Repair of the flexor pollicis longus tendon in children

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This is a retrospective study of primary repairs of flexor pollicis longus in 16 children under 15 years of age. Patients with injuries to the median or ulnar nerve at the wrist, crush injuries, skin loss or fracture were excluded. Repairs were carried out within 24 hours using a modified Kessler technique. The mean follow-up was for two years.

The final results were evaluated using the criteria of Buck-Gramko and Tubiana. They were good or excellent in all except one patient who had a secondary tendon rupture. When compared with the non-injured thumb, however, there was a significant decrease in active interphalangeal flexion ($> 30^\circ$) in one-third of cases. A new method of assessment is proposed for the recovery of function of the flexor pollicis tendon which is more suitable for children. Postoperative immobilisation using a short splint had a negative effect on outcome. The zone of injury, an early mobilisation programme or concurrent injury to the digital nerve had no significant effect on the final result.

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The unique anatomical and mechanical features of the tendon of flexor pollicis longus (FPL) justify its independent study.¹ It lies singly within the fibro-osseous tunnel, with no lumbrical origin and a particular vascular supply.² The outcome after repair of the FPL differs from that of other tendons in the hand because it is thought to be anatomically less complex.

Primary repair after laceration of a flexor tendon in children has a better outcome than a similar procedure in

adults.³⁻⁹ There is only one paper in the literature which describes the outcome after repair of the FPL in children.¹⁰ Although its anatomical position makes it particularly susceptible to injury, there is little information about results after its repair and most must be extracted from studies primarily concerned with the long flexors of the fingers.^{5,11}

We have assessed the outcome after repair of the FPL in children and propose a new method of evaluation of recovery which is more suitable for children is proposed, as those of Buck-Gramko, Dietrich and Gogge¹² and Tubiana, McMeniman and Gordon¹³ were initially described for adults. We also analysed the type of immobilisation and the subsequent programme of mobilisation, and the influence of an associated injury to the digital nerve on the outcome.

Patients and Methods

The criterion for inclusion in this retrospective study was a primary repair of the FPL tendon in a child aged under 15 years. Patients with associated fractures, crush injuries, skin loss, and injuries to the median or ulnar nerves at the wrist were excluded as were those with insufficient data or length of follow-up. We identified 24 patients who had sustained a laceration of the FPL tendon between 1992 and 1997 of whom 16 were available for study. The mean age at the time of surgery was five years (1 to 13). The most common mechanism of injury was a cut by glass (14 patients). Laceration of the tendon occurred in zone 1 in eight thumbs, zone 2 in five, zone 3 in one and zone 5 in two. Zone 1 extends from the A2 pulley at the level of the interphalangeal (IP) joint to the insertion of the tendon, zone 2 between the A1 pulley at the metacarpophalangeal (MP) joint and the A2 and zone 3 between the distal wrist crease and the A1 pulley. Zones 4 and 5 are the same as in the fingers. The right side was involved in nine patients. There was a concomitant laceration of the digital nerve in seven patients and in two the joint was involved. All nerve injuries were repaired at the same time as suture of the flexor tendon. Primary repair was carried out within 24 hours of injury.

The tendon was repaired using a modified Kessler technique with one suture using 4/0 or 5/0 Prolene (Ethicon Inc, Somerville, New Jersey). It was necessary to extend the incision proximally and distally in zones 1, 2 and 3 in order to obtain satisfactory exposure. When the proximal end of

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Table I. Details of the patients and assessments after repair of the FPL

