Operative versus conservative treatment of trigger thumb in children

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Abstract
Trigger thumb is an uncommon anomaly in children with controversial management ranging from simple observation to surgical release. This study aimed to determine the clinical outcomes of surgical release versus conservative treatment. Data from 407 children with 511 trigger thumbs were collected from their medical records. To compare the final outcomes of conservative and operative treatments, age at onset, sex, affected side, familial history, treatment modality, time to conversion from conservative to surgical treatment, recurrence, and complications were analyzed. Forty-one children were excluded owing to loss during follow-up; thus, 366 children were finally included. Conservative treatment was administered to 96 children, of whom 25 experienced successful result and 68 experienced treatment failure and were subsequently treated surgically. There were no cases of post-operative recurrence. After 24 months of age, operative treatment had better outcomes than conservative treatment, which showed a higher failure rate.

Keywords: children, conservative treatment, operative treatment, trigger thumb

1. Introduction
Pediatric trigger thumb is an uncommon anomaly with a reported incidence of up to 3.3 cases per 1000 live births at 1 year of age. Its etiology remains unclear and controversy persists, which is thought to be the result of a mismatch in the size of the flexor pollicis longus tendon and the A1 pulley. Electron microscopic analysis revealed large amounts of mature collagen and fibroblasts without degenerative or inflammatory changes at the A1 pulley and Notta’s nodule in affected individuals.

The ideal treatment for pediatric trigger thumb is controversial. Operative treatment involves release of the A1 pulley, while conservative treatment methods include passive extension exercises, extension splinting, and simple observation. Several recent studies provided support of conservative treatment, although many authors recommend A1 pulley release as a simple, reliable, and definite treatment. In one study, a 63% successful result was reported after simple observation.

This study aimed to determine the clinical outcomes of surgical versus conservative treatment in pediatric trigger thumb.

2. Materials & methods
The study protocol was approved by the Catholic Medical Center Institutional Review Board (VC19RESI0009).

To compare the final outcomes of conservative and operative treatment, a total of 407 children (511 trigger thumbs) treated in 1 institute in 1996 to 2018 were consecutively enrolled prospectively. Among the 407 children, 41 children were excluded due to follow-up loss; thus, 366 children were finally included. The treatment was performed by a pediatric orthopedic surgeon.

Data were obtained from the patients’ medical records. To compare the final outcomes of conservative and operative treatment, the effects of age at onset, sex, affected thumb, familial history, treatment modality, time to conversion from conservative to surgical treatment, recurrence, and complications were analyzed. Conservative treatment included passive extension exercises and periodic observation, while operative treatment involved open A1 pulley release. Conservative treatment was performed in children younger than 24 months or in those older than 24 months whose parents refused surgical treatment. Surgery was performed in children older than 24 months or in those younger than 24 months whose parents wanted quick resolution. Treatment success was defined as no recurrence at 1 year after symptom resolution. Verification of long-term recurrence or complications was conducted through a telephone survey.

Statistical analyses were performed using International Business Machines Corporation Statistical Package for the Social Sciences Statistics for Windows, Version 26.0 (International Business Machines Corporation Corp., Armonk, N.Y.). Continuous variables are expressed as mean ± standard error.
deviation, while non-continuous variables are described as number and percentage. The comparison was performed using the Kruskal–Wallis and chi-square tests. All data were considered significant at $P < .05$.

3. Results
The children recruited in this study were 6 months to 12 years of age. A total of 227 children were under the age of 3 years, while the other 139 children were over the age of 3 years. Of them, 135 were 3 to 8 years of age and 4 were > 8 years of age. The female-to-male ratio was 196 to 170, with no statistically significant difference. Bilateral involvement was noted in 97 children (26.5%) versus unilateral involvement in 269 children (73.5%). 144 [39.3%] on the right and 125 [34.2%] on the left). Of the bilateral cases, 77 children (154 thumbs) initially presented with bilateral involvement, while the other 20 children (40 thumbs) initially presented with unilateral involvement but later demonstrated bilateral involvement. In 3 bilateral cases, 1 side spontaneously resolved and the opposite side was treated surgically. These 3 cases were excluded from the determination of the outcomes of conservative versus operative treatment. Twelve patients had a family history of pediatric trigger thumb, and 2 were twins (Table 1).

