Systematic Review

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Treatment of paediatric trigger finger: a systematic review and treatment algorithm

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Abstract

Purpose Paediatric trigger finger (PTF) is a rare condition as seen by the lack of studies published about paediatric populations. Due to this general lack of information, the steps to employ to correct this disorder, whether surgically or non-surgically, have not yet reached consensus status. The objective of this study is to review the published literature regarding treatment options for PTF in order to develop a proposed step-wise treatment algorithm for children presenting with trigger finger.

Methods A systematic review of the literature was conducted on PubMed to locate English language studies reporting on treatment interventions of PTF. Data was collected on number of patients/fingers seen in the study, the category of the fingers involved, the number of patients/fingers undergoing each intervention and reported outcomes.

Results Seven articles reporting on 118 trigger fingers were identified. In all, 64 fingers were treated non-surgically, with 57.8% (37/64) resolving. In all, 54 fingers were initially surgically treated, with 87% (47/54) resolving. In total, 34 fingers did not have resolution of symptoms following primary treatment, and 27 fingers received follow-up treatment, with 92.6% (25/27) resolving. Overall, 92.4% (109/118) of fingers achieved resolution of symptoms after all treatments were completed.

Conclusion Limitations for this study included few prospective studies and small sample sizes. This is likely due to the rarity of PTF. This review of the literature indicated that a step-wise approach, including non-operative and surgical techniques, should be employed in the management of PTF.

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Level of Evidence III

This work meets the requirements of the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

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Introduction

Paediatric trigger finger (PTF) is a rare disorder occurring up to ten times less frequently than its counterpart, paediatric trigger thumb.[1] Though prevalence rates specific to PTF are scarce, triggering of any digit, thumb or finger, is reported to affect less than 0.05% of children.[2] Furthermore, PTF is much less common than adult trigger finger, a condition which exhibits a 2.6% prevalence rate in non-diabetic adults over the age of 30.[3] Most published studies offer evidence and treatment modalities for paediatric trigger thumb, or they focus on paediatric trigger thumb with a few PTF cases added into the data collection (thumb;[4-25] thumb and finger[26-35]). The evidence base to guide treatment of PTF in isolation is limited. Although published management algorithms and strategies have reported good outcomes through a variety of different means, there is no general consensus as to the best method to treat PTF.[32,36,37]

Saeed Banadaky and Baghianimoghadam[38] provide evidence of successful treatment with casting while Shiozawa et al[39] and Nemoto et al[30] report successfully treating PTF using splinting. Nevertheless, the majority of studies demonstrate satisfactory results using surgical methods to treat triggering digits.[1,5,29,33,35,40-46]

The purpose of this study is to present a systematic review of the literature on non-operative and operative interventions for PTF. We sought to compare outcomes associated with interventions previously reported in the literature to guide future treatment for patients and build a management algorithm spanning non-operative and operative measures.

Materials and methods

Search strategy

A systematic review was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[47] A computerized search of MEDLINE (PubMed) was conducted between 03 March 2017 and 08 March 2017. The search strategy included the following terms: "pediatric" OR "adolescent" OR "child" AND "trigger finger" OR "trigger digit" OR "stenosing tenosynovitis". All potential studies were stored to RefWorks (www.refworks.com, Proquest LLC, Ann Arbor, Michigan), a bibliographic citation manager, to facilitate evaluation of the studies.

Study selection

Our review includes studies involving therapeutic measures for PTF. Studies involving exclusively paediatric trigger thumb or adult-only cases were excluded. PTF cases due to a well-delineated secondary cause, case reports, case series with less than three cases or combination studies of thumb and finger with less than three finger cases were also excluded from the study. Studies published in languages other than English were also excluded. Finally, studies that included children who had received therapy for their triggering digits prior to the study were excluded.

Data extraction

The seven articles[5,27,28,35,39,42,48] selected for in-depth review were examined for number of patients/fingers seen in the study and the category of the fingers involved (index, middle, ring, little). Furthermore, the number of patients/fingers undergoing specific therapies, surgical or non-surgical, were noted. The outcomes of the therapy, resolved or failed, were examined. A finger was deemed resolved if there was complete resolution of triggering, or if the articles' authors subjectively felt that the finger was much improved. Failure was defined as recurrence of triggering in the affected digit. Lastly, an attempt was made to look at incision type, if the therapy was surgical; however, this information was not included in a number of the articles. All data was stored in an Excel (Microsoft, Redmond, Washington) file.

