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Pediatric Trigger Thumb with Metacarpophalangeal Joint Hyperextension or Instability

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

BEF Sheng Jin*
CD Kaiying Shen*
AG Yunlan Xu

Department of Pediatric Orthopedics, Shanghai Children's Medical Center, Shanghai Jiaotong University School of Medicine, Shanghai, P.R. China

* Sheng Jin and Kaiying Shen are first author and contributed equally to this work

Corresponding Author: Yunlan Xu, e-mail: xylproscmc@163.com

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Background: The aim of this study was to provide the first on report on the mechanism and the different treatment measures of metacarpophalangeal joint hyperextension (MCPH) or metacarpophalangeal joint instability (MCPI) in cases of pediatric trigger thumb. Some pediatric trigger thumb patients have disease combined with excessive extension of metacarpophalangeal (MCP) joint or instability of MCP joint.

Material/Methods: A total of 1083 children with trigger thumb surgery were divided into 2 groups (the MCPH group and the MCPI group) by the extension degree of the MCP joint. After tendon sheath released, the MCPH group was treated by a cast and the MCPI group was treated by a cast and a brace. We compared the differences in baseline data and the further functional activities of interphalangeal (IP) and MCP joint between the 2 groups.

Results: Among the 1083 cases, 154 cases (185 thumbs) were trigger thumb with MCPH or MCPI, of which 167 thumbs were placed in the MCPH group and 18 thumbs were placed in the MCPI group. The average age of the MCPH group was 2.8 years, with an average duration of disease of 13 months. The average age of the MCPI group was 6.6 years, with an average duration of disease of 33 months. MCPH still existed after cast removal. In the MCPI group, 12 out of 18 thumbs recovered; 6 thumbs relapsed at 2-4 months after brace removal.

Conclusions: Trigger thumb with MCPH and MCPI in children is significantly associated with multi-joint laxity. While there was still MCPH after cast treatment, there was no need for further treatment during the short-term follow-up. Cast and brace treatment after surgery was a simple, easy method for treatment of MCPI and had a good effect.

MeSH Keywords: Joint Instability • Metacarpophalangeal Joint • Pediatrics • Trigger Finger Disorder

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Background

Both the etiology and treatment strategy of trigger thumb in children are controversial at present. Congenital, traumatic, and acquired factors are all considered possible causes of this disease [1–4]. Most scholars now generally agree that the condition of trigger thumb in children cannot heal by itself. It is necessary to release the trigger thumb and remove part of the A1 tendon sheath by surgery [2,5]. However, some scholars have reported that the self-healing rate of trigger thumb in children could reach 10% to 50% [3,6,7]. A Japanese author reported that the success rate of conservative treatment with splints was as high as 89% [8].

The clinical features of trigger thumb in children are usually manifested as thumb interphalangeal (IP) joint with limited extension and palmar of metacarpophalangeal (MCP) joint with Notta nodule that can be touched. Besides these features, however, we also found that some children had MCP joint hyperextension (MCPH) or thumb self-controlled click, manifested as MCP joint instability (MCPI), and most of these children had multi-joint laxity concurrently. Therefore, we consider that trigger thumb combined with MCPH or MCPI may be associated with multi-joint laxity. An American author reported that MCP joint volar plate advancement was performed for MCPH while the trigger thumb was treated surgically [9]. The aforementioned study only described the operation method and did not mention the cause of MCPH. As far as we know, except for the aforementioned article, no literature has reported the cause, or the treatment of pediatric trigger thumb combined with MCPH or MCPI. The purpose of this study was to report the mechanism of MCPH and MCPI in pediatric trigger thumb patients and the different treatment for these 2 MCP joint manifestation.

