REPAIR OF THE FLEXOR TENDON INJURIES OF THE HAND IN CHILDREN: ANALYSIS OF THE REPAIR TECHNIQUES AND TYPE OF IMMOBILIZATION

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ABSTRACT

This is a prospective study of flexor tendon repair in 26 children with 35 involved fingers, their age ranged between 1.5 to 15 years (average 7). They were presented for surgery within 3 weeks of the injury. Tendon repair using the 4-strand core suture technique was performed in 65% of the hands and 2-strand in 35%, and postoperatively 73% of the patients were immobilized by an above-elbow splint. The average follow up period was 9 months (ranged from 4 to 24). Using the Louisville scoring system, satisfactory results was achieved using 4 strand core suture technique and immobilization by above-elbow splint in 77% of the patients. The postoperative complications consisted of tendon ruptures in 15% of the cases mostly in those repaired by 2-strand core sutures with immobilization by below-elbow splint. So we believe that in children the suture technique and type of immobilization had a great influence on the final outcome following flexor tendon injuries.

INTRODUCTION

The treatment of flexor tendon injuries in the hand generally requires special care in order to prevent long term sequelae, and the restoration of satisfactory finger performance remains as one of the most difficult and challenging problems.[1-3] In children flexor tendon injuries are complicated problem and there are still poor outcome because of delay in diagnosis, small fingers with small size flexor tendons which make the repair technically difficult requiring great expertise, and in addition the inability of young child to cooperate after surgery. The proper surgical repair techniques, postoperative immobilization methods and the rehabilitation protocol affect the rate of healing, the strength of the repair and final tendon gliding.[4-8] Recently, it is reported that primary repair of the flexor tendon injuries in children produces better results than in adults, because healing is more quick, and have a greater ability to remodel scars and adhesions and rarely develop contractures.[5,8-10] The purpose of this article is to evaluate the effect of the repair technique and types of postoperative immobilization on the functional outcome after flexor tendon repair in children.

PATIENTS AND METHODS

This comparative study between two operative management of pediatric flexor tendon injuries was conducted between April 2001 and Dec 2007 at Basrah General Hospital and only 26 patients (35 fingers) less than 16 years old with sufficient follow up time were included. Cases with the thumb injuries, associated fractures, and with crush injuries were excluded. Fifty eight percent were males and 42% females, the age of the patients ranged from 1.5 to 15 years.

In 77% of the patients, tendons were lacerated by glass, 32 digits (91%) had injury to both flexor digitorum superficialis (FDS) and flexor digitoram profundus (FDP) tendons and in only 3(9%) just the FDP tendon was injured. In 20 patients (77%) the right hand was involved. Tendon injuries occurred in zone II in 9 fingers (34%), zone III in 14(54%), zone IV in 1(4%) and zone V in 2 (8%). In all these cases, we performed surgery within 3 weeks after injury with direct end to end repair. The injured tendons were repaired by nonabsorbable sutures (4/0 and 5/0 Prolene), in 17 patients (65%) (23 digits) we use the 4-strand core sutures (cruciate technique) combined with interrupted epitendinous suture and with 2-strand repair technique in 9(35%) (13digits). Postoperatively, immobilization by above-elbow dorsal splint with the wrist, metacarpophalangeal joint (MP) and interphalangeal joints (IP) in flexion applied in 19 patients (73%) and below elbow splint in 7(27%) for a period of 4 weeks without passive motion. After that the splint was removed and active mobilization started. The results were assessed according to the Louisville evaluation system depending on pulp-to-distal palmar crease (DPC) distance and the extension deficits.[11] The criteria in this system as follows: Excellent; Flex within 1cm of DPC with less than 15 degrees of extension deficit. Good; Flex within 1.5 cm of DPC with less than 30 degrees of extension deficit. Fair; Flex

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within 3 cm of DPC with less than 50 degrees of extension deficit. Poor; Flex over 3 cm with DPC or extension deficits over 50 degrees.

RESULTS

The average period of postoperative follow up was 9 months (range 4 to 24), the outcome was recorded after surgery and during the follow up period examination.