Case	Age	Zone	Associated laceration of the digital nerve	Complication	Immobilisation (wks)	Follow-up (wks)	Pinch-grip	Buck-Gramcko et al ^{12*}	Tubiana et al ^{13*}	Authors*
1	3 yrs 10 mths	2		Rupture	5	32	N/A	P	P	P
2	4 yrs	1	Yes		6	12	N/A	E	E	E
3	13 yrs 6 mths	1	Yes		6	65	90	E	G	F
4	6 yrs 3 mths	1	Yes		6	24	100	E	E	E
5	5 yrs	1			4	18	80	E	E	E
6	9 yrs 9 mths	2	Yes		6	12	95	E	E	G
7	8 yrs 6 mths	1	Yes		4	39	80	E	E	E
8	1 yr 6 mths	2	Yes		6	16	N/A	E	E	E
9	1 yr 10 mths	1			4	24	N/A	E	E	E
10	3 yrs 7 mths	5			4	14	N/A	E	E	E
11	6 yrs 8 mths	3			4	30	100	E	E	E
12	1 yr 4 mths	2			4	34	N/A	G	G	P
13	5 yrs	2			5	12	100	E	E	G
14	4 yrs 6 mths	1			4	12	N/A	E	E	E
15	4 yrs	1	Yes		5	16	N/A	E	E	F
16	2 yrs	5			5	12	N/A	E	E	G

* E, excellent; G, good; F, fair; P, poor

Table II. Evaluation of recovery of the FPL according to the criteria of Buck-Gramcko et al¹²

	Degrees	Points
Flexion of IP joint	50 to 90	6
	30 to 49	4
	10 to 29	2
	< 10	0
Extension deficit	0 to 10	3
	11 to 20	2
	21 to 30	1
	> 30	0
Total active movement	>40	6
	30 to 39	4
	20 to 29	2
	< 20	0
Evaluation		
Excellent		14 to 15
Good		11 to 13
Fair		7 to 10
Poor		0 to 6

Table III. Evaluation of the recovery of the FPL according to the criteria of Tubiana et al¹²

	Degrees	Assessment
Flexion of IP joint	>60	F1
	>30	F2
	<30	F3
Extension deficit	<15	E1
	<30	E2
	>30	E3
Evaluation		
Excellent		F1E1
Good		F2E1
Fair		F3E1 or F2E2
Poor		F3E2 or E3

the FPL was retracted, retrieval was accomplished by 'milking' the palm with the wrist in acute flexion. We did not have to use an incision at the wrist to retrieve the proximal end. The epitenon was approximated by a running 6/0 or 7/0 synthetic suture in six patients. One tendon with a distal rupture was reattached to the terminal phalanx with a 4/0 suture over a dorsal button. The pulleys were preserved to prevent significant bowstringing. All patients received prophylactic intravenous antibiotics and the wounds were irrigated and debrided. Postoperative management involved immobilisation, without early passive movement, in either a complete above-elbow cast (9 patients) or a below-elbow splint (7) for four to six weeks with the wrist and MP and IP joints in flexion and with the first web space widely abducted. Thereafter, active mobilisation was encouraged.

At follow-up we measured the active and passive range of movement at the MP and IP joints on the affected and non-affected hands. The results (Table I) were evaluated using the criteria of Buck-Gramcko et al¹² (Table II) and Tubiana et al¹³ (Table III) and our method (Table IV). Measurement of pinch strength for both hands was assessed in patients above the age of five years. Interpretation of this test can be difficult in patients under this age.

Results

The mean postoperative follow-up was two years (1 to 5 years 4 months). According to the criteria of Buck-Gramcko et al¹² 14 patients had an excellent result, one good and one poor. According to the classification of Tubiana et al¹³ 13 patients had excellent results, two good

Table IV. Evaluation of FPL recovery according to our criteria

	Degrees	Points
Flexion of IP joint non-injured side –	0 to 20	6
flexion of IP joint of involved side	21 to 40	4
	41 to 50	2
	>50	0
Extension deficit (comparison with contralateral side)	0 to 10	3
	11 to 20	2
	21 to 30	1
	>30	0
Evaluation		
Excellent		8 to 9
Good		6 to 7
Fair		4 to 5
Poor		0 to 3

and one poor. Using our own assessment, nine were excellent (56%), three good (19%), two fair (12.5%) and two poor (12.5%). One patient had a secondary rupture of the tendon and was considered to have a poor result. She was a three-year-old girl who was immobilised in a below-elbow splint. She was treated by a further repair with lengthening at the musculotendinous junction, and had a good result at the last follow-up. There have been no repeat operations for lysis of adhesions and no infection occurred in this series.