Material and Methods

Following approval from the institutional review board, a series of 1083 consecutive pediatric patients who had trigger thumb surgery (1366 thumbs) in our center from 2010 to 2018 are retrospectively analyzed. The indication for surgery was the following: children older than 2 years old, with painful triggering, and a locked IP joint (Sugimoto stage IV). Among these patients, 154 cases (185 thumbs) were complicated with MCPH or MCPI. We defined the MCPH group as having an MCP joint that could be further extended to 30°–70° after extending the MCP joint to 0° (Figure 1), and the MCPI group was defined by the self-controllable click of MCP joint in the process of MCPH (Video 1). According to the Beighton score [10] which is usually used to assess the joint hypermobility (Table 1), the children who meet 3 or more items of the Beighton score at the same time were identified as having multi-joint laxity (Figure 2). The data collected for the 2 groups included age, duration of disease, history of passive thumb exercise or brace treatment, family history, and whether or not the patients suffered from multi-joint laxity.

Both groups underwent flexor pollicis longus tendon sheath release and partial resection of A1 trochlear. In follow-up treatment, the MCPH group was treated by a cast with the IP joint in an extending position and the MCP joint in a 20° flexion position. After one-week, joint function exercises were started after the removal of the cast. The MCPI group in the first week was treated the same as the MCPH group. But after 1 week, part of the cast was removed to restore the IP joint functional activity and MCP joint was still in 20° flexion position for 5 weeks. After 5 weeks, the patients began to use a brace in order to prevent the MCP joint posterior subluxation. Except for the time of passive functional exercises for the IP joint 3 times a day, the patients were required to wear the brace for 6 weeks.

Statistical analysis was used to compare the differences in baseline data between the MCPH group and the MCPI group, and to observe the functional activities of the IP joint and the MCP joint after treatment. Statistical analysis was conducted with SPSS 18.0 software. The independent *t*-test was used to compare continuous variables and the χ^2 test was used to

Table 1. The Beighton score for multi-joint laxity.

Items	Points
Passive hyperextension >90° of the fifth finger with the palm and wrist touching a solid surface (measured bilaterally)	2
Passive flexion of the thumb to touch the volar aspect of the forearm (measured bilaterally)	2
Passive hyperextension >10° of the elbow with the upper limb extended and the palm turned up (measured bilaterally)	2
Passive hyperextension >10° of the knee while the subject stands up (measured bilaterally)	2
Standing trunk flexion with knee fully extended to touch the floor with both palms flat	1
Interpretation: For children: Score ≥6: positive; Score <6: negative; For adults: Score ≥5: positive; Score <5: negative	

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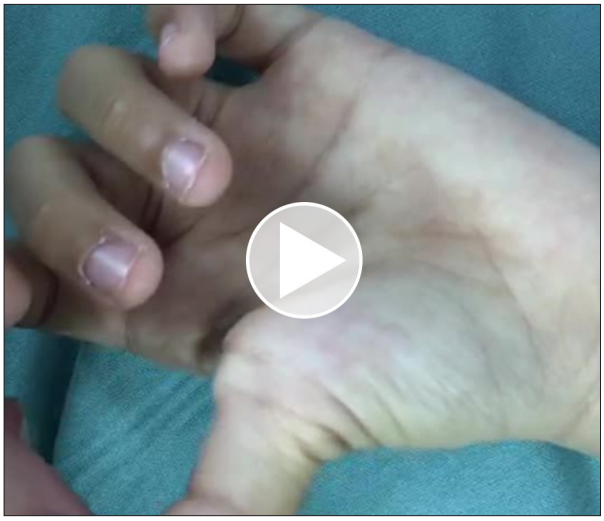
Figure 1. Metacarpophalangeal joint hyperextension. We defined the metacarpophalangeal joint hyperextension group for the metacarpophalangeal joint can be further extended to 30–70° after extending metacarpophalangeal joint to 0°.



Video 1. Metacarpophalangeal joint instability.

