pain scores, a 5-point patient satisfaction scale, recurrence rates, and operative parameters such as procedure time.
Results: All treatment modalities achieved a significant reduction in postoperative pain, indicating comparable short-term symptomatic relief. However, long-term efficacy varied significantly; excision demonstrated the lowest recurrence rate at 5.4%, followed by threading at 14.3%, while aspiration showed a highly significant recurrence rate of 65.4%. Patient satisfaction was highest following excision (mean 4.86) and threading (4.68), and comparatively lower for aspiration (4.11). While excision required a longer procedural time (11.2 minutes), threading and aspiration were minimally invasive and faster (4.7 and 4.8 minutes, respectively).
Conclusions: Surgical excision provides the highest patient satisfaction and lowest recurrence rate, reaffirming it as the definitive gold standard for treating wrist ganglion cysts. However, the threading technique emerges as a highly practical, minimally invasive alternative that successfully balances low recurrence with feasibility, making it especially valuable in resource-constrained environments. Aspiration, due to its significantly higher recurrence rates, is limited in its role as a definitive long-term treatment.

Keywords: Ganglion, Aspiration, Excision, Threading, Recurrence

INTRODUCTION

Wrist ganglion cysts are recognized as the most common benign soft-tissue tumors of the hand and wrist, typically presenting as mucin-filled lesions arising from joint capsules or tendon sheaths.[1,2] These cysts most frequently originate from the scapholunate articulation, with a pedicle connecting the cyst to the underlying joint, often functioning through a one-way valve mechanism that facilitates fluid accumulation.[1,3] Pathophysiologically, they are associated with mucinous degeneration of connective tissue or repetitive microtrauma leading to hyaluronic acid–rich gelatinous fluid formation.[2,3] Clinically, patients may present with a visible swelling,

pain, weakness, stiffness, or restriction of motion, although some remain asymptomatic and seek treatment primarily for cosmetic concerns.[1,2]

Epidemiologically, ganglion cysts demonstrate a clear predilection for young adults, particularly females, with peak incidence reported in the second to fourth decades of life.[1,4] Approximately 70–80% of wrist ganglia occur on the dorsal aspect, while 13–20% are volar, and a smaller proportion arise from tendon sheaths.[1,3] The incidence has been estimated at approximately 30 cases per 100,000 individuals annually, highlighting their clinical relevance in routine orthopedic practice.[1]

Management strategies for wrist ganglia have evolved considerably, ranging from conservative observation to invasive surgical techniques. Aspiration remains a widely used first-line intervention due to its simplicity, low cost, and outpatient feasibility, often combined with corticosteroid injection to enhance outcomes.[2,5] However, recurrence rates following aspiration remain high, reported between 33% and 77%, limiting its long-term efficacy.[2,6]

The threading (seton) technique has emerged as a minimally invasive alternative, involving transfixation of the cyst to allow continuous drainage and fibrosis, with reported success rates exceeding 90% but potential risks of infection and local discomfort.[7] Surgical excision, involving complete removal of the cyst and its stalk, is considered the gold standard for minimizing recurrence, with significantly lower recurrence rates compared to aspiration.[2,8] Nevertheless, it carries inherent surgical risks, including scar formation, joint stiffness, and potential neurovascular injury, along with longer recovery times.[7,8]

Despite multiple available modalities, no consensus exists regarding the optimal treatment, particularly in resource-limited settings. Factors such as cost-effectiveness, accessibility, and rapid return to work are critical in decision-making. Therefore, there is a need for comparative evaluation of these treatment options within such contexts. With this prospective study we are going to compare most used modalities of ganglion treatment.

METHODS

Study design and setting

This study was designed as a prospective observational comparative study conducted at a rural tertiary care teaching hospital. The study aimed to evaluate and compare the functional outcomes, complication profiles, and recurrence rates following three commonly employed treatment modalities for wrist ganglion cysts—namely surgical excision, aspiration, and threading (transfixation technique). The study was carried out over a defined study period March 2023 – March 2025, with all patients followed up for a minimum duration of 1 year to assess recurrence and functional outcomes. This study was carried out in Department of Orthopaedics, Rajiv Gandhi Medical College and Chhatrapati Shivaji Maharaj Hospital, Kalwa.