Treatment took 6 to 36 months. Conservative treatment was performed in 96 children, of whom 64 were younger than 24 months and 32 were older than 24 months. Of them, 68 required conversion to operative treatment. Operative treatment was performed on a total of 338 patients (421 thumbs): 270 cases (332 thumbs) in which surgical treatment was initially chosen and 68 cases (89 thumbs) in which conservative treatment was converted to operative treatment. None of the surgically treated patients experienced recurrence at 1 year after surgery (100% success rate) versus 26.9% of the conservatively treated patients. No complications occurred during or after treatment (Table 2).

Conservative treatment failure occurred in 44 of 63 children younger than 24 months versus in 24 of 30 children aged older than 24 months. The success rate was 30.2% (failure rate, 69.8%) for children younger than 24 months versus 20% (failure rate 80%) for children older than 24 months (Table 3). As the age at first presentation increased, conservative treatment was less likely to be successful.

Cystic degeneration of the flexor pollicis longus tendon occurred in 15 of 338 patients who underwent operative treatment. Pathology revealed myxoid degeneration and fibrosis. In the case of cystic degeneration of the flexor pollicis longus tendon, 3 patients were younger than 3 years old and 12 were older than 3 years old, showing a tendency of the condition to increase with age (Fig. 1).

4. Discussion
For the treatment of pediatric trigger thumb, operative treatment involves A1 pulley release, while conservative treatments include simple observation, extension splinting, and passive extension exercise. Operative treatment is performed if conservative treatment fails. Although many studies have compared operative and conservative treatments, the ideal treatment remains controversial. In a study from 1974 by Dinh and Meggitt(5) of 105 patients (131 thumbs), operative treatment was performed in 105 thumbs and conservative treatment was performed in 26 thumbs, in which successful result occurred in 19 thumbs. In this study, there were cases older than 4 years of age in which flexion contracture persisted after operative treatment; thus, operative treatment should be performed for children diagnosed after 3 years of age. In addition, conservative treatment showed an approximately 73% success rate, which was quite high. In our study, conservative treatment was chosen in 96 cases, among which successful result occurred in 23 (26.9%). Success rates of 30.2% and 20% were achieved for children younger than 24 months versus those older than 24 months. There were no cases of remaining flexion contractures after operative treatment. Both studies agreed that as age increases, conservative treatment alone cannot easily resolve the condition. However, Skov et al(6) observed 37 children (40 thumbs) who underwent operative treatment for a mean 69 months. No cases of residual flexion contracture, neurologic complications, or scar-related complications occurred, even if operative treatment was delayed until beyond 3 years of age. Han et al(7) performed surgery on

### Table 1
Baseline characteristics of the study subjects.

| Number of patients (n) | 366 |
|------------------------|-----|
| Mean age at presentation (months) | 33.0 ± 20.2 |
| Onset (mo) | 7.7 ± 12.0 |
| Gender - Male (n,% | 170 (46.4) |
| Affected thumb (%) | 0 (0.0) |
| Unilateral | 269 (73.5) |
| Right | 144 (39.3) |
| Left | 125 (34.2) |
| Bilateral | 97 (26.5) |
| Family history (%) | 12 (3.3) |
| Palpable nodule (%) | 239 (65.8) |
| IP joint flexion contracture (%) | 312 (88.1) |
| Treatment modality (%) | 0 (0.0) |
| Operative treatment | 270 (73.8) |
| Unilateral | 215 (79.6) |
| Bilateral | 55 (20.4) |
| Conservative treatment | 93 (25.4) |
| A1 pulley hypertrophy (%) | 337 (92.8) |
| Residual flexion contracture (%) | 0 (0.0) |

Data are number (percentage), means ± SD.

### Table 2
Operative versus conservative treatment.

| Number of patients (n) | 270 | 93 |
|------------------------|-----|-----|
| Age at presentation (mo) | 36.6 ± 19.5 | 22.5 ± 18.6 |
| Onset (mo) | 8.5 ± 12.9 | 5.1 ± 7.2 |
| Gender - Male (n,% | 125 (46.3) | 44 (47.3) |
| Affected thumb (%) | 0 (0.0) | 68 (73.1) |

Data are number (percentage), means ± SD.