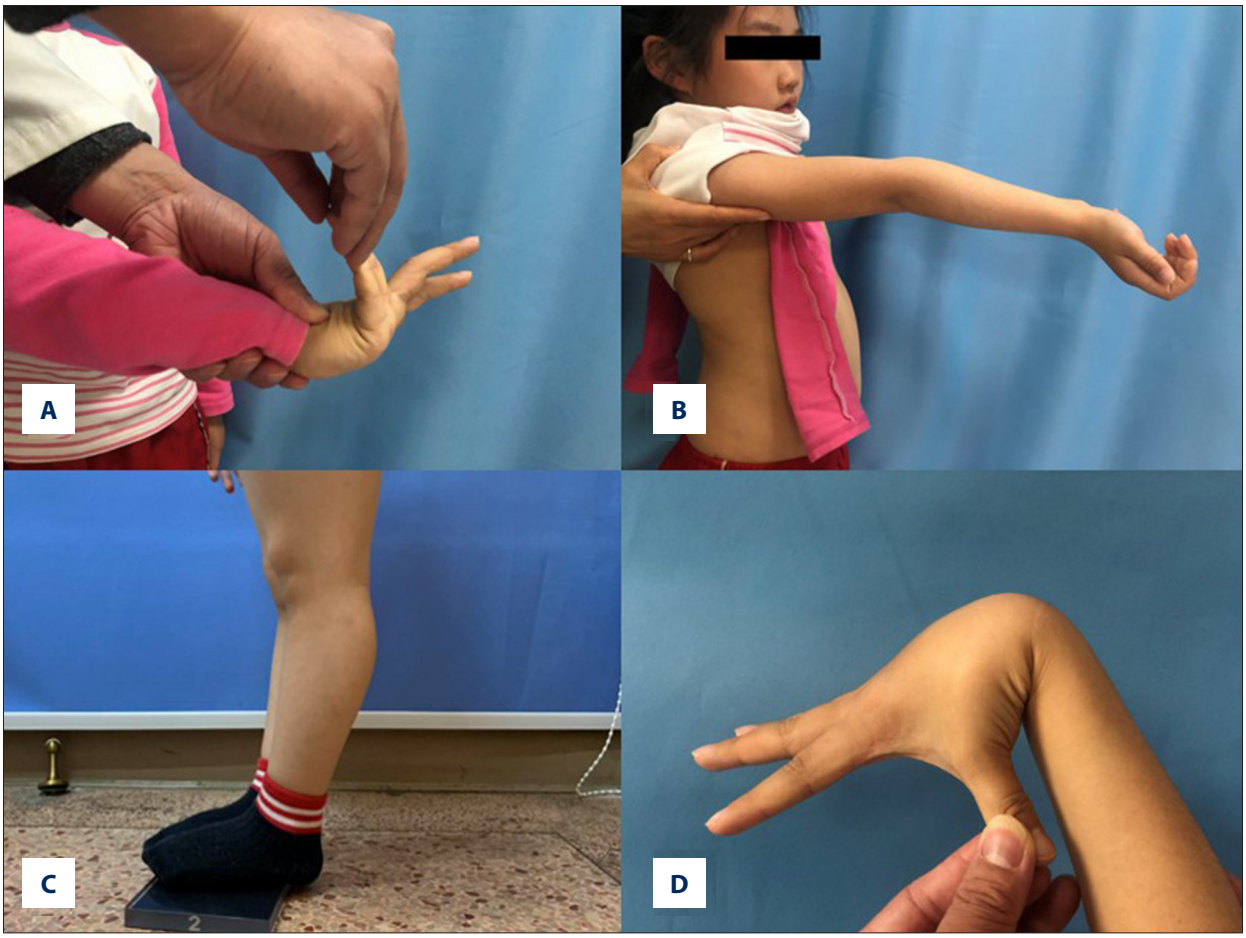


Figure 2. Clinical manifestations consistent with generalized joint laxity. (**A**) Passive hyperextension >90° of the fifth finger with the palm and wrist touching a solid surface. (**B**) Passive hyperextension >10° of the elbow with the upper limb extended and the palm turned up. (**C**) Passive hyperextension >10° of the knee while patient stands up. (**D**) Passive flexion of the thumb to touch the volar aspect of the forearm.

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Table 2. Comparison of metacarpophalangeal (MCP) joint hyperextension/instability in patients with multi-joint laxity and non-multi-joint laxity.

	Multi-joint laxity (n=143)	Non-multi-joint laxity (n=940)	*p* Value
Proportion (%)	13.2	86.8	
MCP hyperextension/instability (thumb)	172	13	0.008

MCP – metacarpophalangeal.

