

# The Efficacy of Nonsurgical and Surgical Interventions in the Treatment of Pediatric Wrist Ganglion Cysts

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**Purpose** The treatment of ganglion cysts of the wrist remains understudied in the pediatric population, with the literature showing variable recurrence rates following different interventions. This study sought to determine whether surgical and nonsurgical management of pediatric ganglion cysts was associated with improved resolution rates when compared to observation alone.

**Methods** We identified 654 cases of pediatric ganglion cysts treated across 5 institutions between 2012 and 2017. The mean age at presentation was  $11.6 \pm 5.2$  years. Of the patients, 315 had >2 years (mean, 50.0 months) of follow-up, either via chart review or telephone callbacks. There were 4 different treatment groups: (1) observation, (2) cyst aspiration, (3) removable orthosis, and (4) surgical excision.

**Results** For patients followed >2 years, the cyst resolved in 44% (72/163) of those observed. Only 18% (9/49) of those treated with aspiration resolved, and 55% (12/22) of those treated with an orthosis resolved. Surgical excision was associated with resolution of the cyst in 73% (59/81) of patients. Observation had higher rates of resolution compared to aspiration. Orthosis fabrication and observation had similar rates of cyst resolution. Surgery had the highest rates of resolution when compared to observation and aspiration. Patients older than 10 years were less likely to have the cyst resolve with observation (35%; 28/80) than those younger than 10 years (53%; 44/83) at >2 years of follow-up.

**Conclusions** This study did not find evidence that nonsurgical treatments were associated with improved rates of cyst resolution compared to observation alone in a large pediatric sample. Surgical excision had the overall highest rate of resolution. Despite the costs and increased clinic time of orthosis fabrication and aspiration, these treatments were not associated with improved rates of cyst resolution in pediatric ganglion cysts compared to observation, with aspiration having higher rates of recurrence compared to observation. (*J Hand Surg Am.* 2022;47(4):341–347. Copyright © 2022 by the American Society for Surgery of the Hand. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Type of study/level of evidence** Therapeutic IV.

**Key words** Ganglion cyst, pediatric.

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**G**ANGLION CYSTS ARE THE MOST common soft tissue mass found in the upper extremity.<sup>1–4</sup> They can arise from various joint capsules or tendon sheaths, but most commonly occur at the wrist joint.<sup>1,5</sup> The pathogenesis is not fully understood, but it is suspected to be the result of repetitive microtrauma, which leads to the mucinous degeneration of the joint connective tissue or, potentially, a capsular rent allowing leakage of synovial fluid and subsequent pseudocapsule formation.<sup>1,6</sup> The cysts are often asymptomatic and many resolve spontaneously. However, some cysts can become painful and interfere with patient functioning or cause poor cosmesis, leading patients to seek intervention. Historically, ganglion cysts were sometimes treated by crushing the cyst at home, but more modern interventions include observation, orthosis fabrication, aspiration, and surgical excision.<sup>1,2</sup> Needling (repeated cyst puncture) and cortisone injections have also been used, although likely more frequently in the adult population than in children.<sup>7</sup>

Ganglion cysts arise in all age groups and populations, but are most commonly seen in the young adult female population, with an estimated 70% of cysts occurring in people aged 20–40.<sup>1</sup> Ten percent of ganglion cysts occur in patients under the age of 20, and only 1% to 2% of ganglion cysts occur in children under the age of 10.<sup>1</sup> Due to the relative underrepresentation of the pediatric age group among patients who present with a ganglion cyst, this population remains largely understudied. This is important because it is unclear whether pediatric ganglion cysts behave differently compared to their adult counterparts, and this condition commonly presents to the pediatric upper extremity specialist.