Variables that may have contributed to bias were noted and were considered in the review of the articles, such as studies that reported on trigger thumb as well as trigger finger. For studies reporting both trigger thumb and trigger finger cases, the number of patients with triggering fingers involved was not determinable; however, the number of trigger fingers was determinable. Therefore, results were reported by number of fingers involved.

Results

There were 272 articles identified via the PubMed search. The titles of the 272 articles were reviewed for relevance to the above inclusion/exclusion criteria, leaving a total of 43 articles for further review. The bibliographies of those 43 studies marked for potential inclusion in the analysis were also reviewed to identify additional studies meeting the above criteria. From the bibliography search, 78 additional studies were identified and found to be duplicates. The abstracts or full text of the 43 original articles were read for inclusion/exclusion criteria. Articles were then selected for inclusion based upon the aforementioned criteria, leaving a total of seven articles.[5,27,28,35,39,42,48] An overview of the literature search and selection process is detailed in Fig. 1.

There were a total of 118 fingers included in the data from the seven studies. Among the included studies, the most frequent finger involved in triggering was the middle finger. The fingers involved were as follows: index finger 9.3% (11/118), middle finger 55.1% (65/118), ring finger 23.7% (28/118) and little finger 11.9 % (14/118).

Table 1 provides a summary of the finger demographics extracted from the seven studies, and Table 2 provides a summary of the treatments and outcomes for the trigger fingers included in these studies.

Bae[5] saw 18 patients with a total of 23 trigger fingers – two index, 12 middle, three ring and six little – over a 20-year period between 1996 and 2006. These patients had a mean age of 4.5 years with an age range between one and 12 years old at the time of presentation. All 23 patients' fingers underwent an A1 Pulley release with division of a slip of the flexor digitorum superficialis (FDS) tendon through a Bruner incision. After the initial surgery, 21 fingers in 16 patients had resolution of triggering. Two fingers in two patients failed to resolve after the initial treatment. Both patients received follow-up surgeries. One patient had a division of the other slip of the FDS, and the other patient had an excision of an aberrant muscle belly from the FDS. Both patients had resolution of triggering symptoms after their follow-up surgery. The average follow-up was 43 months with a range of three to 111 months.

De Smet and colleagues[27] saw ten patients with a total of 15 trigger fingers – two index, eight middle and five ring – over a six-year period between 1990 and 1996. Two patients had spontaneous recovery of the triggering finger, and 13 patients had an A1 pulley release through a transverse incision. All patients in this study had resolution of triggering symptoms and no patients required follow-up surgery. One limitation of this study is that it was a mixed study of trigger thumbs and trigger fingers, with the majority of cases being trigger thumbs.

