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ORIGINAL ARTICLE

Trigger thumb in children: comparison of results between percutaneous release and open surgery

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KEYWORDS
Trigger thumb;
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Abstract
Objective: Assess the differences between open and percutaneous release of trigger thumb in children.
Material and methods: We performed a retrospective study of all the patients operated on at our institution between January 2000 and February 2009. Our exclusion criteria were: patients with trigger fingers other than the thumb, that were being operated on simultaneously of another condition, admitted for other reasons or refused treatment. The surgical technique was left to the preference of the attending physician.
Results: We found 176 trigger thumbs (159 children), with a mean age of 2.58 years, the majority being unilateral (n=142). Statistically significant differences between the two treatments were only found regarding surgical time ($p<0.01$); percutaneous release (14,56min) was less time-consuming than the open technique (33,49min).
Conclusion: Percutaneous release in children is a good, simple, cheap and fast alternative but it requires compliance of the parents in order to avoid recurrence and to obtain complete success.

PALABRAS CLAVE
Pulgar en resorte;
Cirugía

Pulgar en resorte en niños. Comparación de resultados entre la liberación percutánea y la cirugía abierta

Resumen
Objetivo: Evaluar las diferencias entre la liberación abierta y percutánea del pulgar en resorte en niños.

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Material y métodos: Hemos realizado un estudio descriptivo retrospectivo de los niños intervenidos desde enero de 2000 hasta febrero de 2009 en nuestro centro. Se excluyeron aquellos pacientes con afectación de dedos largos (no pulgares), intervenidos simultáneamente de otras patologías o ingresados por otros motivos, así como aquellos que rechazaron el tratamiento propuesto. Se realizó una u otra técnica quirúrgica, así como las revisiones posteriores, según las preferencias del facultativo que atendía al paciente.
Resultados: Encontramos 176 pulgares en resorte (159 niños), con una edad media de 2,58 años, siendo la mayoría unilaterales (n=142). Hemos encontrado diferencias estadísticamente significativas entre ambos tratamientos con respecto al tiempo quirúrgico (p<0,01), siendo menor en la polectomía percutánea (14,56min) respecto a la cirugía abierta (33,49min).
Conclusión: La polectomía percutánea en niños es una buena alternativa, sencilla, económica y rápida pero, requiere la colaboración familiar para evitar las recurrencias y obtener el éxito completo.

Introduction

Trigger finger is an uncommon pathology in children, with an incidence rate of between 0.05% and 0.3%[2] It accounts for 2% of all congenital abnormalities of the upper limb in children.[3] In the paediatric population, the thumb is involved in 90% of the cases and is usually diagnosed at about 3 years of age.

The aetiology is subject to debate, with both congenital[4] and acquired[2,5] origins being considered; however, in recent years, the latter is the more widely accepted.

Clinically, it presents as discomfort, pain and a clicking feeling during flexo-extension of the finger, palpable nodes, or fixed contractures in flexion ("triggering") that may require passive movements to attain full extension.[6]

We carried out this study to assess the differences that exist between open polectomy and percutaneous release. To do so, we compared the hospital stay, surgery time, and the number of relapses.

Material and methods

We have conducted a retrospective, descriptive study of the children who underwent surgery at our centre between January, 2000, and February, 2009. Those patients with long finger involvement (not thumbs), who were undergoing simultaneous surgery for other pathologies or who were admitted to hospital for other reasons were excluded, as were those who refused the treatment proposed.

The surgical technique chosen and the subsequent check-ups were performed in accordance with the treating physician's preferences.

Open release

The open technique is performed in the operating theatre, under general anaesthesia, and with loco-regional ischaemia. We then perform an incision in the palmar aspect of the metacarpophalangeal fold, the neurovascular package is identified, and finally the A1 pulley is partially split. We perform cutaneous closure using reabsorbable suture and a compressive dressing is used and removed 7 days later.