Table 3. Comparison of baseline data between metacarpophalangeal joint hyperextension (MCPH) group and metacarpophalangeal joint instability (MCPI) group.

	MCPH group (n=167)	MCPI group (n=18)	p Value
Age (y)	2.8 (1.1–5.4)	6.6 (3.9–7.6)	0.023
Duration of disease (m)	13 (1–20)	33 (20–48)	0.027
Passive exercise and/or brace (thumb)	24	17	0.013
With multi-joint laxity (thumb)	153	16	0.764
Positive family history (thumb)	68	7	0.386

MCPH – metacarpophalangeal joint hyperextension; MCPI – metacarpophalangeal joint instability.

compare categorical variables in the 2 groups. The level of statistical significance was set at $P<0.05$.

Results

In this series, there were 154 cases (185 thumbs) of trigger thumb with MCPH or MCPI, of which 143 cases (172 thumbs) were complicated with multi-joint laxity. The incidence of MCPH or MCPI was significantly higher in the trigger thumb patients with multi-joint laxity than with non-multi-joint laxity (Table 2). Among all cases of trigger thumb with MCPH or MCPI, the MCPH group had 141 cases (167 thumbs), and the MCPI group had 13 cases (18 thumbs). In the MCPH group, the average age was 2.8 years and the mean duration of disease of 13 months, while in the MCPI group, the average age was 6.6 years and the mean duration of disease of 33 months. In the MCPH group, MCPH often occurred at the same time as IP joint flexion. In the MCPI group, IP joint extension limitation was the first symptom, and then MCPI occurred. In the MCPH group, 19 cases (24 thumbs) once had undergone passive and violent thumb stretching exercises and/or brace fixation before operation, while in the MCPI group 12 cases (17 thumbs) had done so. Compared with the MCPH group, the MCPI group had older age and longer duration of disease, and the proportion of passive exercises or brace treatment before operation was significantly higher than that of the MCPH group, but there was no significant difference in cases whether combined with multi-joint laxity or not (Table 3).

Video 2. Some trigger thumb patients with metacarpophalangeal joint hyperextension or instability also had a family history.

In addition, we also found family history in some trigger thumb patients with MCPH or MCPI. Of 154 cases of trigger thumb with MCPH or MCPI in this series, 75 patients had at least one of their parents who had MCPH or MCPI on one side or both sides (Video 2).

In the cases of MCPH, the MCPH still existed after the removal of the cast at 1-week. However, the children felt that the thumb function was not limited and there was no pain or discomfort. Therefore, their families refused to do further treatment for MCPH deformity. In the cases of MCPI, 12 of 18 thumbs had a stable MCP joint and 6 thumbs had relapsed MCPI at 2 to

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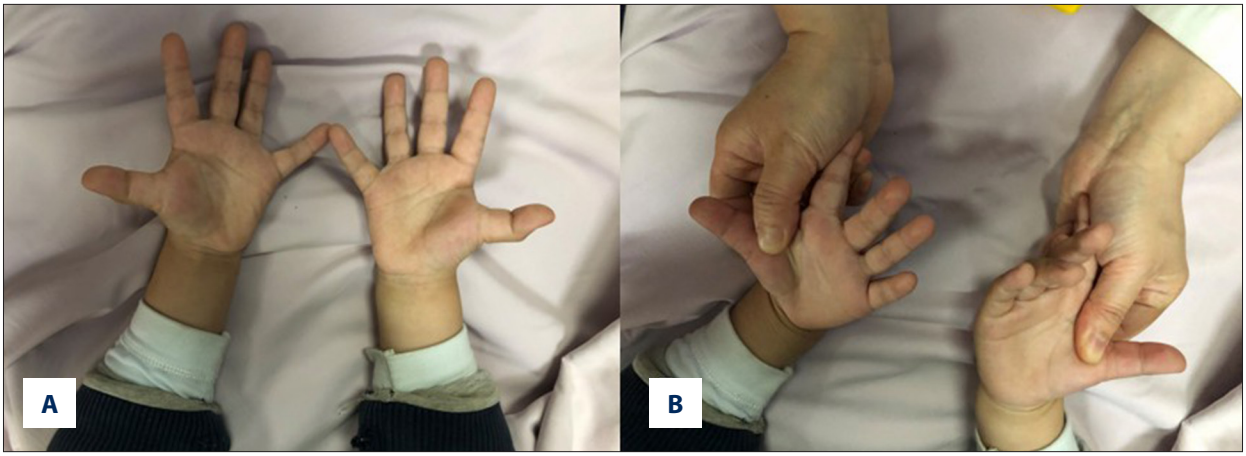