In children, the spontaneous resolution rate with observation alone ranges from 48% to 83% in the small cohorts that have been reported (50 patients or less). By comparison, there is a spontaneous resolution rate of 40% to 58% reported in the adult population.<sup>2,8,9</sup> Multiple studies of pediatric cysts have also reported higher rates of recurrence with aspiration and surgery compared to their adult counterparts, but most studies in the pediatric population are limited by relatively small samples, leading to variable conclusions and recurrence estimates.<sup>2,10–14</sup> Most patients present complaining of pain, unsightly cosmesis, and concerns for tumor.<sup>9</sup> Observation is certainly the preferred treatment for ganglion cysts that are not painful and do not interfere with function.

Because of these differences both in presentation and responses to treatment, ganglion cysts in the pediatric population require more study. When considering the surgical risk and difficulties of performing aspirations in children, it is important to confirm the benefit of such interventions. The aim of this study was to determine whether common interventions, such as orthosis fabrication, aspiration, and surgery, improved the rate of resolution of pediatric ganglion cysts when compared to observation alone.

## MATERIALS AND METHODS

Institutional review board approval was obtained from University of Texas Southwestern Medical School for this study. A retrospective chart review of 654 cases of pediatric wrist ganglion cysts was completed. Patients were treated across 5 large, pediatric, hospital-based institutions between the years 2012 and 2017. All patients 18 years old and younger were included. Patient charts were identified by using all applicable International Classification of Disease codes or by conducting a diagnosis-based query of each institution's data management system. Cysts located elsewhere than the wrist (such as flexor tendon sheath ganglions) were excluded. Both demographic information and treatment details were collected, including cyst location and size, prior trauma, original treatment plan, course of treatment, cyst recurrences, complications, and last date of follow-up. Due to the limits of retrospective chart reviews, as well as limitations of parental recollection, we were unable to precisely categorize which cysts recurred rather than persisted after treatment. The term “recurred” is used to describe any cyst that was present at the time of follow-up.

To determine the ultimate outcome of the cyst, telephone callbacks were attempted for all patients to obtain at least 2 years of follow-up from the time of initial treatment and to eliminate the bias of only studying patients who chose to follow-up in the clinic for persistent ganglion cysts. The interview was performed by an author who was not involved with the clinical care of the patient. During these calls, families were asked about the current state of the cyst and whether they ever sought additional treatment. If a callback was unable to be completed, the date of the last clinical visit was used to determine the length of follow-up time. Patients were also analyzed by age, dichotomizing at age 10 years based on previous studies demonstrating a difference

in both cyst locations and rates of cyst persistence in those under 10 years compared to those over the age of 10.<sup>2,9,14</sup>

Four different treatment groups were identified: (1) observation, (2) cyst aspiration, (3) removable orthosis, and (4) surgical excision. No patients underwent needling or rupture of the cyst in clinic. A chart review did not provide consistent details regarding the success, amount, or appearance of the aspiration. Patients who initially chose observation but later underwent surgery due to a lack of cyst resolution did not cross over to the surgery group.

### Statistical methods

A chi-square or Fisher exact test was used for categorical variables, as appropriate. The 4 treatment groups were compared, followed by a *post hoc* pairwise comparison, adjusting for multiple comparisons using the Bonferroni method. Statistical significance was set at a *P* value < .05. A power analysis was performed, assuming that the surgery group was 50% of the observation group and estimating a difference of the resolution rate to be at least 20%. This estimated required sample sizes of 73 for surgery and 146 for observation to provide 80% power at the 5% significance level.

### RESULTS

Of 654 patients, 416 were female (64%) and 238 were male (36%). The mean age at presentation was  $11.6 \pm 5.2$  years (range, 147 days to 18 years). Of the cysts, 333 (51%) occurred on the left wrist and 314 (48%) occurred on the right wrist. Laterality was unknown in 3 patients. Of the cysts, 460 (70%) were dorsal, 192 (29%) were volar, and 2 had an unknown location. Twelve percent of cysts (76) were associated with a prior injury or trauma to the area, whereas 88% (578) had no known related injury. The most frequent initial treatment was observation (49.7%), followed by surgical excision (26%), aspiration (15%), and orthosis fabrication (10%; Fig. 1).