Percutaneous release

Percutaneous release is performed under general sedation. The thumb is placed in maximum extension, but without allowing the flexor to be reduced. An intramuscular needle is introduced into the sheath of the flexor at the level of the A1 pulley with the bevel positioned longitudinally. By means of a longitudinal movement parallel to the sheath of the tendon, said pulley is severed with the needle. After verifying that there is no residual "triggering" by performing full passive flexion and extension of the joint, the thumb is bandaged in maximum extension (fig. 1). Later, the physical therapy that must be performed at home is explained to the parents, consisting of passive movements of full flexo-extension of the interphalangeal joint.

We defined relapse as the persistence of symptoms that fail to abate with home rehabilitation consisting of flexion-extension exercises after performing one of the two techniques (open or percutaneous). Likewise, we recorded a lack of collaboration on the part of the family when, after relapse appears, we found that the family has not carried out the exercises properly, in our presence, or when the family tells us that they have not done the exercises.

The patients who underwent open surgery were seen during the post-operative period while those in whom the percutaneous polectomy was performed were seen 3 times every week in order to appraise the outcome achieved, the possible complications, and relapses requiring additional surgery.

Furthermore, the existence of infectious, vascular, or neurological complications was assessed. Insofar as neurological complications are concerned, since the nerve function can only be evaluated starting at 6 years of age,[7] we measured sensitivity by inspecting the skin in search of lesions due to insensitivity to pain (self-mutilations, burns, etc.).

The statistical techniques used to compare both groups were the non-parametric Mann-Whitney's U test (for

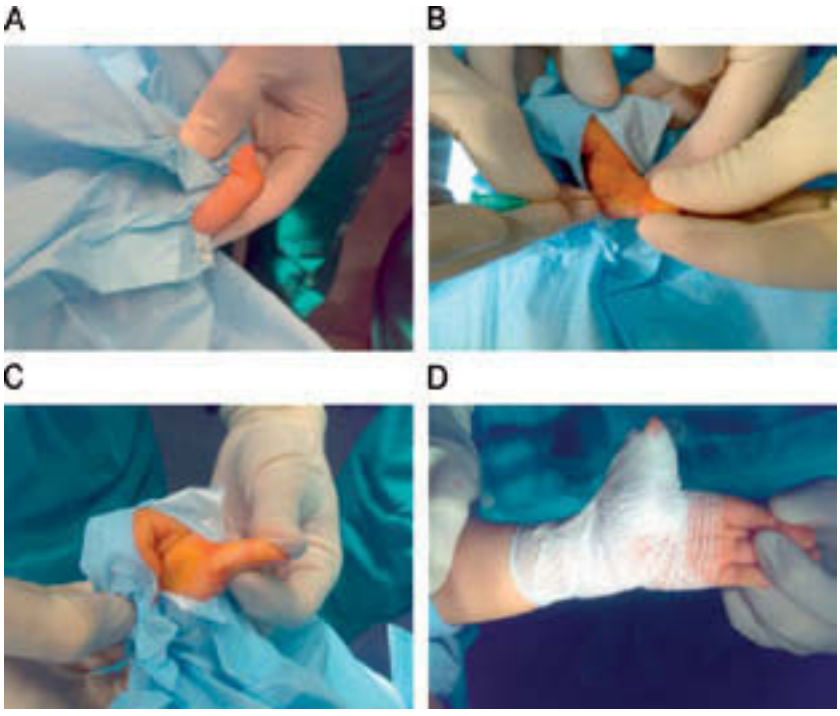

Figure 1 A) Pre-operative clinical view of the trigger thumb of the right hand. B) Insertion of the needle into the sheath of the tendon at the level of the A1 pulley. C) Maximum extension of the thumb following release. D) The thumb is bandaged in full extension.

quantitative variables) and Pearson's chi-square (for categorical variables).

