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ORIGINAL STUDY

Excision of painful dorsal wrist ganglion by open or arthroscopic approach : a compariso n study

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Dorsal wrist ganglion can be removed through open or arthroscopic excision. The better method for relieving pain remains unknown. In this study, we addressed the following questions: (1) does open excision provide better pain relief than arthroscopic? (2) is there any difference in patient satisfaction, functional outcome, and re-operation rate?

Forty-five patients with painful dorsal wrist ganglions underwent open or arthroscopic excision. Posterior interosseous neurectomy was performed during open excision. Clinical outcomes were assessed with a focus on pain relief. Patient satisfaction, recurrence, and reoperation due to residual pain were also assessed. The average pain scores improved significantly after both, open and arthroscopic excision. However, five patients who underwent arthroscopic excision reported the same or worse pain, whereas all patients who underwent open excision reported postoperative alleviation of pain. The recurrence rate was comparable. Patient satisfaction was better in those who underwent open excision. Reoperation was performed in four patients who had residual pain after arthroscopic excision. Both, open and arthroscopic methods can alleviate pain in patients with painful dorsal wrist ganglion. However, 20% of the patients who underwent arthroscopic excision reported residual or persistent pain.

Keywords : ganglion, wrist, arthroscopy, posterior interosseous nerve

Level of evidence : III

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INTRODUCTION

Ganglion is a common cystic mass in the wrist. The dorsal wrist is the most prevalent location for the occurrence of wrist ganglion (*17*). This ganglion usually originates from the dorsal side of the scapholunate interosseous ligament (*1*). Most cases are asymptomatic; therefore, patients with dorsal wrist ganglion generally seek medical advice due to a cosmetic issue or concern about the possibility of a tumor (*21*). However, some patients may complain of wrist pain and discomfort that limits their daily activities. The cause of this pain has not been established. A mass effect on nearby

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structures or an inflammatory reaction to ganglion may be the cause. Compression or irritation of the terminal branch of the posterior interosseous nerve (PIN), located on the base of the fourth extensor compartment, has been identified as a potential source of pain (Figure 1) (*6,11,15*). Other concomitant pathologies of the wrist joint such as intercarpal ligament tears and subclinical instability of the scaphoid can also cause pain (*14*).

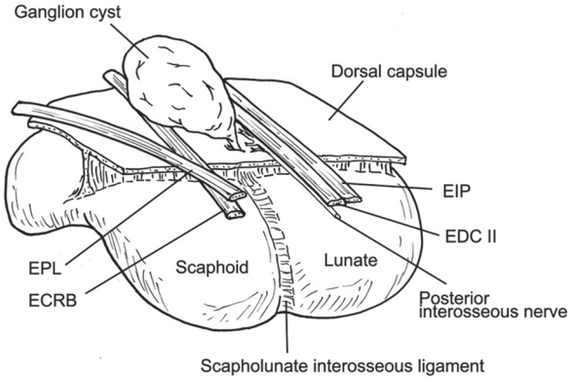

Fig. 1. — Schematic illustrations of dorsal wrist ganglion and its association with neighboring posterior interosseous nerve. EPL: extensor policis longus, ECRB: extensor carpi radialis brevis, EIP: extensor indicis proprius, EDC II: extensor digiti communis of index finger

Various treatment modalities have been proposed, including observation, needle aspiration, controlled rupture, and surgery (*11*). Nonsurgical methods can be considered initially in most instances. Surgery can be offered when patients have persistent pain, weakness, and limited function or when they desire removal of the ganglion for cosmesis. Open or arthroscopic excision is the current mainstay of surgical treatment with an acceptable recurrence rate. The open procedure, which does not require complex equipment, is regarded as the standard method. Arthroscopic excision has gained wide acceptance among hand surgeons as a minimally invasive procedure. Advantages include fewer scars, less postoperative pain, and faster recovery (*2,8,10,12,13,18,19*).

Although many favorable outcomes regarding recurrence and symptom improvement have been reported for both surgical procedures, there are few reports comparing the clinical outcome with respect to pain (*1,4,10,12*). In one prospective randomized study, a comparison of open and arthroscopic excision showed a similar rate of ganglion recurrence and residual pain after both procedures; however, the presence of preoperative pain and the intensity of residual pain were not considered (*12*). Although open excision is more invasive than the arthroscopic approach, this method can offer an additional advantage over the arthroscopic approach by removing the PIN terminal branch, which may be the source of the pain (*20*).

The purposes of the present study were to assess the clinical outcome after surgical excision in patients with painful dorsal wrist ganglion and to determine whether there is a difference between open and arthroscopic excision in terms of pain relief. Unlike previous studies, we only included patients who had considerable dorsal wrist pain with ganglion.