JOURNAL OF CHILDREN'S ORTHOPAEDICS

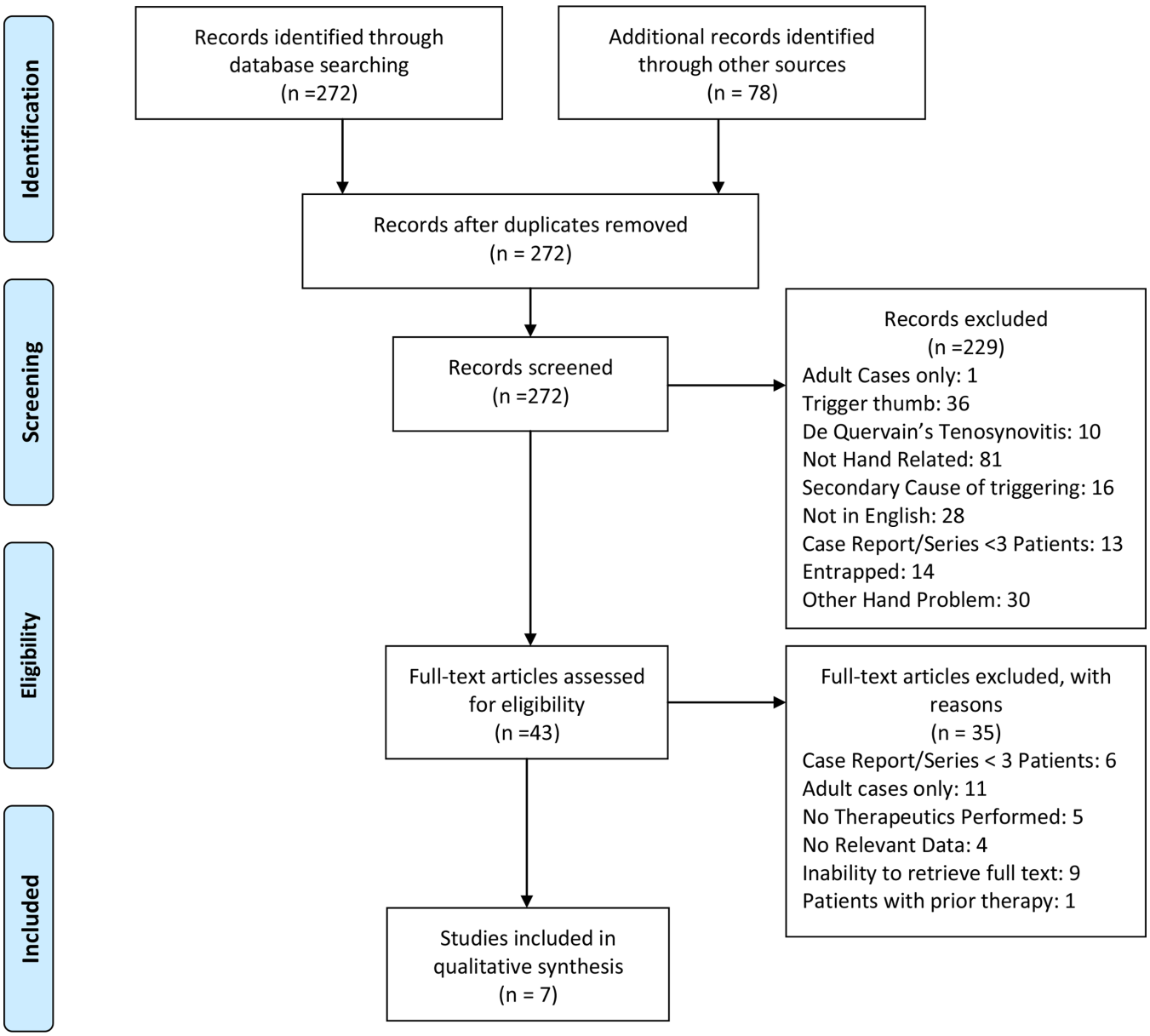

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart of the literature search identifying the number of articles found and the number of relevant articles.

Table 1 Summary of finger demographics

Article	Index	Middle	Ring	Little
Bae[5]	2	12	3	6
De Smet et al[27]	2	8	5	0
Moon et al[28]	1	5	2	0
Shiozawa et al[39]	4	28	11	4
Tordai and Engkvist[42]	2	8	4	3
Kraemer et al[48]	0	1	1	1
Wood and Sicilia[35]	0	3	2	0
Total	11	65	28	14

Kraemer and colleagues[48] saw a total of 183 patients with 253 trigger digits over a seven-year period between 1978 and 1985; however, of these, only three were trigger fingers – one middle, one ring and one little. All three trigger fingers received an A1 pulley release through a transverse incision. All three patients had resolution of triggering symptoms and no fingers required follow-up surgery. This study reported a mix of trigger thumbs and trigger fingers, with the majority of the cases being trigger thumbs. As such, it was not possible to derive the actual number of patients involved with trigger fingers.