Of the patients, 315 (48.2%) had >2 years of follow-up via either chart review or telephone callbacks. The median follow-up time for this group was 46 months (range, 24–119 months; Table 1). The demographics of this group were similar to those of the larger cohort of 654 patients with ganglion cysts. Of these 315 patients, 99 had >2 years of follow-up in the chart, and 50 of these were able to be contacted for telephone callbacks. The other 216

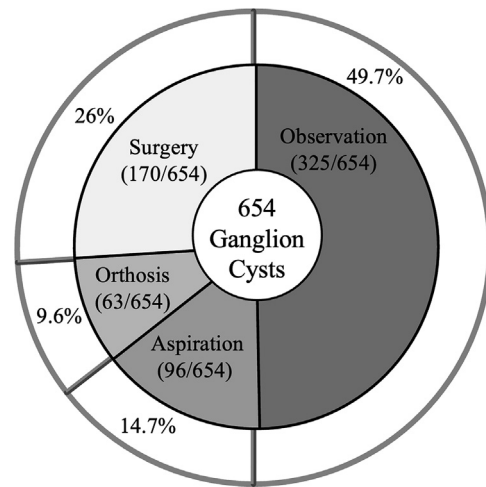


FIGURE 1: Patients across treatment groups.

patients had >2 years of follow-up via telephone callbacks only.

The presence or absence of pain, but not the pain level, was documented for 284 of the 315 patients at the initial visit. Pain was present in 28% (41/144) of patients observed, 60% (28/47) of patients choosing aspiration, 68% (13/19) of patients who were treated with orthosis fabrication, and 42% (31/74) of those treated with surgery.

The rate of resolution across all 4 treatment modalities was 48.3% (152/315). Surgical excision had the highest rates of resolution (72.8%; 59/81). Aspiration had the lowest rate of resolution (18%; 9/49; Table 2). For nonsurgical treatments, observation had higher rates of resolution than aspiration, but not compared to orthosis fabrication alone (Table 3). Of the 49 patients who underwent aspiration, 13 patients also had a concurrent intracyst steroid injection. The resolution rate was 19.4% (7/36) for patients who had aspiration alone and 15.4% (2/13) for those who had aspiration with a steroid injection. When comparing surgical excision to nonsurgical treatments, surgical excision had higher rates of resolution than both observation and aspiration, but not when compared to orthosis fabrication alone. For the 22 patients who had recurrent cysts after surgery, the time to recurrence was available for 10 patients, with a median time to recurrence of 28 months after surgery (range, 2–89 months).

Patients  $\leq 10$  years of age at presentation had higher rates of resolution (56%; 63/113) than patients >10 years of age (44%; 89/202). The younger cohort also had higher resolution rates with observation alone compared to the older

**TABLE 1. Mean Length of Follow-Up of Treatment Groups (P < .05)**

Treatment Group	Mean, mo	SD	Median, mo	Range, mo
Observation (n = 163)	53.9	21.4	54.0	24–107
Aspiration (n = 49)	38.1	19.2	28.6	24–119
Orthosis (n = 22)	66.3	23.9	64.5	24–113
Surgery (n = 81)	44.3	17.4	39.0	24–101
Total (n = 315)	49.8	21.6	46.0	24–119

**TABLE 2. Resolution Rates After >2 Years of Follow-Up (n = 315)**

Treatment Group	Resolution, % (n/N) [95% CI]
Observation	44.2% (72/163) [36.5% to 51.8%]
Aspiration	18.4% (9/49) [7.5% to 29.2%]
Orthosis	54.5% (12/22) [33.7% to 75.4%]
Surgical Excision	72.8% (59/81) [63.2% to 82.5%]

cohort (Table 4). In patients >10 years of age, 80% (342/430) of cysts were dorsal, 20% (87/43) were volar, and 1 was unknown. For patients ≤10 years of age, cysts were still more common on the dorsal aspect of the wrist, although with a much smaller majority, with 53% dorsal (118/224) and 47% volar (105/224).