Results

Using both the hospital database, as well as the departmental database, we found 176 trigger thumbs (159 children), of which 86 were males (48.9%) and 90 females (51.1%). The mean age was 2.58 years. Most of the cases were unilateral (n=142). Of the 34 bilateral cases (19.3%), 27 were treated by means of open surgery (79.4%) and 7 by means of percutaneous polectomy (20.6%). The mean hospital stay was 0.69 days. Success was achieved in163 cases (92.6%).

Open surgery was the surgical technique performed in 70.5%(n=124). The mean age of the patients was 2.65 years, with a mean hospital stay of 0.90 days and a mean surgery time of 33.49 min (range between 10 and 65 min).

The percutaneous release accounts for 29.5% of the interventions (n=52) with a mean age of 2.4 years, a mean hospital stay of 0.21 days, and a mean surgery time of 14.56 min (range between 5 and 25 min).

It is worth noting that statistically significant differences were only found between both treatments with respect to surgery time ($p<0.01$), the percutaneous polectomy requiring less time (14.56 min) than open surgery (33.49 min).

There has been a total of 13 relapses (7.4%), of which 7 were after open surgery (5.6%) and 6 following percutaneous release (11.5%). All were re-treated by means of open surgery, with 100%success. It is worth mentioning that most of the relapses following percutaneous polectomy occurred in patients who had not done the home flexion-extension exercises or who had done so improperly (table 1).

Table 1 Comparison of surgery time between open surgery and percutaneous polectomy

	Open surgery	Percutaneous polectomy
%patients	70.5	29.5
Mean age	2.65 years	2.4 years
Mean hospital stay	0.90 days	0.21 days
Mean surgery time	33.49 min	14.56 min
Bilateral	74.9%	20.6%
Relapses	5.6%	11.5%

Comparison of surgical times between open surgery and percutaneous polectomy.

During post-operative follow-up, we have not found complications of any type: infection, vascular injury, or neurological complications.

Discussion

Trigger thumb is very uncommon in the children with an incidence rate of 0.05% to 0.3%[2] Despite this, although we have not found any study that attests to it, we believe that it might in fact be the most common surgical treatment

performed on the hand in children. It accounts for 2%of all congenital abnormalities of the upper limb in the paediatric population.[3] The thumb is affected in 90%of the cases in children and it is generally diagnosed at about 3 years of age.

The aetiology is subject to debate, with both congenital[4] and acquired[2,5] origins being considered; however, in recent years, the latter is more widely accepted.

Pathophysiologically speaking, there is a discrepancy between the diameter of the tendon and the sheath that surrounds it at the level of the metacarpal head. It has been posited that by increasing the pressures in the area proximal to the A1 pulley in maximum flexion, hypertrophy and fibrocartilaginous metaplasia is produced on the tendinous aspect of the pulley. By increasing the thickness of the pulley, together with the increased thickness of some areas located on the tendon, movement is blocked. In general, the flexors are strong enough to overcome the block.[6]

Buchman et al.[8] examined nodules and tendinous sheathes in paediatric trigger thumbs under electronic microscopy, revealing large quantities of fibroblasts and mature collagen without any inflammatory or degenerative changes, arguments that fly in the face of a possible degenerative, infectious, or inflammatory origin. As a result, to date, the true aetiology remains unknown.

Treatment (conservative, splints, or surgery), as well as its indications, has been the subject of debate in recent years. Studies dealing with the percutaneous release of trigger fingers in children have appeared recently in the literature.[9,10]

Traditionally, once conservative treatment by means of passive manipulations and/or splints had failed, the treatment applied was surgical release. However, in the last several years, there has been a certain degree of controversy regarding surgical or non-surgical treatment.