Figure 3. The relapsed case in metacarpophalangeal joint instability group after brace removal. (**A**) Interphalangeal joint could not be extended actively when metacarpophalangeal joint was in subluxation. (**B**) When metacarpophalangeal joint was reduced stabilized, interphalangeal joint could resume its extension function.

4 months after removal of the brace. Among them, 3 thumbs had an active extension limitation in the IP joint for 20° when the MCPI occurred. When the MCP joint stabilized, the IP joint could resume its extension function (Figure 3).

Discussion

Trigger thumb is the most common thumb disease in children, with a reported incidence of 1–3% [11]. It was previously known as congenital stenosing tenosynovitis [3,5,12] until research found that the incidence of birth onset was relatively rare, mostly at the age of 1 to 2 years old [2,11,13,14]. It is now generally accepted that the asynchronous growth of the flexor pollicis longus and tendon sheath may cause trigger thumb. The growth of tendon occurs ahead of tendon sheath development so that the tendon sheath is relatively narrow [2,3,15]. Nowadays, many scholars recommend surgical treatment for patients with trigger thumb. But there is no agreement on the age at which surgery is indicated. The surgical indication mentioned in "Green's Operative Hand Surgery (Seventh Edition)" [16] was for children with painful triggering and a rigid deformity (Sugimoto Stage IV) older than 1 year of age should undergo surgery. In contrast, the guidelines established by Dinham and Merggitt [3] recommend surgical release for children at the age of 3 years or older, while Ogino [17] deemed that surgery should be considered for cases without improvement until the age of 5 years, after a period of observation or splinting therapy. In our opinion, we think that children older than 2 years old with painful triggering and a locked IP joint (Sugimoto stage IV) should undergo the surgery.

Joint laxity is a common clinical sign noted in various populations, particularly in children and female patients. Joint laxity is greatest in infancy and gradually declines throughout life, but it is still observed in 2–34% of males and 6–57% of females [18]. Joint laxity varies widely among individuals and is usually genetically determined [19]. However, most individuals with joint laxity are asymptomatic for their entire life. Joint laxity is usually assessed with the Beighton score [10]. Multi-joint laxity (affecting more than 4 joints) is encountered among 7% of normal school children [20]. The incidence of multi-joint laxity is about 4%–13%, and it is more prevalent in young females [21–23]. MCP joint hyperextension is one of the 5 items of the Beighton score. The performance is apposition of the hyperextension thumb against the volar aspect of the forearm.

Among the 1083 trigger thumb cases in this report, 143 patients (13.2%) were also identified with multi-joint laxity, and 185 trigger thumbs had MCPH or MCPI. This finding was consistent with the incidence of joint laxity reported in children (4–13%). Only 11 cases (13 MCPH thumbs) had no clinical manifestation of joint laxity. The hypermobility was purely certified in the MCP joint of affected thumb. Therefore, children with trigger thumbs with multi-joint laxity were more likely to develop MCPH or MCPI compared to children with trigger thumbs without multi-joint laxity. The incidence was significantly different (P=0.008) compare to the trigger thumb without joint laxity. Once a child who has joint laxity develops trigger finger, the function of the MCP joint needs to be evaluated carefully. Similarly, all trigger thumb cases with MCPH or MCPI require the examination of mobility of other joints.