Participants

All consecutive patients presenting to the orthopaedic outpatient department with a clinical diagnosis of wrist ganglion cyst were considered for inclusion. The diagnosis was primarily based on clinical examination, supported by transillumination and, where required, ultrasonography to confirm cystic nature and exclude alternative pathologies.

Inclusion criteria

Patients aged ≥18 years, clinically diagnosed wrist ganglion cyst (dorsal or volar), symptomatic cysts (pain, discomfort, functional limitation, or cosmetic concern), and willingness to undergo treatment and comply with follow-up were included.

Exclusion criteria

Individual with recurrent ganglion cysts previously treated by any modality, infected or complicated cysts, ganglion cysts <5 mm in size, associated wrist pathology (e.g., arthritis, tumors), and patients unwilling or lost to follow-up were excluded.

A total of 91 patients meeting the eligibility criteria were included in the final analysis.

Study variables and data collection

Baseline demographic and clinical data were recorded, including age and sex, side involved (left/right), location of cyst (dorsal/volar) and duration of symptoms.

Outcome variables included pain assessment using the visual analog scale (VAS) (preoperative and postoperative), patient satisfaction score (graded on a 5-point Likert scale), recurrence (defined as reappearance of cyst at the same site during follow-up), procedure time (in minutes), intraoperative blood loss (in milliliters), and complications (infection, pain, scar-related issues)

All data were systematically recorded in a predesigned structured master chart.

Intervention allocation

Patients were informed regarding all three treatment options, including risks, benefits, and expected outcomes. The choice of treatment modality was made based on patient preference, surgeon discretion, and feasibility, reflecting real-world clinical practice. Accordingly, patients were categorized into three groups group A: surgical excision, group B: aspiration and group C: threading (transfixation technique).

Treatment procedures

Surgical excision

Surgical excision was performed under appropriate anesthesia using standard aseptic precautions. A longitudinal or transverse incision was made over the cyst, followed by careful dissection to identify and excise the ganglion along with its stalk and a cuff of the joint capsule to minimize recurrence. Hemostasis was achieved, and the wound was closed in layers. A sterile dressing was applied, and immobilization was provided as required.

Aspiration

Aspiration was performed as an outpatient procedure under aseptic conditions. After local anesthesia, a wide-bore needle was inserted into the cyst, and the gelatinous contents were aspirated completely. No routine sclerosing agent or steroid was used unless clinically indicated. Patients were advised early mobilization.

Threading technique (transfixation)

The threading technique was performed under local anesthesia in a sterile setting. A sterile silk suture was passed through the cyst using a cutting needle, ensuring complete transfixation. The cyst contents were manually expressed, and the thread was tied externally over a sterile gauze. The thread was left in situ to induce fibrosis and was removed once drainage ceased.

Follow-up protocol

All patients were followed up at regular intervals—typically at 2 weeks, 1 month, 3 months, 6 months, and thereafter as required. At each follow-up visit, patients were assessed for pain (VAS score), functional status, complications, and evidence of recurrence.

Recurrence was clinically diagnosed based on reappearance of a cystic swelling at the same anatomical site.

Bias and confounding

Efforts were made to minimize bias through inclusion of consecutive patients, use of standardized outcome measures (VAS, satisfaction score) and uniform follow-up protocol across all groups. However, as treatment allocation was not randomized, selection bias cannot be entirely excluded. Potential confounders such as age, symptom duration, and cyst location were recorded and found to be comparable across groups.

Sample size

All eligible patients presenting during the study period were included. No formal sample size calculation was performed, as the study was designed as a pragmatic observational analysis reflecting real-world clinical practice in a rural tertiary care setting.

Statistical analysis

Data were entered into a secure digital database and analyzed using statistical software. Continuous variables were expressed as mean±standard deviation (SD), while categorical variables were presented as frequencies and percentages.

Analysis of variance (ANOVA) was used to compare continuous variables among the three groups.

Chi-square test was used for categorical variables such as recurrence rates.