### Table 3
Treatments provided by age.

| Age < 24 mo | Conservative care | Surgery | P value |
|-------------|-------------------|---------|---------|
| Success | 19 (30.2) | 66 (100.0) | <.001 |
| Failure | 44 (69.8) | 0 (0.0) |

| Age ≥ 24 mo | Conservative care | Surgery | P value |
|-------------|-------------------|---------|---------|
| Success | 6 (20.0) | 204 (100.0) | <.001 |
| Failure | 24 (80.0) | 0 (0.0) |
23 children (31 thumbs) with a mean age of 7.5 years. Although the patients were older, every flexion contracture completely resolved by 8 weeks postoperative. Although the results were similar to those of our study in that there were no complications of operative treatment regardless of age, cystic degeneration of the flexor pollicis longus tendon tends to occur when children are older than 3 years or the affected period of flexion contracture was longer, suggesting that operative treatment should not be delayed. In 1991, Ger et al. [7] reported providing a mean 40 months of conservative treatment in 41 children (53 thumbs) diagnosed before 6 months of age that required conversion to operative treatment since successful result did not occur. No cases of residual flexion contracture occurred and operative treatment was successful, but extended time was required for full range of motion recovery. Similar to our study showing a low success rate of conservative treatment, it shows good outcomes and must not be delayed.

Dunsmuir and Sherlock [6] reported that 49% of patients showed successful result at a mean 7 months of conservative treatment. A total of 61 children over 3 years of age underwent conservative treatment, showing no residual flexion contracture with full range of motion recovery. Therefore, they recommended sufficient time for observation since the delay of operative treatment caused no complications. Lee et al. [8] reported that conservative treatment by extension splinting in 50 children (62 thumbs) had a 71% success rate, superior to that of simple observation (23%). A prospective study by Jung et al. [9] performed only passive extension exercises on 30 children (35 thumbs) with a mean age of 28 months showed successful result in 28 thumbs (80%). This failure rate was higher in patients with bilateral involvement and fixed flexion contracture.

Watanabe et al. [10] reported 96% successful result in 48 children (60 thumbs) by passive extension exercise, showing better results than simple observation by combining manual therapy. They also devised a classification of trigger thumb to assess the effectiveness of conservative treatment. On the other hand, in our study, most patients presented with stage 3 (fixed flexion contracture) disease at the initial visit. The final result was considered successful only when stage 0 (normal) was achieved. As a result, the success rate of nonsurgical treatment appeared lower. The association between bilateral involvement and failure of conservative treatment was not statistically significant.

A study of 64 children by Koh et al. [11] reported a 60% successful result after a mean 59 months by simple observation and 92% successful result after a mean 22 months by extension bracing (allowing passive extension of the interphalangeal joint and limiting metacarpophalangeal joint hyperextension). This was the same result as that of the study by Watanabe et al. [10] in which the success rate of extension splinting was higher. A prospective study by Baek et al. [11] provided conservative treatment to 53 children (71 thumbs), and 45 thumbs (63%) showed successful result with only simple observation.

This was a retrospective study of 407 children (511 thumbs) treated in a single institute by a single pediatric orthopedic surgeon. The results of conservative treatment of 96 children (118 thumbs) and operative treatment in 341 children (424 thumbs) were analyzed. This study included a larger number of cases than previous studies. We noted no cases of serious complications, residual flexion contracture, or recurrence, and patients and parents reported high satisfaction after operative treatment. Although successful result was achieved with conservative treatment, the treatment period was prolonged, patients were often lost to follow-up, or the parent did not want further waiting; thus, operative treatment was commenced.

This study has several limitations. It was a retrospective study based on medical record review. Since the selection of treatment modality and assessment of results was performed by only 1 surgeon and operative treatment was conducted regardless of age or upon parent request, there could have been selection bias. Further prospective randomized controlled trials of operative versus conservative treatment are needed.

5. Conclusion

In children older than 24 months, operative treatment had better results than conservative treatment; conservative treatment was more likely not to resolve the symptoms; and complications such as cystic degeneration of the flexor pollicis longus tendon may result if treatment is prolonged or delayed. Therefore, our findings suggest that children younger than 24 months of age can be conservatively observed for a certain period of time, whereas children older than 24 months should receive operative treatment.

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