ARTHROSCOPY AND SPORTS MEDICINE

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Arthroscopic excision of wrist ganglions: does trans-cystic or cystic-sparing portal technique affect clinical outcomes?

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Abstract

Introduction The preliminary results of arthroscopic wrist ganglionectomy were contradictory. The approach used for the arthroscopic excision of wrist ganglions may play an important role. We analyzed two surgical approaches for arthroscopic excision of wrist ganglions.

Materials and methods Between April 2009 and October 2014, 49 patients with wrist ganglions who underwent arthroscopic excision in our institute were retrospectively classified into two treatment groups, namely the trans-cystic portal technique (TCP) and cyst-sparing portal technique (CSP). The visual analog scale (VAS), Mayo wrist scores, and disabilities of the arm, shoulder, and hand (DASH) scores were measured for clinical assessment. Recurrence, residual pain, and complications were evaluated at follow-up.

Results No significant differences were found between the groups in terms of demographic data, and preoperative clinical assessment, as well as with regard to postoperative VAS score ($p = 0.898$), Mayo wrist score ($p = 0.526$), DASH score ($p = 0.870$), recurrence ($p = 0.491$), residual pain ($p = 0.690$), and complications ($p = 0.352$). Recurrence was found in 2 of the 47 patients and they were both in the CSP group. At the final follow-up, residual pain was found in four patients in the TCP group and three in the CSP group.

Conclusions For performing arthroscopic resection of wrist ganglions, both techniques are safe regarding the complication rates. In recurrence rate, no significant difference was found between the two groups, but no recurrence was observed when the TCP technique was used.

Keywords Arthroscopic ganglionectomy · Wrist ganglions · The trans-cystic portal technique · The cyst-sparing portal technique

Introduction

Ganglions are the most common soft tissue tumors in the wrist [1]. The etiology of ganglions could be mucinous degeneration, trauma, synovial herniation, or a one-way valve mechanism, so the precise pathogenesis of ganglions remains unknown [2, 3]. Although most patients experience only a vague ache, patients will seek treatment when their ganglions become painful and enlarged, and interfere with their activities [2, 3]. Open excision has historically been the preferred method of surgical treatment [4].

In the past decades, arthroscopic excision was described as a favorable alternative for this entity [5, 6]. Most patients with ganglions seek surgical treatment with a desire to resect the ganglion. Recurrence of ganglions is the most common complication of ganglionectomy [6, 7]. However, the clinical results have been contradictory with regard to recurrence rate [5–7]. Whether the introduction of arthroscopic resection in treating wrist ganglions will decrease the recurrence rate still needs to be elucidated. The approach used for the arthroscopic excision of wrist ganglions may play an important role. According to the literatures, two common techniques can be used for arthroscopic resection of wrist ganglions. One is the trans-cystic portal (TCP) technique [8, 9]. For this technique, the surgeon places a shaver directly into the ganglion and decompresses the ganglion cyst simultaneously. The other is a cyst-sparing portal (CSP) technique [10,

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11]. Care should be taken to not decompress the ganglion cyst while introducing the shaver.

To date, no studies have directly compared different arthroscopic techniques in similar groups of patients managed with the same advanced anesthetic and rehabilitation program. We designed this study to compare the recurrence, complication and residual pain rates between the TCP and CSP techniques for arthroscopic resection of wrist ganglions.

Patients and methods

Between April 2009 and October 2014, 49 patients with wrist ganglions who underwent arthroscopic excision in our institute were classified into one of two treatment groups retrospectively. One group was treated using the TCP technique, and the other, using the CSP technique, as surgeons preferred. Review of patient records and imaging studies for this retrospective study were approved by the institutional review board. Diagnosis was established on the basis of physical examination, and the presence of ganglion sac was proved by sonography (22 cases), or magnetic resonance imaging (MRI, 25 cases) findings [12] based on the surgeons' preference. Patients with occult ganglions [12, 13], previous fracture history, carpal instability, and pre-existing bony lesions, and those who had been followed-up for < 24 months were excluded. Medical records were reviewed for patient demographic data, medical history, operative blood loss and time, follow-up duration, and perioperative complications. The visual analog scale (VAS), modified Mayo wrist scores, and Disabilities of the Arm, Shoulder and Hand (DASH) outcome measure scores [14] were calculated to gauge preoperative clinical conditions.