Resolution rates were similar between cysts in patients of different sexes, cysts appearing on the dorsal versus volar side of the wrist, or cysts associated with a previous injury and those without prior injury (Table 5).

Of the 91/163 cysts that did not resolve after initial observation, 16 had subsequent aspiration with a 25% resolution rate (4/16) and 51 were surgically excised with a 74% resolution rate (38/51; Fig. 2). Of the cysts that did not resolve following initial aspiration (40/49), 24 were subsequently surgically excised. The postaspiration surgical treatment group only demonstrated a 58% (14/24) resolution rate compared to a 73% (59/81) resolution rate in the primary surgical treatment group.

## DISCUSSION

Although pediatric ganglion cysts are commonly encountered by upper extremity specialists, how to best treat them remains unclear, with prior studies showing variable recurrence rates across interventions. Prior studies show that surgery is associated with higher rates of cyst resolution in both children and adults (65% to 94%) as compared to

other interventions.<sup>7,10,14</sup> Our study examined the outcomes of various treatments for pediatric wrist ganglion cysts in a cohort of 654 children. We found aspiration to be associated with increased cyst recurrence when compared to observation and orthosis fabrication, regardless of the aspiration technique. These findings are in line with the adult literature, with a recent meta-analysis showing that aspiration was not associated with a significant reduction in cyst recurrence when compared to observation in the adult population.<sup>7</sup> Surgical excision had the highest rates of resolution overall, but still demonstrated a nearly 30% recurrence rate in our study, which is consistent with previously published recurrence rates of 6% to 35%.<sup>12,14</sup> Potential complications from surgical excision of pediatric ganglion wrist cysts include scar problems (1%–13%), joint stiffness (10%), infection (1%–3%), dysesthesias (2%–3%), weakness (3%),<sup>9,13</sup> and even iatrogenic removal of the radial artery with a volar cyst.<sup>3</sup> These must be discussed when considering surgery. Due to the potential risks of anesthesia on the developing brain, the authors recommend observation in infants and toddlers presenting with a ganglion cyst.

While aspiration in our cohort had a lower resolution rate than the 62% resolution rate reported by Colberg et al<sup>15</sup> in their series of 21 patients aspirated under anesthesia and injected with steroid, our findings were consistent the recent study by Zinger et al<sup>9</sup> who reported recurrence in all 4 of their aspirated (without steroid injection) pediatric ganglion cysts. Aspirations have also been shown to affect future surgery, as 1 study showed that aspiration prior to surgical excision was associated with a 25% increase in postsurgical cyst recurrence in the pediatric population, a trend that was also appreciated in our data, with only a 58% resolution rate in our postaspiration surgical treatment group compared to a 73% resolution rate in our primary surgical treatment group.<sup>13</sup> Although it is unknown why prior aspiration is associated with a decreased resolution rate after

**TABLE 3. Pairwise Comparison of Resolution Rates Across Interventions After >2 Years of Follow-Up (n = 315)**

Treatment Group	Observation (44%, 72/164)	Aspiration (18%, 9/49)	Orthosis (55%, 12/22)	Surgery 73% (59/81)
Observation	—	—	—	—
Aspiration	<b>P &lt; .05</b>	—	—	—
Orthosis	P = .36	<b>P &lt; .05</b>	—	—
Surgery	<b>P &lt; .05</b>	<b>P &lt; .05</b>	P = .10	—

Bold value indicates statistically significant difference.