PATIENTS AND METHODS

This was a retrospective, case-control, comparative study performed from 2005 to 2010. During this period, 107 adult patients with dorsal wrist ganglion underwent surgical excision by a single surgeon. The diagnosis of dorsal wrist ganglion was based on patients' history and physical examination. Ultrasound or magnetic resonance imaging was used in suspicious cases. Surgery was offered to select patients who wished to remove ganglion because of pain, weakness, and concern with its progressive increase in size, or a cosmetic issue. After reviewing the electronic medical records, 66 patients who had painful dorsal wrist ganglion were included in this study. Painful ganglion was defined as dorsally located ganglion eliciting dorsal wrist pain with a pain visual analog scale (pVAS) score $\geq$ 3 points during daily activity or exercise. All the patients had tenderness over the ganglion or dorsal wrist pain at the terminal range of dorsiflexion. Patients were excluded if they had wrist pain in a location other than the dorsal wrist, such as the ulnar side or far radial side, that suggested other pathologies (n = 6); any bony abnormality or carpal instability on physical examination or radiological examination (n = 2);

recurrence after previous surgery (n = 4); or obvious traumatic history to the wrist (n = 2). The remaining 52 patients underwent either open excision (n = 24) or arthroscopic excision (n = 28). The choice of surgical treatment was made through a shared decision-making process after discussing the risks and benefits of each procedure. Patient preference was the basis for selection in most instances. Seven patients were lost to follow-up. Finally, 45 patients (20 open procedures, follow-up rate 83%; 25 arthroscopic procedures, follow-up rate 89%) were enrolled in this study. The average follow-up duration was 32 months (range, 18-49 months). The dominant arm was involved in 26 patients (58%). Each group had similar demographic characteristics (Table 1). Our institutional review board approved this study (IRB number 2015-01 -001 -001).

Table I. — Patients' preoperative demographic data

Variable	Open group	Arthroscopy group	P-value
Number of patients	20	25	-
Age at surgery, years (range)	34.4 (18–60)	34.6 (19–56)	0.947
Sex, number of males (%)	8 (40%)	10 (40%)	1.000
Affected number of right wrists (%)	11 (55%)	15 (60%)	0.770
Dominant arm operated, number (%)	10 (60%)	16 (64%)	0.379
Ganglion size, cm (range)	1.5 (0.5–3.0)	1.3 (0.5–2.0)	0.626
Symptom duration, months (range)	21.8 (3–60)	27.2 (4–60)	0.596
Preoperative pain VAS (range)	4.8 (3–8)	4.8 (3–8)	0.991
Follow-up duration, months (range)	31.9 (18–47)	30.4 (19–49)	0.574

VAS, visual analog scale

Patients had arm block with hemostatic control by pneumatic tourniquet. Open excision consisted of a transverse skin incision approximately 2 cm in length. Care was taken to avoid injuring the superficial vein and cutaneous nerve. We freed the cyst from the surrounding tissue and traced down the stalk to the capsular attachment at the scapholunate ligament. We identified the posterior interosseous nerve lying on the floor of the fourth extensor compartment adjacent to the stalk. The nerve was sufficiently exposed and transected at the most proximal point. The ganglion was excised with a portion of the capsule, leaving the joint open. Care was taken to protect the dorsal portion of the scapholunate interosseous ligament.

A standard arthroscopic technique was used for arthroscopic excision. The 4-5 portal was first established as a visualization portal. The 3-4 portal was carefully created adjacent to the ganglion to avoid uncontrolled decompression of the cyst. We thoroughly examined the wrist joint to identify any intraarticular pathology. Then we localized the dorsal scapholunate ligament and traced it dorsally to the capsular reflection to visualize the stalk of the ganglion or intraarticular ganglion. A 2.9-mm shaver was introduced into the 3-4 portal to debride the ganglion with a portion of the dorsal capsule until the extensor tendon was exposed. Care was taken to avoid injuring the dorsal scapholunate ligament and extensor tendons. We routinely used the direct ganglion portal (i.e., the intrafocal portal) as a working portal to excise the remnant of cystic wall with the arthroscope in the 3-4 portal (*3*).

Postoperatively, the wrist was immobilized in a compressive dressing and volar splint for 5 days. Thereafter, patients were allowed to mobilize the wrist and were advised to avoid strenuous work for approximately 4 weeks. Regular follow-up at the outpatient clinic was arranged at 3- or 6-month intervals.