Surgical technique

All the patients were placed in the supine position, with their arms on a radiolucent table. Most patients underwent local anesthesia, except those who refused to do so. We still performed additional local anesthesia for these patients. The radiocarpal and midcarpal joints were insufflated with epinephrine-impregnated lidocaine. A tourniquet was placed in all the patients as a precaution and inflated when intra-articular bleeding obscured visualization. However, we never inflated the tourniquet. According to the literatures [15, 16], lidocaine with epinephrine not only demonstrated an earlier onset of anesthesia and less pain on injection but also showed potential benefits by reducing intra-articular bleeding and surgeon-rated visualization.

Standard wrist arthroscopy techniques were adopted using a 2.4-mm 30° angulated arthroscope, a 2.9-mm full-radius shaver, and a 1.4-mm microblader. While the patient's elbow was flexed to 90° and arm was suspended in a traction tower with a 10- to 12-lb traction, 6-R and 3–4 portals were created as the visualization portal for dorsal and volar ganglions, respectively. Initially, a thorough systemic examination of the radiocarpal joint was conducted following a sequence from radial to ulnar, and volar to dorsal. We particularly focused on the integrity of the triangular fibrocartilage complex (TFCC), lunotriquetral ligament, scapholunate ligament, radiocarpal ligaments, and joint capsule. The presence of a ganglion stalk, an intra-ligamentous stalk, or synovitis was documented [17]. The TFCC lesions were graded in accordance with the Palmer criteria [18]. We assessed the condition of the interosseous ligaments using the Geissler arthroscopic classification system [19]. We treated all concomitant intra-articular pathologies simultaneously.

Trans-cystic portal technique

For this technique, the surgeons placed the shaver directly into the ganglion cyst. Initially, we applied gentle external pressure over the ganglion to localize the ganglion stalk or focal hyperplasia synovitis. Once the pathology was identified, the shaver was introduced into the 3–4 portal and/or radial midcarpal portal for resection of the dorsal ganglion (Fig. 1a), and the 1–2 and additional volar trans-cystic portals for resection of the volar ganglion. The debridement continued until approximately 1 cm^2 of the capsule had been removed. Care should be taken not to damage the surrounding ligaments and tendons. The extrusion of gelatinous material confirmed the decompression of the ganglion cyst. Regarding the creation of the volar trans-cystic portal, we modified the intra-focal cystic portal technique, which was first described by Chen et al. [8]. We introduced the probe into the 3–4 portal and volar ganglion to facilitate the setup of the volar trans-cystic portal under the guidance of the arthroscope in the 1–2 portal. Finally, the arthroscope was placed into the trans-cystic portal to ensure the complete excision of the residual stalk and ganglion tissue (Fig. 2). If any residual or ganglion tissue was found, we performed arthroscopically guided shaving through the trans-cystic portal again.

Cyst-sparing portal technique

For this technique, the surgeons made every effort not to decompress the cyst prematurely while introducing the shaver. After localizing the ganglion stalk or focal hyperplasia synovitis, the shaver was introduced into the modified 3–4 portal (Fig. 1b) and/or radial midcarpal portal for resection of the dorsal ganglion, and the 1–2 portal for resection of the volar ganglion. Again, the extrusion of gelatinous material confirmed the decompression of the ganglion cyst. Then, the debridement continued until approximately 1 cm^2 of the capsule had been removed. Once the excision of