Table 2 Summary of treatments and outcomes of paediatric trigger fingers from included studies

Study	Number of fingers treated	Primary treatment	Incision type	Number of resolutions after initial treatment	Number of failures after initial treatment	Revision treatment	Number of resolutions after revision treatment	Number of failures after revision treatment
Bae[5]	23	A1 pulley release + resection of 1 FDS tendon slip	Bruner incision (23 fingers)	21 fingers	2 fingers	A1 pulley release + resection of 2 FDS tendon slips (1 finger)	1 finger	-----
						A-1 pulley release + resection of 1 FDS tendon slip + excision of aberrant muscle belly from FDS (1 finger)	1 finger	-----
De Smet et al[27]	15	A1 pulley release (13 fingers)	Transverse incision (13 fingers)	13 fingers	-----	-----	-----	-----
		Spontaneous recovery (2 fingers)		2 fingers	-----	-----	-----	-----
Kraemer et al[48]	3	A1 pulley release (3 fingers)	Transverse incision (3 fingers)	3 fingers	-----	-----	-----	-----
Moon et al[28]	8	Spontaneous recovery (8 fingers)	NS	8 fingers	-----	-----	-----	-----
Shiozawa et al[39]	47	Splinting (24 fingers)	NS	16 fingers	8 fingers	A1 pulley release +/- partial resection of A2 pulley (22 fingers)	22 fingers	-----
		Non-splinting (23 fingers)		7 fingers	16 fingers			
Tordai and Engkvist[42]	17	A1 pulley release (5 fingers)	NS	3 fingers	2 fingers	A1 pulley release (1 finger)	-----	1 finger
		A1 pulley release + division 2 FDS slips (3 fingers)		1 finger	2 fingers	A1 pulley release + division 2 FDS slips (1 finger)	-----	1 finger
		A1 pulley release + extension into tendon sheath (1 finger)		-----	1 finger	A1 pulley release + FDS slip separation + partial A2 pulley release (1 finger)	1 finger	-----
		A1 pulley release + FDS slip separation + partial A-2 pulley release (1 finger)		1 finger	-----	-----	-----	-----
		Spontaneous recovery (4 fingers)		4 fingers	-----	-----	-----	-----
		No therapy (3 fingers)		-----	3 fingers	-----	-----	-----
Wood and Sicilia[35]	5 fingers	A1 pulley release (5 fingers)	Transverse incision (3 fingers)	5 fingers	-----	-----	-----	-----

FDS, flexor digitorum superficialis; NS, not specified

Moon and colleagues[28] saw a total of 40 patients with 43 trigger digits over a three-year period between 1995 and 1998; however, of these, only eight were trigger fingers – one index, five middle and two ring fingers. All eight fingers had spontaneous resolution of triggering symptoms, and no fingers required follow-up surgery. Furthermore, a limitation of this study was that it, too, was a mixed study of trigger thumbs and trigger fingers; therefore, it was impossible to derive the number of patients with only triggering fingers.

Shiozawa and colleagues[39] saw 24 patients with 47 trigger fingers – four index, 28 middle, 11 ring and four little fingers – over a 29-year period between 1981 and 2010. These patients had a mean age of two years and two months with an age range of one month to nine years of age at the time of intervention. In all, 11 patients with 24 fingers received splinting treatment. Within this group 16 fingers had resolution of triggering symptoms and eight fingers failed to resolve. In all, 13 patients with 23 trigger fingers were observed and received no treatment. Within this group seven fingers had resolution of triggering symptoms and 16 fingers failed to resolve. Of the 24 fingers that failed to resolve, 22 of them went on to receive surgical A1 pulley release with or without partial release of the A2 pulley. Of the 24 fingers that failed to resolve, two of them received no further treatment; however, the basis

JOURNAL OF CHILDREN'S ORTHOPAEDICS

for this was not determinable. All of the fingers receiving follow-up therapy had resolution of triggering symptoms.