In 1974, Dinham and Meggitt[11] reported results of 30%and 12%spontaneous resolution, respectively; mainly in children diagnosed between birth and 6 months of life, respectively. These authors recommend surgical treatment in those patients diagnosed at 3 years of age or older so as to avoid residual deformities in flexion. The studies later conducted by Dunsmuir et al.[12] and Mulpruek et al.[13] suggest that conservative treatment can be used, achieving later complete surgical correction, even in children over the age of 3 years. In 2008, Baek et al.[14] indicated a spontaneous resolution rate of 63%in a series of 71 thumbs in children with a mean age of 23 months following a mean follow-up time of 48 months (mean final age: 6 years), concluding that more satisfactory results are attained after long follow-up periods.

Watanabe et al.[15] reported 58 thumbs in 46 children treated by means of daily, passive extension exercises performed under the supervision of the parents, achieving a "satisfactory" result in 96% of the cases, with abnormal final movement in 59% of these cases.

In Japan, Zhon-Liau et al.[16] obtained very satisfactory outcomes with the use of splints, with 71%of their patients showing improvement or complete cure in a series of 24 children with ages ranging from 0 to 4 years after 20 months of follow-up, concluding that, in light of the fact that emergency surgery is not needed, it was advisable to first use splints.

Percutaneous release is a simple and quick procedure; however it entails the potential risk of neurovascular injury, mainly in small fingers. In 2005, Wang and Lin[10] published the first work in children comparing surgical treatment with percutaneous release. They concluded that it was a safe, simple, and affordable technique that required learning how to perform the technique and with a very low risk of neurovascular injury (according to the review of the literature).

The classical treatment in those patients who fail to improve with conservative treatment, allowing them to evolve either by placing splints or with physical therapy, consists of open surgery. It is a simple technique, whose greatest advantage is the direct visualization of the structures, such that there is little likelihood of neurovascular injury. Likewise, it is a procedure that offers good results and has a low complication rate. Thus, the rate of relapse is low: Mulpruek et al.[17] and Moon et al.[18] did not detect any recurrences in their series. Nevertheless, in larger series relapse rates of between 1%[11] and 4.8%[12] have been reported. In children, McAdams et al.,[19] with a series of 30 trigger thumbs that underwent a 15-year follow-up, did not find any relapses after open surgery, though they did observe long-term mobility deficits, with a 23% decrease in the balance of the interphalangeal joint and 17.6% hyperextension in the metacarpophalangeal joint.

From a surgical standpoint, the disadvantages of open surgery are the need for general anaesthesia, ischaemia by means of a tourniquet, and longer surgery time. As we have highlighted in our study, a mean time of 33.49 min is required, i.e. twice the time needed to carry out percutaneous polectomy (14.56 min). Likewise, the literature reports a theoretically higher complication rate of wound infections that, nevertheless, tends to be rare[11] and we did not find any in our series.

The percutaneous release of trigger thumb in children has only recently appeared as a treatment technique that is very often used and with good outcomes in adults. At present, it is deemed to be an optimal treatment option in adults,[20-22] with a multitude of advantages: it can be performed on an out-patient basis; recovery is immediate, and the scar is all but invisible. The same effectiveness has been found as in open surgery without a higher complication rate. Thus, Gilberts and Wereldsma[23] found not significant differences as regards rates of relapse, postoperative pain, and mobility deficits. Ha et al.[21] only detected one relapse and 5 patients had moderate pain out of 185 cases. In our work, we have found a similar relapse rate in both types of procedures, with a slightly lower relapse rate associated with open surgery (5.6%) versus percutaneous polectomy (11.5%).

Recent studies[10,24] propose percutaneous polectomy in children as a simple, safe, effective, and economic procedure with a low complication rate, requiring minimal surgical equipment (an intramuscular needle and compressive dressing). It is an out-patient technique that can even be performed in the orthopaedic surgery, as long as the patient's age or sensitivity allows for the use of a simple local anaesthesia.