The clinical outcome was assessed by a trained observer (H.I.L.) not involved in the primary care of patients. Clinical data obtained at endpoint

was used for comparison. Wrist pain during daily activity was assessed using the VAS from 0 (no pain) to 10 (worst pain ever felt). The raw change in the pVAS postoperatively was calculated by subtracting the baseline from the endpoint. The percent change was computed (raw change in the pVAS ÷ baseline pVAS × 100). The change in pain postoperatively was also measured with the patient global impression change (PGIC) score. The PGIC is a one-item questionnaire that asks patients to describe the change in pain after surgery. Patients answered the PGIC using a 7-point scale as follows: (1) very much improved, (2) much improved, (3) minimally improved, (4) no change, (5) minimally worse, (6) much worse, or (7) very much worse. This scale is validated in a study of chronic neuropathic or non-neuropathic pain (9). A score of 1 and 2 ("very much" and "much improved", respectively) on the PGIC indicates a clinically important difference. Patient-rated wrist evaluation (PRWE) was used to measure self-reported pain and disability. The recurrence of ganglion was checked grossly. In suspicious cases with pain, sonography was performed to confirm occult ganglion. Subjective satisfaction of the results of surgery was measured with a numeric rating scale: 0, not satisfied and 10, entirely satisfied.

Statistical analyses were performed using SPSS software (version 14.0; SPSS Inc., Chicago, IL, USA). The paired t and Fisher exact tests were used to assess differences in the pre- and postoperative results of each group. The Student's t test, Mann-Whitney test, or Fisher exact test were used to assess differences between the open and arthroscopy groups. A P value <0.05 indicated significance.

RESULTS

The mean pVAS improved significantly post-operatively in both groups (both, $P < 0.001$, Table 2). The average raw and percentage change in the pVAS postoperatively was greater for open excision compared with arthroscopic excision. However, it did not reach a statistically significant level ($P = 0.079$ and 0.229, respectively; Table 2). The average PGIC score was not significantly different between groups (Figure 2, Table 3). Evaluation of the PGIC demonstrated that no patients in the open group reported that their wrist pain was the same postoperatively compared with their preoperative pain (i.e., no change postoperatively), and only 5 (20%) in the arthroscopy group reported no change postoperatively ($P = 0.056$). Eighty five percent and 72% of patients in the open and arthroscopic groups, respectively, reported that their pain was much improved or very much improved ($P = 0.473$). No patients' pain became worse postoperatively.

Satisfaction VAS postoperatively was better in the open group (9.3 vs. 7.8, $P = 0.042$; Table 4). The mean postoperative PRWE score was similar between groups (Table 4). After a mean follow-up of 32 months, ganglion had grossly recurred in 3 patients (15%) who had open excision and in 4 (16%) who had arthroscopic excision. The average duration of recurrence postoperatively was 15.2 months (range, 5-30 months). No complications were noted after both surgeries. We did not observe any obvious intra-articular lesions during arthroscopic examination.

Among 5 patients who had residual pain after arthroscopic excision, 4 underwent reoperation using the open method due to persistent pain. Among these patients, 2 had gross recurrence and another 2 showed an occult lesion, which was only detectable on ultrasonography. During reoperation, thick fibrous tissue and mucoid degeneration was found over the dorsal scapholunate ligament. The posterior interosseous nerve had been transected; however, it was not retracted and adhered to the scar tissue. In 1 patient, neuroma formed at the end of the proximal stump. We dissected the PIN and excised it at the most proximal end as much as possible. All patients who underwent reoperation achieved satisfactory pain relief.

DISCUSSION

Few studies have compared changes in preoperative pain after surgical removal of painful dorsal wrist ganglion. In this comparison study, we found the following: (1) pain was resolved postoperatively in both approaches, and (2) reoperation was performed in four patients who had residual pain after arthroscopic excision.

Table II. — Comparison of postoperative clinical outcomes regarding pain between the two groups*

	Open	Arthroscopy	P-value
Postoperative pVAS	0.8 (1.2)	1.9 (2.3)	0.180
Raw change in pVAS	4.1 (2.2)	2.9 (2.1)	0.079
% change in pVAS	81.0 (30.5)	65.2 (39.4)	0.229

*Values are presented as mean (standard deviation). pVAS, pain visual analog scale

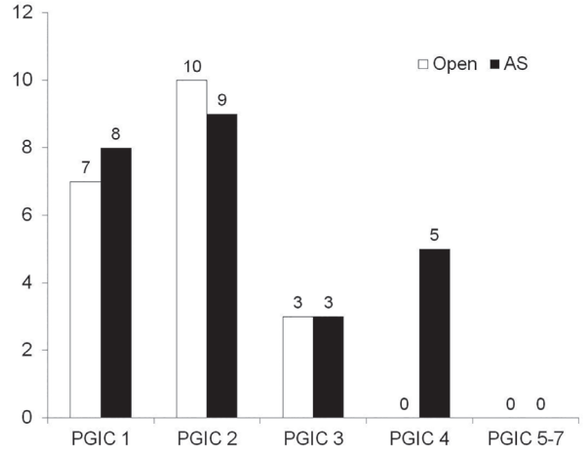

Fig. 2. — Number of patients according to the patient global impression change (PGIC) score. AS, arthroscopic

Table III. — Comparison of patient global impression change (PGIC) scores between the two procedures

	Open	Arthroscopy	P-value
Average PGIC (mean [standard deviation])	1.8 (0.7)	2.1 (1.1)	0.542
Clinically meaningful improvement in PGIC (1 and 2) n (%)	17 (85%)	18 (72%)	0.473
No change and worse PGIC n (%)	0 (0%)	5 (20%)	0.056

We acknowledge several limitations in this study. First, our case series was retrospective, and selection bias likely influenced our analysis. Since the type of surgery was not randomized or blinded, there may be selection biases. Second, our study population was small. This is because we only included patients with sufficient pain that impaired daily activity. A properly powered prospective study might be beneficial.