Tordai and Engkvist[42] saw 12 patients with 17 trigger fingers – two index, eight middle, four ring and three little fingers – over an eight-year period between 1989 and 1997. Four patients with five trigger fingers received an A1 pulley release. Of these, three patients with three trigger fingers had resolution of triggering symptoms, while one patient with two trigger fingers failed to have resolution. This patient received a follow-up A1 pulley release on one of the digits that did not have resolution of symptoms; nevertheless, this digit failed treatment a second time. Furthermore, it is unclear why the patient's other triggering digit did not receive follow-up therapy; however, it seems that the second digit may not have had recurring symptoms until later. The authors make note that this patient had some delayed motor development. The authors make note of another patient with delayed motor development and three triggering fingers who received an A1 pulley release with division of both slips of the FDS tendon. One of the patient's fingers had resolution of triggering symptoms; however, two fingers did not resolve, of these, one finger received a follow-up A1 Pulley release and division of the two FDS slips. However, this finger failed to resolve after the follow-up intervention. Moreover, it is also unclear why the patient's other triggering digit did not receive follow-up treatment, but, like the other patient, it seems that the other digit had recurrence of triggering at a later time. Another patient with one triggering finger received an A1 pulley release with extension of the incision into the tendon sheath; however, this patient did not experience resolution of triggering symptoms and required a follow-up surgery. The follow-up surgery was an A1 pulley release with separation of the FDS tendon slips and a partial A2 pulley release. The follow-up surgery for this finger led to resolution of triggering symptoms. One patient with one triggering finger received an A1 pulley release with separation of the FDS tendon slips and a partial A2 pulley release. This patient had resolution of triggering symptoms and did not require follow-up surgery. Four patients with four trigger fingers had spontaneous resolution of triggering symptoms. Lastly, one patient with three trigger fingers was only observed; however, this patient failed to have resolution of triggering symptoms in any of the affected digits and was lost to follow-up, so the patient could not receive follow-up therapy.

Wood and Sicilia[35] saw 27 patients with 37 trigger digits over an 18-year period; however, of these, only five were trigger fingers – three middle and two ring fingers. All five fingers received an A1 pulley release and three of these digits received the surgery through a transverse incision. Furthermore, all five fingers had resolution of triggering symptoms. This study combined both trigger fingers and trigger thumbs, therefore, it was not possible to determine the number of patients affected by triggering fingers.

When summarizing the results, 64 fingers were treated non-surgically, and of these, 57.8% (37/64) had resolution of symptoms. Approximately 52% (21/40) of fingers that were observed had resolution of symptoms. In total, 67% of patients (16/24) that were treated with splinting as initial therapy achieved satisfactory resolution of triggering. In the surgical group, 54 out of 118 total fingers received initial surgery for triggering digits. Of those, 87% (47/54) had successful resolution of symptoms. Of 26 digits treated with an A1 pulley release alone, a resolution rate of 92.3% (24/26) was observed. Alternative surgical treatment in 26 of the 54 digits included A1 pulley release and resection of one or more of the FDS tendon slips. The resolution rate in this grouping was 84.6% (22/26). Finally, half of the digits (1/2) that received supplementary releases to an A1 pulley release, other than resection of one or more of the FDS tendon slips, achieved satisfactory resolution of symptoms.

Of the 34 fingers that did not have resolution of triggering symptoms following primary treatment, 27 received a follow-up treatment with 92.6% (25/27) of the fingers having resolution of symptoms. In summary, 92.4% (109/118) of fingers had resolution of triggering symptoms after either primary treatment or primary treatment with follow-up treatment, 1.7% (2/118) of fingers failed treatment altogether and 5.9% (7/118) of fingers that failed primary treatment were unaccounted for.

Table 3 provides the summary of the therapies performed and the primary and secondary treatment outcomes.

Table 3 Summary of therapies performed and the outcomes of primary and secondary interventions

Therapy	Fingers receiving therapy	Resolution of triggering symptoms	Failure to resolve triggering symptoms	Failed fingers receiving follow-up treatment	Resolution	Failure
A1 pulley release	26	24	2	1	0	1
A1 pulley release + 1 or more FDS slip release	26	22	4	3	2	1
Splinting	24	16	8	7	7	0
No treatment	40	21	19	15	15	0
Other (A1 pulley release + extra releases)	2	1	1	1	1	0
Totals	118	84	34	27	25	2

FDS, flexor digitorum superficialis

Discussion

There is no consensus in the literature on the best method to treat PTF, largely due to the rarity of the disorder within the paediatric population.[1-3] This lack of consensus could be attributed to the varying treatment strategies employed at different centres.[1,5,30,39,42] However, some studies offer step-wise approaches which have led to successful results.[37] A trial of non-operative therapy is often attempted first as spontaneous resolution can, and often, does occur. Our review of the literature notes that over 50% (21/40) of fingers that were observed had successful spontaneous recovery of symptoms. Additionally, splinting was frequently a successful initial treatment modality as 66.6% (16/24) of triggering digits that received splint therapy had successful resolution of symptoms. Across all reviewed studies there were a total of 64 digits that received initial non-operative treatment. Of the 64 digits, 57.8% (37) had resolution of the triggering, and of those that did not have resolution of symptoms, 22 went on to successful operative management with relief of triggering symptoms in all 22 fingers. Therefore, a period of failed non-operative therapy did not seem to portend poor future surgical results and a trial of conservative management is a worthwhile initial step in treatment of PTF, with splinting seeming to offer higher rates of success 66.6% (16/24) than observation 52.5% (21/40).

