DEROTATION OSTEOTOMY FOR CONGENITAL RADIOULNAR SYNOSTOSIS

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ABSTRACT

Objective: To evaluate the clinical and functional results of derotation osteotomy through the mass of synostosis for the treatment of congenital radioulnar synostosis in children.

Place and duration of study*:* Study was conducted in the Department of Orthopaedic and Spine Surgery, Hayatabad Medical Complex Peshawar from September 2008 to June 2014.

Patients and methods: This series included twelve patients with congenital radioulnar synostosis. All patients were managed with derotation osteotomy through the synostosis mass. The indication for surgery was limitation in performing the activities of daily life secondary to pronation deformity. Almost all patients had severe pronation of the forearm. Preoperative assessment was performed for all patients, including both clinical and radiological assessment. Eight patients were type III and four patients were type II according to Cleary and Omer. The posterior approach was used to expose the synostosis and osteotomy was done. Distal fragment rotated to 10 – 20 degree of supination and bone was fixed with K wires. Another K- wire put in distal fragment at right angle to the bone. This helps in manipulation correction of rotation.This wire is incorporated in postoperative cast to give stability. The patients were followed up regularly to check the union at osteotomy site. Wires were removed, when solid union was visible on radiograph.

Results: There were 12 patients operated during the study period. There were five female and seven male patients. The mean age at surgery was 5.19 years (range 4–11 years). Four patients were unilateral and eight were bilateral. The right forearm was operated in eleven patients and the left in one patient. The mean time of union of osteotomy was 7 weeks (range 5–12 weeks). The mean correction achieved in the all patients was 77.91° (range 45–100°). All patients were satisfied and showed improvements in the ability to perform the activity of daily life as compared to pre operative status. Two patients had complications.

Conclusion: Derotation osteotomy through the synostosis fusion mass to bring the forearm to 10°-20 supination gives rise to improvement in upper limb function. It is simple and effective method, as the compensatory movement of the shoulder and wrist will allow proper positioning of the forearm.

Keywords: congenital radioulnar synostosis, derotaation osteotomy, fusion mass

INTRODUCTION

Congenital radioulnar synostosis is an uncommon forearm malformation and was first described in 1793 by Sandifort's in museum anatomicus[1]. During early morphogenesis longitudinal segmentation produces separation of the distal radius and ulna. However, temporarily, the proximal ends are united and continue to share a common perichondrium. Abnormal genetic or environmental factors operating at this time could interrupt subsequent proximal radioulnar joint separation leading to congenital radioulnar synostosis[2,3]. Congenital radioulnar synostosis may be associated with other abnormalities such as polydactyly, syndactyly, thumb aplasia, and other upper limb malformations. It may also be associated with well-known syndromes like Arthrogryposis, Apert's syndrome, Carpenter's syndrome, Williams' syndrome and chromosomal abnormalities like Klinefelter's syndrome. Males are affected more commonly than females. It is bilateral in 60% of the cases[4]. Congenital radioulnar synostosis can be classified by many ways but the most commonly used classification system was devised by Cleary and Omer[5]. They proposed four radiographic types: Type I: fibrous synostosis with a reduced and normal-appearing radial head. Type II: osseous synostosis with normal radius. Type III: osseous synostosis with a hypoplastic and posteriorly dislocated head. Type IV: a short osseous synostosis with an anteriorly dislocated radial.

As congenital radioulnar synostosis usually involves the proximal ends of the radius and ulna, most often fixing the forearm in pronation which results in marked difficulty in daily activities [6]. When the dominant side is involved child has difficulty in holding a bowl, glass in his/her hand, difficulty in face washing and handling shirt buttons [7]. Congenital radioulnar synostosis is difficult to treat. Generally, there are two surgical options to treat such patients. One is the mobilization operation to separate the radioulnar synostosis to restore forearm