Table IV. — Comparison of function, satisfaction, and recurrence between the two procedures

	Open	Arthroscopy	P-value
PRWE	2.8 (3.7)	12.6 (17.9)	0.148
Satisfaction NRS	9.3 (1.3)	7.8 (2.3)	0.042
Reoperation (n)	0	4	0.117
Gross recurrence (%)	3 (15%)	4 (16%)	1.000

PRWE, patient-rated wrist evaluation. NRS, numeric rating scale

In the current study, a favorable improvement in pain was noted after both procedures. Numerous case series have reported favorable clinical results regarding pain, which were similar to our results. In one report on open excision with 103 patients, pain was initially reported by 78%, but this deceased to 28% at follow-up, although the intensity of pain was not described (*7*). In another series, pain relief was observed in 79% patient with radical open excision of 51 patients (*4*). Preoperatively, 87% of patients had pain and in 19%, this was of a sufficient severity to interfere with daily activities.

Good relief of preoperative pain was also reported after arthroscopic excision of 38 patients with an initial pVAS ≥ 3, only four reported that their pain was a 3-4 on the pVAS at follow-up (*10*). Except for seven patients, 41 reported improvement in pain (*19*). A recent study reported that 24 of 78 wrists with preoperative pain had postoperative residual pain (*13*). However, the severity of residual pain was not described. In another report, among 37 patients, 35 with preoperative pain reported that their pain completely disappeared postoperatively (*2*). However, there was few report, which directly compared the post-operative pain between open and arthroscopic excision.

Five patients who had arthroscopic excision reported the same or worse pain, whereas all patients who had open excision reported improvement in preoperative pain. The discrepancy between our results and other reports might partly originate from different patient selection. We specifically selected patients with only remarkable pain. Many patients with dorsal wrist ganglion do not experience pain in their wrist (*2,16,21*). Heterogeneous patient populations in previous reports failed to evaluate

whether preoperative pain was properly relieved postoperatively. Moreover, the severity of pain was not mentioned in detail.

Our results indicate that arthroscopic excision seems less effective in terms of pain relief. A possible reason for residual pain after arthroscopic excision may be that the extraarticular structures and PIN are inadequately addressed. It is noteworthy that there was no other intraarticular pathology during arthroscopic examination, which might be a cause of pain. Open excision is more amenable to extensive debridement of extracapsular pathology, including possible separated cyst, mucinous degeneration, or extensor tenosynovitis.

PIN has been previously indicated as a possible source of wrist pain (*6,11,15*). There is a basic difference in performing PIN neurectomy between open and arthroscopic method: direct transection versus blind avulsion. In open excision, we dissected the nerve to a sufficient length followed by transection, allowing the proximal nerve stump to be retracted proximally. When we used arthroscopy, we routinely excised a portion of the dorsal wrist capsule. Because the PIN lies on the fourth compartment floor adjacent to the ganglion base, we assumed that the nerve could be ruptured during blinded debridement of the joint capsule, but it was consistently located in scar tissue, which might have caused the residual pain. Findings observed during revision open excision indicate that the avulsed nerve stump may become adhered to the fibrous scar instead of being retracted proximally. A previous report stated that an injured PIN during arthroscopy might be the cause of dorsal pain (*5*). Since we did not experience any newly developed wrist pain in patients who had not complained about pain preoperatively before arthroscopic excision, it seems that blind avulsion of the PIN itself was not a sole reason for residual pain. A local inflammatory environment, which is specific to patients with pain, might cause pain by irritating the avulsed PIN.

Among patients who showed gross recurrence, no patients reported residual pain after open excision, and two of four patients complained of pain after arthroscopic excision, highlighting that recurrence does not necessarily induce pain. We presumed that PIN resection may contribute to pain relief despite recurrence after open excision, whereas no pain relief after arthroscopic excision may be attributed to the nerve stump adhering to the scarred capsule.

According to the results of the current study, we recommend both treatment modalities as primary treatment for painful dorsal wrist ganglion. However, the open technique is potentially more valuable to surgeons seeking to ensure that the source of pain is completely addressed. The possibilities of residual pain should be discussed with patients who will undergo arthroscopic excision in advance.

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