Fig. 1 Establishment of portals in the trans-cystic portal (black arrow) group (**a**) and cyst-sparing portal (white arrow) group (**b**). Usually, the trans-cystic portal was as same as a 3–4 portal. The contours of the ganglion cyst were marked as a dashed circle. *RMC* radial midcarpal portal; *LT* Lister's tubercle
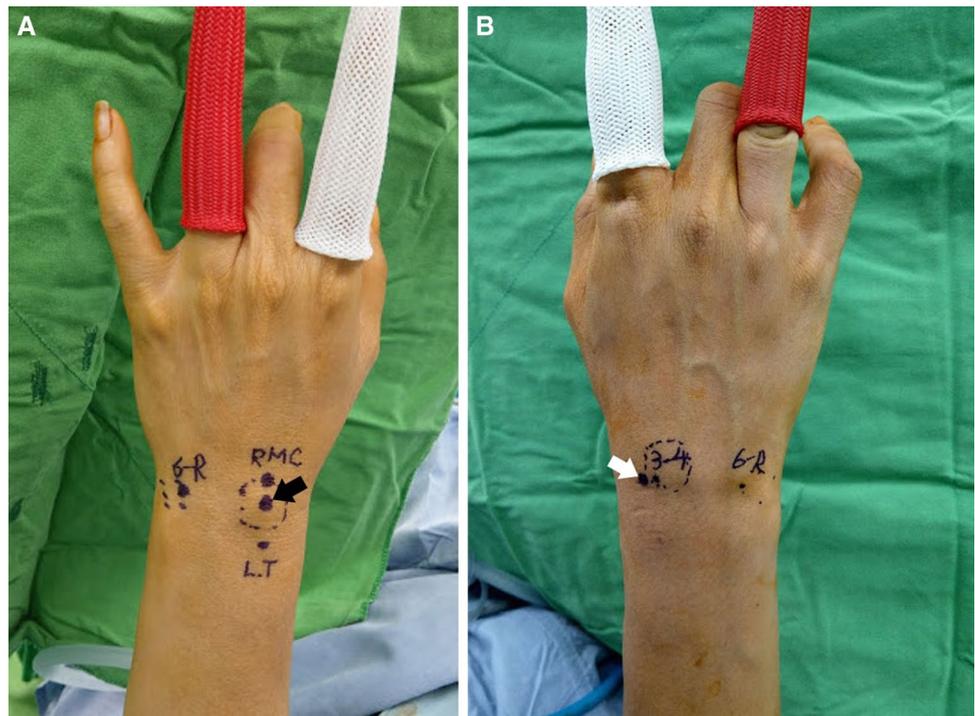
ganglion stalk and redundant capsule tissue was completed, the wrist was palpated to evaluate the efficacy of the arthroscopic ganglionectomy.

Activity was allowed immediately as tolerable, except for those with concomitant intra-articular abnormalities. Strenuous work was avoided for 4 weeks. After the treatment of the intra-articular abnormality, the wrist was splinted for 6 weeks.

Postoperative assessment

Follow-up examinations were performed at 2, 4, and 6 weeks; at 3 and 6 months; at 1 year; and annually thereafter. All the patients attended follow-up examinations for a minimum of 2 years. At each follow-up visit, the clinical results, recurrence, residual pain, and complications were evaluated. VAS, modified Mayo wrist, and DASH scores were calculated at the final follow-up visit to gauge clinical outcomes. Reappearance of cyst at the same site represented a recurrence. A VAS score of ≥ 2 was defined as residual pain. We also recorded complications such as wound infection, hematoma, nerve injury, vascular injury, and tendon injury.

Statistics

Data were analyzed using the SPSS statistical software package (SPSS Inc., Illinois, USA). Age, cyst duration, operative time, and follow-up duration were compared between the groups by using independent t tests. Sex, injured side,

recurrent, co-existing pathology, residual pain, complications, and recurrence were compared between the groups using Fisher's test. VAS, modified Mayo wrist, and DASH scores were compared between the groups using the Mann–Whitney U test. Tests were two-tailed, and p values of < 0.05 were considered statistically significant.

Results

Of the 49 patients, 1 presented with scaphoid nonunion and 1 died of a road accident 8 months after the operation. In the remaining 47 patients, there were 32 dorsal ganglions (18 in TCP, 14 in CSP) and 15 palmar ganglions (4 in TCP, 11 in CSP). Of the ganglions, 36 were primary (15 in TCP, 21 in CSP) and 11 were recurrent (7 in TCP, 4 in CSP). With regard to previous treatment in the recurrent ganglions, two aspirations and nine open excisions were stated. No significant differences were found between the groups in terms of demographic data (Table 1). During the operation, arthroscopy showed TFCC abnormalities in 15 patients (6 in TCP, 9 in CSP). Six TFCC lesions were repaired and nine lesions were debrided only. We also identified 28 scapholunate lesions (15 in TCP, 13 in CSP) and performed thermoshrinkage only for them. Only 4 ganglion stalks were identified in this study. Of these ganglion stalks, one was located in the midcarpal joint and three were in the radiocarpal joint nearby the scapholunate interval. The remaining patients showed hyperplasia synovitis. In terms of location,