**TABLE 4. Resolution Across Patients Aged 10 Years and Older Compared to Less Than 10 Years (>2 Years of Follow-Up)**

Treatment Group	Resolution in Patients ≤10 Years Old (n/N) [95% CI]	Resolution in Patients >10 Years Old (n/N) [95% CI]
Observation	53% (44/83) [42% to 64%]	26% (28/110) [17% to 34%]
Aspirate	30% (3/10) [2% to 58%]	15% (6/39) [4% to 27%]
Orthosis	75% (3/4) [33% to 117%]	50% (9/18) [27% to 73%]
Surgery	81% (13/16) [62% to 100%]	71% (46/65) [60% to 82%]

**TABLE 5. Resolution Across Various Cyst Demographics (>2 Years of Follow-Up)**

Demographic and Clinical Characteristics	Resolution (n/N) [95% CI]
Male	52% (59/114) [43% to 61%]
Female	52% (104/201) [45% to 59%]
Dorsal	54% (123/228) [48% to 60%]
Volar	46% (40/86) [36% to 57%]
Left	54% (87/161) [46% to 62%]
Right	49% (74/152) [41% to 57%]
Prior Trauma	43% (19/44) [29% to 58%]
No Prior Trauma	53% (144/271) [47% to 59%]

surgical excision, hypotheses include scarring, leading to disrupted surgical planes with a more difficult dissection, or wide or aberrant stalks, leading to incomplete excision.<sup>13</sup>

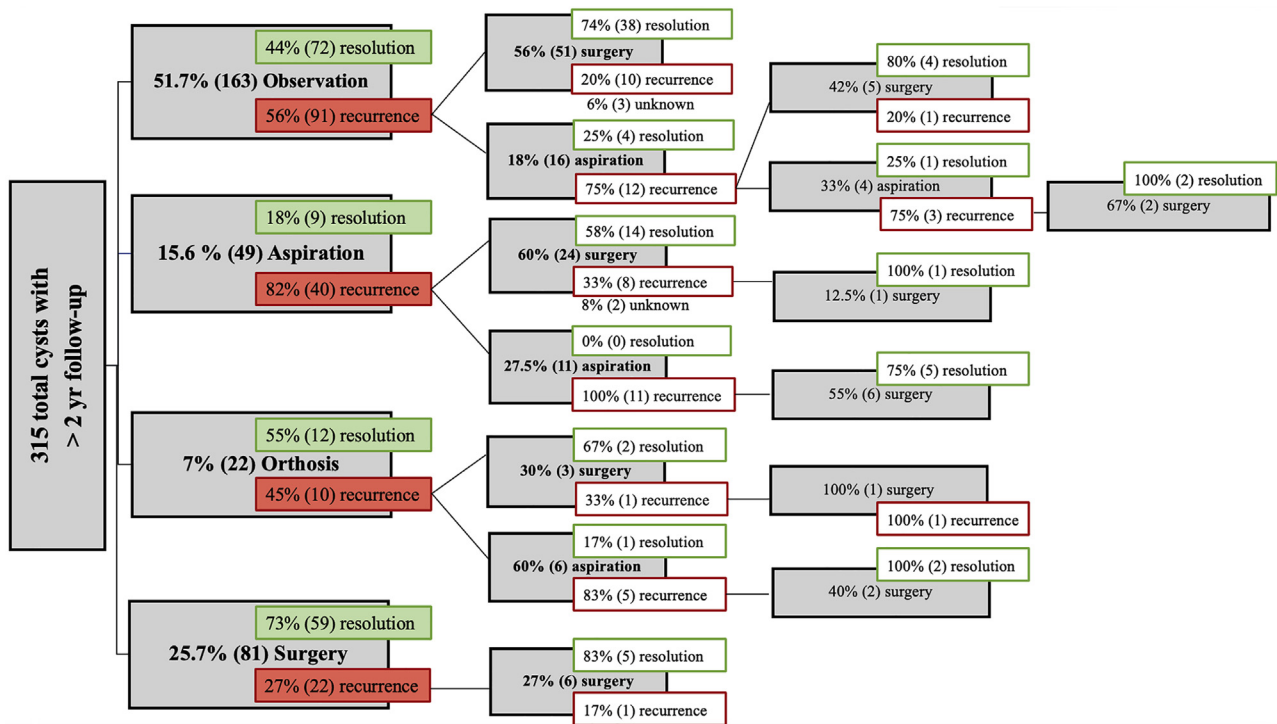
Previous studies have shown that in children under the age of 10, cysts appear more commonly on the volar wrist (58% to 77% of cases), as compared to the dorsal location that is more common in adults (60% to 70% of wrist ganglia) and in children over the age of 10 (73%).<sup>2,14,16</sup> In our cohort, patients aged 10 years and under had cysts on the volar wrist (47%; 10/244) more commonly than those who were older than 10 years of age (20%; 87/430). Similar to the study by Zinger et al,<sup>9</sup> we found that patients who