Generally the excellent results were seen in 12 patients (46%), good in 8(31%), and poor in 6 patients (23%). (Table-)

Table 1. ***Results of tendon repair***

	Patients	Fingers
Excellent	12 (46%)	16 (45%)
Good	8 (31%)	9 (26%)
Fair	-	-
Poor	6 (23%)	10 (29%)

The overall excellent and good results were achieved in 20 patients (77%), in this group, the tendons in 16 of the cases (21 digits) were repaired using 4 strand core suture technique and 2 strand core suture in 4(4 digits), and of these 20 patients, 17 were immobilized with an above-elbow splint and 3 with below-elbow splint.(Table-2)

Table 2. Results ***after surgery according to the repair technique and type of splint.***

	Excellent		Good		Total patients
	Potations	*Digits*	*Patients*	*Digits*	
Repair type					
4-strand	**10**	**14**	**6**	**6**	**16**
2-strand	**2**	**4**	**2**	**3**	**4**
Type of splint					
Above-elbow	**11**	**13**	**6**	**6**	**17**
Below-elbow	**1**	**3**	**2**	**3**	**3**

The unsatisfactory results were seen in 6 patients (10 digits) (Table-3). In 5 patients(8 digits) the tendons were repaired using 2 strands core suture while 4 strand suturing in one (2 digits). Four patients (6 digits) were immobilized with a bellow- elbow dorsal splint and with above-elbow splint in 2(4 digits). Rupture of the repaired flexor tendons occurred in 4 patients (15%) (6 digits), all were immobilized with below-elbow splint, and in 3 cases (4 digits) the splint was removed within 2 weeks after surgery by the patient.

Table ***3. Poor results after surgery according to the repair technique and type of the splint.***

	No. of patients	*No. of digits.*
Repair type		
4-strand	1	2
2-strand	5	8
Splint type		
Above-elbow	2	4
Below-elbow	4	6

DISCUSSION

In children, diagnosis of flexor tendon injuries is not always easy[9], in our locality most were treated as a simple cut by the paramedics or in the hospitals by inexperienced doctors. In this study, the incidence of excellent to good outcomes after flexor tendon repair in patients below 15 years was 77%. Satisfactory results have been reported previously in 76% to 100% of the cases.[9,12,13] In our series repair of the tendons using 4 strand cruciate core suture with epitendinous suture achieved satisfactory results in 80% of the patients out of 20, and poor function with 2-strand core suture in 83% out of 6 patients. Many authors assumed that increasing the number of strands crossing the repair site and the grasping power gives greater tensile strength of the repair, thus allowing active postoperative mobilization without the risk of rupture, and the circumferential peripheral suture basically makes a smooth approximation of tendon ends, and also augments the repair.[5,14,15] Problems of postoperative immobilization in the very young are extremely difficult to solve.[16] Fitoussi et al reported that the necessity of strict immobilization with an above-elbow cast, especially in patients younger than 6 years, in our study out of 20 patients 85% have satisfactory results after above-elbow

immobilization, and out of the 6 patients with postoperative immobilization using a short splint have a negative effect in 67%. Because of inability of the young children to cooperate in the postoperative care, many suggested to enclose the arm, forearm and the hand completely in a large closely applied cast with delayed mobilization to decrease the risk of tendon rupture and enables easy management with satisfactory results.[6,8,10,16] In our series out of 26 patients, tendon ruptures occurred in 4 patients (15%) this incidence was somewhat in accordance to other studies which has been reported to occur in 3% to 11% of children after tendon repair.[5,9,16] In most of the cases tendons were repaired by 2 strand core sutures and immobilized with below-elbow splint, the same was also reported in previous literatures that all the ruptures occurred in patients treated with 2 strands core sutures and with below-elbow postoperative immobilization, and immobilization with above–elbow cast is effective for preventing tendon rupture.[5,6,8,9,16] It is now accepted that the suture technique should provide sufficient strength to prevent both gap formation and repair failure.[17,18] The more damage of the structures around the tendons at the initial trauma, suboptimal surgical techniques in an inexperienced hands, and prolonged immobilization can lead to joint stiffness and impaired hand function,[4,17,19,20] on the other hand the use of strong repair techniques, decreased tendon bulk and irregularity of the tendon surface maximize healing and minimize adhesion formation which may decrease the need for complex secondary procedures.[14,21]

In conclusion, we believe that hand injuries in children require especial attention, and it is important to examine every finger carefully because a significant flexor tendon lacerations can be missed in small puncture wounds. The early initial tendon repair generally gives better results than repair after three to four weeks.

Our study suggests that in children the repair of flexor tendons at all levels with the 4 strand core suture and epitendinous suturing is more effective technique than those repaired with a 2 strands core suture, and it is better to apply above-elbow dorsal splint in the postoperative period for not less than 4 weeks.

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