Fig. 2 Establishment of a volar trans-cystic portal. We introduced a probe into the 3–4 portal and volar ganglion to facilitate the setup of the volar trans-cystic portal under the guidance of arthroscope in a 1–2 portal. After the prominence caused by the probe was identified, the skin over the probe was cut. Then, the arthroscope was placed into the trans-cystic portal to perform an excision of the residual stalk and ganglion tissue

Table 1 Demographic data of the patients

	TCP ($N=22$)	CSP ($N=25$)	p value
Age (years)	29.5 ± 6.34	34.3 ± 10.56	0.066[a]
Gender (female)	9 (40.9%)	17 (68%)	0.082[b]
Injured side (dominant)	9 (40.9%)	15 (60%)	0.248[b]
Duration (months)	19.3 ± 18.45	18.2 ± 13.24	0.811[a]
Recurrent	7 (31.8%)	4 (16%)	0.303[b]
Preop VAS	3.5 (2–7)	3 (2–7)	0.790[c]
Preop Mayo	65 (35–85)	60 (40–80)	0.417[c]
Preop DASH	29.6 (9.1–61.4)	29.5 (11.4–72.7)	0.781[c]
Follow-up (months)	33.1 ± 9.00	37.5 ± 9.15	0.102[a]

TCP trans-cystic portal technique, *CSP* cyst-sparing portal technique, *VAS* visual analog scale, *Mayo* modified Mayo wrist scores, *DASH* disabilities of arm, shoulder and hand outcome measure

[a]Analyzed using an independent *t* test

[b]Analyzed using a Fisher's test

[c]Analyzed using a Mann–Whitney *U* test

15 palmar ganglions arose from the interval of volar ligaments in the radiocarpal joint. Of the dorsal ganglions, there were 6 from midcarpal joint, 14 from radiocarpal joint and 12 from both.

Recurrence rates

During the follow-up, two patients (8%) in the CSP group had a recurrence. No recurrence was found in the TCP group. However, the number did not reach a significant difference. All the recurrences were found in the female patients. One patient received ganglionectomy in our early practice. In the other patient, MRI revealed a multi-lobulated cyst.

Clinical outcomes

At the final follow-up, no significant differences were found between the groups with regard to the VAS, modified Mayo wrist, and DASH scores. The median VAS scores in the TCP and CSP groups were 0.5 (0–3) and 1 (0–3), respectively ($p = 0.898$). Eventually, residual pain was found in four patients in the TCP group and three in the CSP group.

Complications

No major medical complications (acute myocardial infarction, cerebrovascular accident, pneumonia, etc.) were observed perioperatively. In the CSP group, one episode of extensor tendon injury was found during shaving of the dorsal capsule in our early practice. Fortunately, it was just a small laceration and the patient did not have any symptom in the follow-up. Two cases of ulnar-sided wrist pain occurred after ganglionectomy with simultaneous type IB TFCC repair in the CSP group. At the 6-month follow-up, the patients were doing well after the suture material was absorbed. Two patients, one in the CSP group and the other in the TCP group, had extensor tendonitis. The extensor tendonitis subsided at the 3-month follow-up. The numbers of complications in the TCP and CSP groups were one (4.5%) and four (16%), respectively ($p = 0.352$). Although the numbers of patients did not reach statistical significance, those in the CSP group tended to have a higher complication rate. The differences in clinical outcomes between the two groups are summarized in Table 2.