Multiple studies in our review forego non-operative management in favour of initial operative management of PTF. In all, 54 of the 118 total fingers compiled across all studies had initial surgical therapy for triggering digits; 87% (47/54) had successful resolution of symptoms. Of these 54 fingers, 26 were treated with an A1 pulley release alone, with a resolution rate of 92.3% (24/26). Alternative surgical treatment in 26 of the 54 digits included A1 pulley release plus resection of one or more of the FDS tendon slips. The resolution rate in this grouping was 84.6% (22/26). The intraoperative technique reported by Bae[5] sought to identify tendon pathology on a slip of the FDS tendon and resect the pathological slip over the other; however, when no pathology was found, the FDS slip was chosen arbitrarily. From our review, A1 pulley release with or without FDS slip resection is a reasonable treatment option if surgical management is to be pursued. Nonetheless, since non-operative management offers both cost-effective and low-risk potential for good outcomes, surgical treatment can reasonably be deferred initially and reserved for those who fail splinting or watchful waiting. More studies are needed to determine whether A1 pulley release alone or combined with FDS tendon slip resection afford patients better results.

Lastly, two of the 54 fingers (1.7%) received an A1 pulley release plus either extension of the incision into the tendon sheath, or a partial A2 pulley release with separation of the FDS tendon slips. Of these two separate techniques, the former was successful and the latter unsuccessful. Unfortunately, little conclusive evidence can be drawn from these two techniques. Ultimately, as Schaverian and Godwin[37] suggest, all other possible sources of triggering including the tendon sheath, the A2 pulley, the A3 pulley and the other slip of the FDS tendon, should be examined and pursued. Other potential sources of triggering are mentioned in Tordai and Engkvist[42] Therefore, if intraoperative triggering remains following A1 pulley release and resection of an FDS tendon slip, exploration of the incision site for any sites of mechanical pathology with subsequent release should be performed.

Other treatment methods of triggering digits exist within the literature; however, these methods of treatment are mostly performed in adults. These other therapies include steroid injections and percutaneous methods of release.[49-56] Throughout the literature review, we found no studies published on the treatment of PTF with steroid injections or percutaneous release; however, there were some studies published over the percutaneous release of trigger thumb.[19,21,57] Masquijo and colleagues[19] concluded that percutaneous release of the paediatric trigger thumb was not safe due to risk of iatrogenic injury to nerves and vessels as well as the possibility of an incomplete release of the A1 pulley. Due to differences in the underlying pathology of PTF and adult trigger finger, these methods of treatment may not be appropriate in the treatment of children.[32]

The results and analysis presented in this paper are subject to the limitations of the underlying studies including retrospective review, limited follow-up periods (three months in some instances), small sample sizes, non-randomized trials and possible non-adherence to splinting regimens. Furthermore, many of the articles relied on the researchers' judgement on whether a triggering digit resolved or failed, rather than measuring resolution *versus* failure with validated patient-reported outcomes. To our knowledge, no algorithmic method of treating PTF that includes the possibility of non-operative therapy currently exists in the literature. Additional randomized controlled studies are needed to truly qualify the benefits of one treatment method over another. Our review seeks to offer some guidance based on multiple centres' experience treating PTF successfully through a variety of different means. While our review supports the use of both surgical and non-surgical options, a step-wise treatment algorithm is useful to guide surgeons, particularly in lower volume centres. In Fig. 2, we have provided an algorithm based on the existing evidence with conservative treatment attempted prior to surgical intervention. Based on our review of the literature we recommend a step-wise approach with re-evaluation after each measure to determine if triggering is still present.