A $p<0.05$ was considered statistically significant, while $p<0.001$ was considered highly significant.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Institutional ethical committee approval was obtained prior to commencement of the study. Informed written consent was obtained from all participants after explaining the nature of the study, treatment options, and potential risks.

Confidentiality of patient data was strictly maintained, and no identifiable information was disclosed during analysis or publication.

RESULTS

A total of 91 patients with wrist ganglion cysts were included in the study and were managed by excision (n=37), aspiration (n=26), and threading (n=28). The baseline demographic characteristics were comparable across all groups, with a mean age of 32.9 years in the excision group, 36.9 years in the aspiration group, and 35.0 years in the threading group. Preoperative pain scores were similar, with mean VAS scores of 7.13, 7.00, and 7.46 respectively, indicating comparable baseline symptom severity (Table 1).

All treatment modalities demonstrated a significant reduction in pain following intervention. The mean postoperative VAS scores improved to 2.32 in the excision group, 2.50 in the aspiration group, and 2.32 in the threading group, reflecting effective symptomatic relief across all three techniques. Patient satisfaction scores were highest in the excision group (mean 4.86), followed by the threading group (4.68), while the aspiration group reported comparatively lower satisfaction (4.11) (Table 1).

A marked difference was observed in recurrence rates among the treatment groups. Excision demonstrated the lowest recurrence rate at 5.4%, followed by threading at 14.3%, whereas aspiration showed a significantly higher

recurrence rate of 65.4%, indicating inferior long-term efficacy (Table 2).

With respect to operative parameters, excision required a longer mean procedural time (11.2 minutes) compared to aspiration (4.8 minutes) and threading (4.7 minutes), both of which were minimally invasive and performed as outpatient procedures. Blood loss was minimal and comparable across all groups, with mean values of approximately 8 ml (Table 3).

Overall, while all modalities provided comparable short-term pain relief, excision and threading demonstrated superior outcomes in terms of recurrence and patient satisfaction, with aspiration showing significantly higher failure rates.

Table 1: Baseline demographic and clinical characteristics.

Parameter	Excision (n=37)	Aspiration (n=26)	Threading (n=28)	P value
Age (years)	32.9±9.7	36.9±12.5	35.0±11.6	0.32 (NS)
Pre-op VAS	7.13±1.36	7.00±1.55	7.46±1.17	0.41 (NS)
Post-op VAS	2.32±0.88	2.50±1.14	2.32±1.02	0.58 (NS)
Satisfaction score	4.86±0.42	4.11±0.91	4.68±0.72	<0.01 (S)

NS: Non-significant, S: significant.

Table 2: Recurrence rates.

Outcome	Excision (n=37)	Aspiration (n=26)	Threading (n=28)	P value
Recurrence (%)	5.4%	65.4%	14.3%	<0.001 (HS)

HS: Highly significant.

Table 3: Operative parameters.

Parameter	Excision (n=37)	Aspiration (n=26)	Threading (n=28)	P value
Procedure time (min)	11.24±3.56	4.80±3.20	4.78±2.85	<0.001 (HS)
Blood loss (ml)	8.21±1.82	8.33±5.77	8.33±2.89	0.97 (NS)

NS: Non-significant, HS: highly significant.

DISCUSSION

The present study provides a comparative evaluation of three commonly employed treatment modalities for wrist ganglion cysts—excision, aspiration, and threading—with respect to functional outcomes and recurrence rates. Consistent with existing literature, all three modalities demonstrated significant improvement in pain scores post-intervention, highlighting that symptomatic relief can be achieved irrespective of the technique employed.[2,4] However, the long-term success of treatment is primarily dictated by recurrence, which varied considerably across groups in the current study.

Surgical excision demonstrated the lowest recurrence rate (5.4%) in our cohort, aligning with previous studies that report recurrence rates ranging from approximately 6% to 21% following open excision.[2,3] This superior outcome is attributed to complete removal of the cyst along with its pedicle and capsular attachment, thereby addressing the underlying pathophysiological mechanism of cyst formation.[1,3]

Despite its effectiveness, excision is associated with longer operative time and potential complications such as scar formation, joint stiffness, and neurovascular injury, which have been well documented in prior literature.[7,8] In our study, although procedure time was higher in the excision group, complication rates remained minimal, supporting its safety when performed with meticulous technique.