The potential risk of the percutaneous intervention is the possibility of neural injury, given the proximity of the neurovascular package to the A1 pulley, mainly when performed on thumbs, and due to the lack of direct visualization. In adults, it is cause for debate in any number of articles. Bain et al.[25] carried out a study in 17 adult cadavers to assess the location of the digital nerve with respect to the area of release and showed that most of them were located at a distance of 2.9 mm, although in 29% of the cases, it was less than 2 mm, causing them to advise against the percutaneous technique in thumbs. Despite this, numerous surgeons have performed this technique with good results. Tanaka et al.[26] presented a study of 116 thumbs in adult patients treated with percutaneous polectomy with a 91%success rate and not a single case of neural injury. Patel and Moradia[27] operated on 57 thumbs with the same result (95%success and not a single sensitivity deficit). Gilberts and Wereldsma[23] operated on 83 thumbs with sensitivity deficit on the radial side in 3 cases, with significant alteration in only 1 case. On the basis of these series, it can be concluded that the likelihood of neural injury is 1%[24] In paediatric patients, theoretically, the risk is higher because the thumb is smaller, with less space and greater proximity to the neural package at the point of release. Nevertheless, specific studies have not been conducted to assess this point. As a result, only expert surgeons who have learned and performed the technique in adults are appropriate to perform it in children. In our work, we have not had a single case of neural injury. In addition to learning the technique, Jou and Chern[22] proposed the use of ultrasound to avoid neurovascular injury and confirm the release of the A1 pulley. In their prospective study of 107 fingers in adults using ultrasound-guided percutaneous release, they concluded that ultrasound afforded them direct, continuous visualization and enabled them to perform an effective, safe release without recurrences.

Hence, it is essential that the percutaneous technique be learned well, with full knowledge of the anatomy and proximity of the structures. There are two key points. First of all, the needle must be inserted to exactly the correct depth, since if it is placed too superficially, we will only incise the skin, whereas if it is placed too deep, we can injure the bone or flexor tendon. Secondly, for the cut made with the needle, a straight, longitudinal movement must be made parallel to the tendon, avoiding "pivot movement".[10]

Percutaneous polectomy presents a low relapse rate according to the literature. In adults, Ha et al.[20] and Maneerit et al.[28] had 0.5%and 3%recurrences, respectively. In children, Ruiz-Iban et al.,[22] in their series of 27 trigger thumbs, presented a 4% recurrence rate, whereas the Japanese authors Wang et al.,[10] in their series of 40 percutaneous polectomies, had absolutely no relapse.

Our series presents a relapse rate that is slightly higher than that reported by these authors, approximately 11.5%, largely as a result of the lack of mobilization in the first weeks following surgery. Therefore, it is important to point out that the ultimate success of the percutaneous release has much to due with the collaboration of the families in the physical therapy at home.[24] Early, aggressive, and constant movement is essential during the first 2-3 weeks after the procedure in order to prevent relapse, insisting when talking with the family on the importance this has for the success of the technique.

As far as the influence the learning curve has had on both techniques is concerned, we have not evaluated this point, since open surgery has been practised at our centre for many years and we believe the learning curve has not had any influence. As regards percutaneous release, although it is a new technique in our centre, the physician who performs it has enough experience using the technique, which is why it was also not quantified.

The true beginning of the intervention may have influenced the surgery time, since, when we began to perform the percutaneous release, we did not intervene until we had peripheral venous access. At present, we intervene at the same time as IV access is being achieved; hence, the surgery time may have decreased even further.

Conclusions

Trigger thumb is an uncommon pathology in children; it is apparently an acquired condition of unknown aetiology. In recent years, conservative and surgical treatment of the condition is being evaluated. With respect to open surgery, we can conclude that it is a safe treatment alternative with a low rate of complications; however, it calls for general anaesthesia and longer surgery time. Nowadays, percutaneous polectomy in children is a good, simple, affordable, and quick option; however, the technique must be performed by an expert in order to avoid neurovascular injury Likewise, it requires subsequent collaboration on the part of the family if recurrences are to be avoided and full success achieved.

Conflict of interests

The authors state that they have no conflict of interests.

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