were older had a lower rate of cyst resolution as compared to younger patients.

There are several limitations and weaknesses to this study, most importantly the inherent limitations of the study's retrospective design, as well as only having 48% of our patient cohort with >2 years of follow-up after initial treatment. The impact of loss of follow-up to the magnitude of the treatment effect is potentially considerable and could result in either an overestimation or underestimation of the rate of cyst resolution. In addition, a determination of cyst resolution was done for some via phone interviews and was therefore subject to the parent report instead of being evaluated by a clinician, leading to both recall and ascertainment bias. Postoperative scarring may be difficult to differentiate from a recurrent cyst, or an occult cyst may recur without visible signs to a parent. Uniform assessment by a physician for all patients in the cohort would standardize assessment of cyst resolution.

A *post hoc* power analysis showed that for the 2 treatment groups with the most similar resolution rates, observation (44% resolution rate) and orthosis fabrication (55% resolution rate), the sample was underpowered to detect differences.

Since data were collected across multiple institutions, the cysts were treated by various surgeons and techniques, which possibly had an impact on the outcomes. This is also somewhat of a strength,



**FIGURE 2:** Secondary interventions for patients with >2 years of follow-up.

however, because it may make our findings more generalizable than those of a single-institution study. The lack of established indications for the various treatments of pediatric ganglion cysts, especially when comparing 5 different centers, likely led to selection bias in the different treatments, with more symptomatic cysts being treated more often with surgery. However, this scenario reflects clinical practice. The authors are unaware of any published indications of when to offer orthosis fabrication, aspiration, observation, or surgery, other than family preference. As much of the treatment of pediatric ganglion cysts is anecdotally driven by parent and patient preferences, a standardized, prospective study design would overcome the many methodological weaknesses and eliminate the recall bias and ascertainment bias of this retrospective study.

The presence of pain was also markedly different among treatment groups, potentially signifying increased severity of the condition and leading to more treatment, as pain was present in only 28% of observed patients but present in 42% to 68% of those in the other 3 treatment groups. The presence and severity of pain may have led to bias in the selection of treatment.

Despite the methodological limitations of this study, it offers new information for physicians when counseling pediatric patients with ganglion cysts of the wrist. The authors no longer offer aspiration or

orthosis fabrication as methods of definitive treatment of pediatric ganglion cysts, although aspiration may be offered as a temporizing method for children who are experiencing limitations in sports and activities and wish to defer possible surgery to a more convenient time if the cyst recurs after aspiration. Orthosis fabrication may be offered to alleviate pain symptoms associated with cyst irritation caused by wrist motion, but not as a treatment that would be expected to lead to cyst resolution. These recommendations preserve time and resources by reducing procedures that are not beneficial and unnecessarily invasive, particularly in the pediatric age group. When discussing treatment options for pediatric ganglion cysts, physicians should counsel families on the relatively high recurrence rate of all treatment options, but that spontaneous resolution will occur in almost half of patients with observation alone.

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