Patients with MCPH or MCPI had significant differences in age, duration of disease, and nonsurgical treatment such as extension splint fixation and/or passive extension exercises, but there was no significant difference in combination with multi-joint laxity (P=0.764). We found that most MCPH or MCPI in trigger thumbs was associated with multi-joint laxity, which was usually genetically determined. In our study, 75 of

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154 cases in the MCPH group or MCPI group had family history of joint hypermobility. More patients (141 cases, 167 thumbs) with MCPH had a short duration of disease (average 13 months, range 1–20 months). MCPH often occurred at the same time as IP joint flexion. On the contrary, 13 cases (18 trigger thumbs) with MCPI had longer duration of disease (average 33 months, range 20–48 months). MCPI was a secondary occurrence of restricted extension of the IP joint. Because of the long duration of disease, parents could not be sure whether the thumb had MCPH at the beginning of the disease, but they were sure that there was no MCP joint click at that time. Twelve of 17 thumbs had an average 28 months (range 19–43 months) of extension splint fixation and/or passive extension exercises and took no special measures to prevent MCPH. In the conservative treatment and functional activities, the passive or active extension of MCP joint compensates for the insufficient hand function due to IP flexion. The volar plate of the MCP joint is gradually excessively extended and the MCPI occurs over time [19].

After surgical release and partial resection of A1 trochlear in trigger thumb with MCPH, a forearm-based thumb spica soft cast with the IP joint extended and the MCP joint 20° flexed was applied for 1 week; full IP and MCP joint movement begun after the cast was removed. Although it has been reported that trigger thumb in children with concomitant MCP joint hyperextension laxity can be treated safely with predictable results by releasing the A1 trochlear and advancing the volar plate [9], we do not recommend further intervention or fixation for the MCPH because it is associated with multi-joint laxity, in which the joint mobility is greatest in infancy and gradually declines throughout life. All the MCPH patients in this study had no pain, discomfort, or thumb dysfunction in the follow-up, and the degree of MCPH on the affected side was consistent with that on the opposite side in unilateral cases. So, the children and their families temporarily refused further surgical treatment. In view of the possible future occurrence of osteoarthritis and pain, we will conduct further long-term follow-up of these cases.

For trigger thumb with concomitant MCPI, a short-arm thumb spica soft cast for 6 weeks and additional spica splint for 6 weeks with the MCP joint at 20° flexed were applied after surgical release of A1 trochlear, aiming to relieve the compensatory hypertension of volar plate and prevent the unstable subluxation of the MCP joint. The instability and click were improved by years in 10 of 16 thumbs, the recurrence of instability occurred in 6 of 16 thumbs at 2 to 4 months after brace removal. Two children (3 thumbs) could not extend the IP joint actively when the MCP joint was in subluxation, and the IP joint could be extended in full range after the MCP joint was reduced (Figure 3). It is considered that for the relative hypertension of flexor pollicis longus caused by MCPI, the volar plate repair and advancement procedure should be scheduled.

Pediatric trigger thumb with concomitant MCPH and MCPI occurs frequently, but there are only sporadic reports focused on the occurrence of individual secondary MCPH after non-surgical manipulation and extension splint fixation [8,24,25]. Lee warned against prolonged passive stretching because the possibility of producing hyperextension of the MCP joint; iatrogenic hyperextension at the MCP joint following splinting was noted and should be avoided [26]; but for the treatment of MCPH, only one related article reported 7 cases of volar plate advancement [9]. Our report is the first study focusing on trigger thumb with concomitant MCPH and MCPI associated with multi-joint laxity, and we are also the first to report different management for hyperextension and habitual subluxation of MCP joint. Limitations of the present study include its retrospective design, the relatively short mean follow-up period, and the vast heterogeneity in the 2 groups due to the low incidence of trigger thumb with MCPI.

Conclusions

Pediatric trigger thumb with MCPH has a relatively high incidence, and most of these cases are combined with multi-joint laxity. Improper manual reposition in patients with multi-joint laxity will aggravate MCP joint hyperextension. No further treatment for MCPH is recommended. Trigger thumb with MCPI is rare and usually occurs in joint laxity patients who have undergone prolonged splinting and/or passive stretching. Attention should be paid to observe and prevent the MCP joint subluxation during conservative treatment. Once it appears, surgical release of the A1 trochlear and cast combined brace fixation are recommended promptly. Further surgical treatment and long-term follow-up of relapsed cases of MCPI are still in progress.