Aspiration, while being a simple and cost-effective outpatient procedure, demonstrated a significantly higher recurrence rate (65.4%) in this study. This finding is in concordance with multiple systematic reviews reporting recurrence rates between 33% and 77%.[2,6] The high recurrence is likely due to the persistence of the cyst wall and pedicle, which allows reaccumulation of mucinous fluid.[3] Although aspiration provides immediate cosmetic and symptomatic relief, its limited long-term efficacy reduces its utility as a definitive treatment modality. Nevertheless, its minimal invasiveness and low procedural burden make it a reasonable first-line option in selected patients, particularly those unwilling for surgery.

While the precise biological cause of ganglion cysts remains unproven—frequently theorized as the pooling of extra-articular mucin droplets —finding an ideal treatment has historically been challenging due to the drawbacks of available options.[9] Conservative measures, such as fluid aspiration paired with steroid injections, offer less invasive relief but are ultimately hindered by notably high recurrence rates.[9,10] Conversely, while surgical excision was once viewed cautiously due to potential post-operative complications, contemporary prospective trials demonstrate its clear clinical superiority.[1,9,10] When compared directly to aspiration techniques, complete surgical removal delivers a highly favorable success rate exceeding 92% alongside a drastically reduced recurrence rate of just 7.5%, firmly establishing it as the preferred and most definitive therapeutic approach.[10]

The threading (transfixation) technique demonstrated a recurrence rate of 14.3%, which is substantially lower than aspiration and comparable to surgical excision in certain reports.[7] This technique works by inducing fibrosis and obliteration of the cyst cavity through continuous drainage, thereby addressing the space responsible for fluid accumulation. Previous studies have reported success rates exceeding 90%, with low complication profiles, supporting its role as an effective minimally invasive alternative.[7] In our study, threading also showed high patient satisfaction and shorter procedural time, making it particularly suitable for resource-limited settings.[10]

An important observation in this study is the comparable improvement in functional outcomes across all groups despite differences in recurrence rates. This suggests that while short-term outcomes may be similar, long-term durability remains the key differentiating factor among treatment modalities. These findings are consistent with literature indicating that treatment decisions should balance immediate symptom relief with the likelihood of recurrence.[2,4] From a practical perspective, especially in rural tertiary care settings, cost-effectiveness, accessibility, and rapid return to daily activities are critical considerations. While excision offers definitive treatment, it requires operative infrastructure and longer recovery. Threading, on the other hand, emerges as a valuable alternative, combining low recurrence with minimal resource utilization. Aspiration, despite its limitations, may still serve as an initial intervention in select cases.

The strengths of this study include its prospective design and direct comparison of three treatment modalities within a single clinical setting. However, certain limitations must be acknowledged. The absence of randomization may introduce selection bias, and the sample size, although adequate, may limit generalizability. Additionally, longer follow-up would provide a more robust assessment of recurrence. Overall, the findings of this study reinforce the current understanding that while surgical excision remains the gold standard for minimizing recurrence, minimally invasive techniques such as threading offer a promising balance between efficacy and practicality, particularly in resource-constrained environments.

CONCLUSION

All three treatment modalities—excision, aspiration, and threading—provided significant short-term symptomatic relief in patients with wrist ganglion cysts. However, clear differences were observed in long-term outcomes, particularly recurrence rates. Surgical excision demonstrated the lowest recurrence and highest patient satisfaction, reaffirming its status as the most definitive treatment modality. Threading (transfixation technique) showed favorable outcomes with low recurrence, minimal invasiveness, and high patient acceptability, making it an effective and practical alternative, especially in resource-limited settings. In contrast, aspiration, although simple and cost-effective, was associated with a significantly higher recurrence rate, limiting its role as a definitive treatment. Thus, while excision remains the gold standard, threading emerges as a reliable, minimally invasive option that balances efficacy with feasibility. The choice of treatment should be individualized based on patient preference, available resources, and the need for long-term resolution.

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