Discussion

The most important finding of this study was while performing arthroscopic resection of wrist ganglions, no significant difference was found between two techniques in terms of recurrence and complication rates, but no recurrence was observed when the TCP technique was used. Furthermore,

Table 2 Clinical results

	TCP (N = 22)	CSP (N = 25)	p value
Operative time (min)	88.6 ± 27.00	92.4 ± 25.67	0.627[a]
Co-existing pathology	17 (77.3%)	19 (76%)	1.00[b]
Postop VAS	0.5 (0–3)	1 (0–3)	0.898[c]
Postop Mayo	85 (65–100)	90 (70–100)	0.526[c]
Postop DASH	5.7 (0–27.3)	4.5 (0–27.3)	0.870[c]
Residual pain	4 (18.2%)	3 (12%)	0.690[b]
Complications	1 (4.5%)	4 (16%)	0.352[b]
Recurrence	0 (0%)	2 (8%)	0.491[b]

TCP trans-cystic portal technique, *CSP* cyst-sparing portal technique, *VAS* visual analog scale, *Mayo* modified Mayo wrist scores, *DASH* disabilities of arm, shoulder and hand outcome measure

[a]Analyzed using an independent *t* test

[b]Analyzed using a Fisher's test

[c]Analyzed using a Mann–Whitney *U* test

we also found a high incidence rate of co-existing intra-articular pathologies. The number of co-existing intra-articular pathologies in the TCP and CSP groups was 17 (77.3%) and 19 (76%), respectively. This is similar to current findings (52–100%) [11, 20] because most of our patients had painful ganglions. Not only recurrence rate but also residual pain rate is an important measure of treatment success, because patients will only seek treatment when their ganglions have become painful, enlarged, and interfering with activities [2, 3]. Several studies have described co-existing intra-articular lesions as the underlying cause of painful ganglions [5, 20, 21]. The residual pain rate has been reported to be as high as 23% [21]. We addressed all intra-articular lesions and treated them with arthroscopic aids. For residual pain, the incidence in the TCP and CSP groups was 18.2% and 12%, respectively. Both techniques achieved promising results.

However, treating other pathologies simultaneously will lead to a critical issue. It is completely unknown if the ganglion was the original cause for the clinical symptoms and if the resection of the ganglion did lead to the improvement of symptoms or the treatment of other pathologies. Other limitations also restrict the scope of this comparative investigation. First, although wrist ganglions are not uncommon, our number of cases was small. The reason is that we shared accurate information and addressed any misconceptions with the patients and eventually treated many pain-free ganglions conservatively. The small sample size limited the power of this study to detect a significant difference ($\alpha = 0.05$). Relative short-term follow-up is also a limitation of this investigation. Another limiting factor of the present study is its retrospective design. Therefore, randomized clinical comparison studies of different arthroscopic techniques for ganglion excision with long-term follow-up are warranted. Many different techniques have been proposed for patients who seek treatment for wrist ganglions. However, forceful rupture, aspiration, and steroid injection all have high recurrence rates [22–24]. Today, surgical excision has been the mainstay treatment for wrist ganglions [25]. Theoretically, arthroscopic excision has advantages of direct visualization of the stalk, a smaller incision with less destruction of surrounding structures, treating the co-existing intra-articular pathologies, and rapid functional recovery. However, no clinical study has shown that arthroscopic excision is superior to open excision [26]. Furthermore, Kang et al. [27] performed a prospective randomized comparison of recurrence rates between arthroscopic and open techniques, and reported that recurrence rates for arthroscopic excision (11%) were higher than those for open excision (9%).

In the early history of open excision of ganglions, recurrence rates were up to 40% [28]. Then, efforts have been made to delineate the deep attachments and ganglion stalk, and complete resection could be performed safely with lower recurrence rates [2]. Therefore, visualization and complete excision of the stalk are paramount in arthroscopic ganglionectomy [6, 29]. It is interesting that Kang et al. [27] reported that the stalk was visible in all arthroscopic resections but found recurrence in 3 (11%) of 28 patients in the arthroscopic group. By contrast, Edwards and Johansen [11] identified a discrete stalk in only 4 of 45 cases and no recurrences in their series. They concluded that identification of a discrete stalk is an uncommon finding and not necessary for successful resection [11, 21]. This is similar to our results. We found a discrete stalk in 4 of 47 cases. Furthermore, Wiedrich and Osterman [17] described that the intra-articular presentation of the ganglion could be a visible large stalk, an intra-ligamentous stalk, or focal hyperplasia synovitis. Currently, complete resection of the ganglion stalk, synovitis, or redundant dorsal capsule is the standard approach for arthroscopic ganglionectomy [5, 9, 13, 21].