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References:

1. Wang HC, Lin GT: Retrospective study of open versus percutaneous surgery for trigger thumb in children. Plast Reconstr Surg, 2005; 115: 1963–70
2. Slakey JB, Hennrikus WL: Acquired thumb flexion contracture in children. Congenital trigger thumb. J Bone Joint Surg Br, 1996; 78: 481–83
3. Dinham JM, Meggitt BF: Trigger thumbs in children: A review of the natural history and indications for treatment in 105 patients. J Bone Joint Surg Br, 1974; 56: 153–55
4. Marriot FPS, Basu S: Trigger thumb in infancy and childhood. A survey of 80 patients. Ulster Med J, 1967; 36: 53–61
5. Sprecher EE: Trigger thumb in infants. J Bone Joint Surg Am, 1949; 31: 672–74
6. Dunsmuir RA, Sherlock DA: The outcome of treatment of trigger thumb in children. J Bone Joint Surg Br, 2000; 82: 736–38
7. Mulpruek Prichasuk S: Spontaneous recovery of trigger thumbs in children. J Hand Surg Br, 1998; 23: 255–57
8. Nemoto K, Nemoto T, Terada N et al: Splint therapy for trigger thumb and finger in children. J Hand Surg Br, 1996; 21: 416–18
9. Li Z, Wiesler ER, Smith BP, Koman LA: Surgical treatment of pediatric trigger thumb with metacarpophalangeal hyperextension laxity. Hand (NY), 2009; 4(4): 380–84
10. Beighton P, Horan F: Orthopaedic aspects of the Ehlers-Danlos syndrome. J Bone Joint Surg Br, 1969; 51(3): 444–53
11. Kikuchi N, Ogino T: Incidence and development of trigger thumb in children. J Hand Surg Am, 2006; 31: 541–43
12. Fahey JJ, Bollinger JA: Trigger-finger in adults and children. J Bone Joint Surg Am, 1954; 36(6): 1200–18
13. Rodgers WB, Waters PM: Incidence of trigger digits in newborns. J Hand Surg Am, 1994; 19(3): 364–68
14. Moon WN, Suh SW, Kim IC: Trigger digits in children. J Hand Surg Br, 2001; 26(1): 11–12
15. Marek DJ, Fitoussi F, Bohn DC, Van Heest AE: Surgical release of the pediatric trigger thumb. J Hand Surg Am, 2011; 36(4): 647–52.e2
16. Wolfe SW, Pederson WC, Hotchkiss RN et al: Green's operative and hand surgery (seventh edition). Philadelphia, PA, Elsevier 2017
17. Ogino T: Trigger thumb in children: Current recommendations for treatment. J Hand Surg Am, 2008; 33: 982–85
18. Remvig L, Jensen DV, Ward RC: Epidemiology of general joint hypermobility and basis for the proposed criteria for benign joint hypermobility syndrome: Review of the literature. J Rheumatol, 2007; 34: 804–9
19. Everman DB, Robin NH: Hypermobility syndrome. Pediatr Rev, 1998; 19: 111–17
20. Carter C, Wilkinson J: Persistent joint laxity and congenital hip dislocation. J Bone Joint Surg Am, 1964; 42B: 40–45
21. Secxkin U, Tur BS, Yilmaz O et al: The prevalence of joint hypermobility among high school students. Rheumatol Int, 2005; 25: 260–63
22. Brown GA, Tan JL, Kirkley A: The lax shoulder in females. Issues, answers, but many more questions. Clin Orthop Relat Res, 2000; 372: 110–22
23. Engelbert RH, Uiterwaal CS, van de Putte E et al: Pediatric generalized joint hypomobility and musculoskeletal complaints: A new entity? Clinical, biochemical, and osseal characteristics. Pediatrics, 2004; 113: 714–19
24. White JW, Jensen WE: Trigger thumb in infants. Am J Dis Child, 1953; 85: 141–45
25. Jahss SA: Trigger thumb in children. J Am Med Assoc, 1936; 107: 1463–64
26. Lee ZL, Chang Ch, Yang WY: Extension splint for trigger thumb in children. J Pediatr Orthop, 2006; 26: 785–87

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