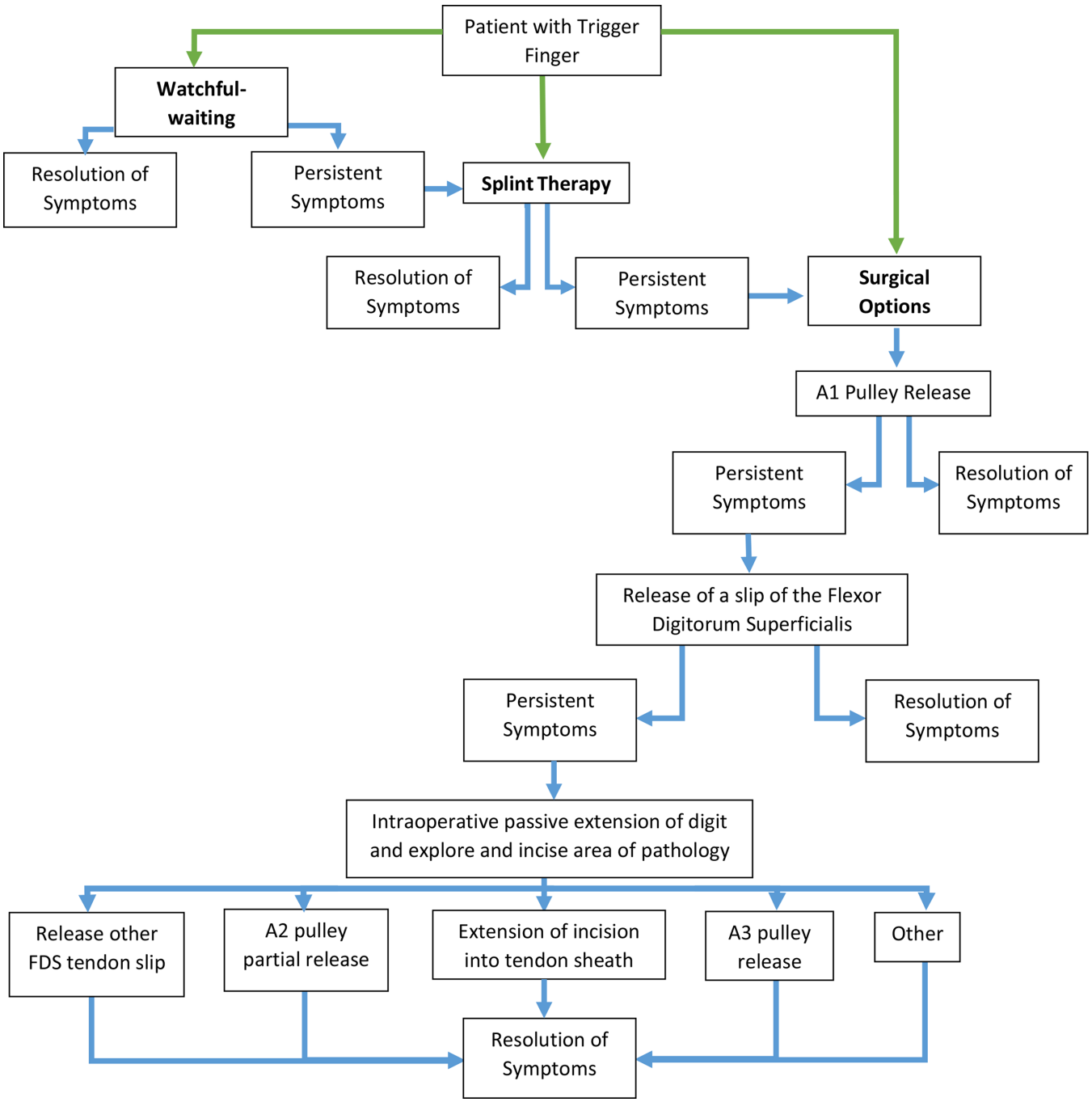

Fig. 2 Suggested management algorithm for paediatric trigger finger (FDS, flexor digitorum superficialis).

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COMPLIANCE WITH ETHICAL STANDARDS

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ICMJE CONFLICT OF INTEREST STATEMENT

None declared.

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