Factors related to recurrence were more multifarious than the straightforward concept of residual stalks. The technical requirements for successful arthroscopic excision of ganglions remain to be defined. Chen et al. [8] were concerned that the resection of only the ganglion stalk without removal of the sac may yield slightly higher recurrence rates than the formal open resection of the sac and stalk. They recommended the use of an intra-focal cystic portal for both arthroscopic examination and shaving. Some surgeons also suggested using an intra-cyst portal to detect multi-lobulated cysts that may cause early recurrence [9]. In this study, we hypothesized that the use of an intra-cyst portal could decrease the recurrence rate after arthroscopic ganglionectomy. Although the difference in recurrence rate between the groups did not reach statistical significance, the TCP technique demonstrated a lower recurrence rate (0%). Edwards and Johansen [11] described that premature decompression of the cyst may obscure any presence of a

stalk while adopting the TCP technique. However, discrete stalks were identified in only 4 (9%) of 45 cases in their report. We identified a stalk, synovitis, or redundant capsule in all the patients. Eventually, two recurrences were found in our series, both in females. One had inadequate dorsal capsulectomy due to lack of surgical experience in our early practice. The other had a multi-lobulated cyst detected on MRI. Regarding the recurrence rates, a technique that could excise the stalk or hyperplasia synovitis and ganglion sac, and treat co-existing intra-articular pathologies, and preoperatively identify multi-lobulated cysts may achieve a lower recurrence rate.

Regarding complications, the incidence in the TCP and CSP groups were 4.5% and 16%, respectively. The complication rate of wrist arthroscopy is yet to be thoroughly evaluated. The creation of portals and introduction of instruments require a thorough knowledge of the wrist anatomy and appropriate surgical skill of the surgeon. Poor positioning of portals and forceful insertion of instruments may damage tendons, ligaments, cutaneous nerves, articular cartilages, and vascular structures [30]. Therefore, Wiedrich and Osterman [17] concluded that only those who have basic competency with wrist arthroscopy should perform this procedure. In our early practice, one case of extensor tendon injury was found during shaving of the dorsal capsule. Two cases of extensor tenosynovitis occurred after operation. Overly aggressive arthroscopic resection can result in extensor tendon injury. Some surgeons suggested placing the scope in a 6-R portal to obtain better visualization during dorsal capsulectomy [5]. Bain et al. [31] recommended using a tape-assisted technique to protect the extensor tendon while performing dorsal capsulectomy. Furthermore, we recommend performing arthroscopic ganglionectomy under local anesthesia. Under local anesthesia, the patient remains awake and will feel pain when the tissue outside the capsule is shaved. We could also evaluate the extensor tendon immediately after operation. When performing arthroscopic resection of volar wrist ganglions, the proximity of the major neurovascular structures must be considered because radial artery lesions, injury of the median nerve, and neuropraxis of the superficial radial nerve have been described [32]. Even in open excision of volar ganglions, injuries to the radial artery and median nerve have been reported [26, 33]. For the establishment of a volar trans-cystic portal, we modified the intra-focal cystic portal technique [8]. We introduced a probe into the 3–4 portal and volar ganglion to facilitate the setup of the volar trans-cystic portal under the guidance of an arthroscope in a 1–2 portal. No neurovascular injury was found in our patients.

In summary, while performing arthroscopic resection of wrist ganglions, both techniques are safe in terms of complication rates. Although surgeons can perform arthroscopic ganglionectomy using familiar techniques, only those with

basic competency of wrist arthroscopy should perform this procedure. After resection of the ganglion and treatment of other pathologies both groups achieved a lower residual pain rate. In recurrence rate, no significant difference was found between two groups, but no recurrence was observed when the TCP technique was used.

Compliance with ethical standards

Conflict of interest No competing interest was declared.

Ethical approval This retrospective study was approved by the institutional review board. The protocol no. was EMRP-102-006.

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