In those tested for pinch grip the injured side achieved 92% of the strength of the opposite thumb. The injured side showed a significant decrease ($\geq 30^\circ$) in active IP joint flexion when compared with the opposite side in five cases. Comparison of the active range of movement for the injured and normal hands revealed percentage differences of 87% and 97% for the IP and MP joints, respectively. The mean active flexion of the IP joint on the injured side was 80° compared with 92° in the other thumb. There was no increase in the active range of movement of the MP joint compared with the other side.

Of the seven patients immobilised with a below-elbow splint, four showed a significant decrease of flexion of the IP joint ($\geq 30^\circ$) and one had a secondary rupture. Of the nine patients immobilised with an above-elbow closed cast, only one showed a significant decrease in flexion of the IP joint and none had a secondary rupture. The mean active movement at the IP joint was 73° after repairs in zone 2 and 80° in zones 1, 3 and 5.

Injuries to the digital nerve associated with rupture of the flexor tendon in zones 1, 2 or 3 had no significant effect on the final movement of the thumb.

No disturbance of the growth of the thumb was noted at the final follow-up.¹⁴

Discussion

Evaluation criteria. Injuries to the flexor pollicis longus are uncommon in children. Apart from one paper¹⁰ the results of repair of the FPL tendon in children must be extracted from general studies on injuries to flexor tendons.^{15,16} In our study, primary repair of the FPL tendon in

16 children using the modified Kessler suture achieved excellent results in 14 patients (88%) and good in one (6%) using the criteria of Buck-Gramcko et al.¹² According to the criteria of Tubiana et al.,¹³ 13 patients (81%) had excellent results and two good (13%). There are probably two reasons for these satisfactory results. First, the anatomy of the FPL tendon differs from that of the long finger flexors; it is single and has no lumbrical attachment. Secondly, the blood supply to FPL is better than that in the tendons of the fingers.² It is also better in children than in adults, leading to less formation of adhesions.¹⁷ Full active movement of the IP joint is not always recovered. Five patients (31%) showed a loss of $\geq 30^\circ$ when compared with the opposite side. The normal range of movement of the IP joint has been reported as between 60° and 130° .¹⁵ In these five patients, we did not observe an increased range of active movement at the MP joint which can occur as an adaptive phenomenon to compensate for the decreased active range of IP joint movement.

The Buck-Gramcko and Tubiana classifications^{12,13} were initially used for adults. In children they give overoptimistic results and are probably not suitable. Our own evaluation criteria for FPL repairs in children included the active range of movement of the contralateral IP joint and the extension deficit (Table IV). Applying our criteria, 12 patients (75%) had good or excellent results and four (25%) fair or poor results.

Zone of injury. Many authors¹⁸ assumed that the results of injury in zone 2 of the thumb would correlate with the poor results often found in 'no-man's land' in the fingers. Our results indicate that the zone of injury had little effect on the postoperative range of movement. Our series, however, is small and this point should be analysed in larger prospective studies in the future.

Influence of associated laceration of the digital nerve. We did not find that an associated laceration of the digital nerve had any significant effect on the final result, and this had been noted by Vahvanen et al.¹⁶

Immobilisation. The one patient who sustained a secondary rupture of the tendon was immobilised after operation in a short below-elbow splint. Four of the five patients who had a significant decrease in flexion of the IP joint were also immobilised in a short splint. Bell et al.¹⁹ reported the necessity of strict immobilisation in an above-elbow cast, especially in children under six years of age. Wakefield¹¹ also highlighted the problems of immobilisation in the very young. We now think that it is necessary, especially in very young children, to use an above-elbow cast with the wrist, MP and IP joints in flexion for postoperative immobilisation.

O'Connell et al.²⁰ and Berndtsson and Ejekkar²¹ found no significant difference between patients who had an early passive movement programme and those without. In our patients, there was no significant postoperative formation of adhesions. In children under five years co-operation is poor in the postoperative period. It is now our practice therefore

to enclose the arm, forearm and hand completely in a large closely applied plaster cast with no early programme of mobilisation.

Primary repair after laceration of the FPL in children achieved satisfactory functional results in most cases. Post-operative immobilisation must be strict with an above-elbow cast. Evaluation criteria should include the assessment of the active range of IP joint movement on the contralateral side.

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