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rotation. The results of mobilization operation are disappointing with high rate of recurrent fusion[8-10]. Recently, a free vascularized fascial flap placed between the separated forearm bones has been reported to successfully block postoperative recurrence of the synostosis[11,12]. The second surgical option is osteotomy to realign the forearm in a position suitable for performing the activities of daily living. Most patients are not disabled enough to justify an extensive operation. Any disabling pronation or supination deformity should be corrected by osteotomy. Motion of the shoulder, especially when the elbow is extended, compensates well for the deformity in most children. Osteotomy occasionally is indicated in children with bilateral hyperpronation. One forearm can be positioned in neutral rotation to assist in hygiene. In unilateral cases patient can adopt easily. In severe cases rotational osteotomy is needed for achieving a more functional position of the forearm.

There are many types of rotational osteotomy that can be summarized into osteotomy at the synostosis, osteotomy at two sites in the diaphysis of the radius and the ulna, and osteotomy at one site in the distal diaphysis of the radius. The generally accepted surgical treatment is derotation osteotomy using Kirschner wires (K-wires), plate, external fixator, or even a cast to fix the osteotomy[13-15]. In our region the most important consideration in such cases is being able to eat with right hand. Our holy prophet (PBUH) has advised to eat with right hand[20]. Most parents of the patients wished their children to be able to eat with rifht handWe describe the surgical technique, results and complications of derotational osteotomies through the synostosis with K- wire stabilization of the osteotomy site.

PATIENTS AND METHODS

This study was conducted in the Department of Orthopaedic and Spine Surgery Hayatabad Medical Complex. Between September 2008 and June 2014, twelve patients with congenital radioulnar synostosis were managed with derotation osteotomy through the synostosis fusion mass. There were five female and seven male patients. The mean age at surgery was 5.16 years (range 4–11 years). Four patients were unilateral and eight were bilateral (table I). The right forearm was operated in eleven patients and the left in one patient. Preoperative assessment was performed for all patients, including both clinical and radiological assessment. The clinical assessment included the ability of performing the activities of daily life, the degree of pronation deformity, and the range of motion of the elbow and wrist. The radiographic assessment was based on the classification of Cleary and Omer. Preoperative assessment of the patients revealed that all of them had limitation of the activities of daily life. The limitation of activity was mostly due to extreme pronation of forearm (Fig I). Eight patients were type III and three patients were type according to Cleary and Omer. Before surgery the parents were thoroughly explained about the surgical procedure, its complications and limitations.

Surgery was performed under general anesthesia with the patient in the supine position under tourniquet control. Forearm held over chest by the assistant. The posterior approach was used to expose the synostosis mass. Osteotomy was done in distal part of mass with multiple drill holes and then breaking with an osteotome. Distal fragment rotated from pronation to 10 -20 of supination and bone was fixed with K wire passed from olecrenon (Fig II). Another wire put in distal fragment at right angle to the bone. This wire helps in manipulation, correction of rotation and stability. This wire is incorporated in postoperative cast and in case of any vascular compromise the supination can be reversed (Fig III). Postoperatively, close observation for neurovascular complications was performed in the first 24 hours. In case of any vascular compromisation the rotation can be reversed easily with the help of transverse wire. Upto two weeks if the supination is considered less further supination can be achieved. Above elbow plaster cast

Table I. Patients data

Serial No.	Age	Sex	side	Pre op pronation	Post op Supination	gain	Remarks
				In Degrees			
1	04	M	R	60	10	70	
2	04	M	L	65	20	85	
3	03	F	R	60	15	75	
4	06	F	R	90	10	100	
5	05	M	R	45	15	60	
6	07	M	R	70	15	85	Posterior interoseous nerve palsy
7	06	M	R	60	15	75	
8	11	F	R	55	20	75	
9	04	M	R	65	15	80	
10	03	F	R	70	15	85	VIC
11	05	M	R	60	10	70	
12	04	F	R	60	15	75	
Average	5.16	F=5, M=7		68.75 PRO	14.58 SUP	77.91	

Fig. I: Pre operative picture

Fig.II. Intra operative picture

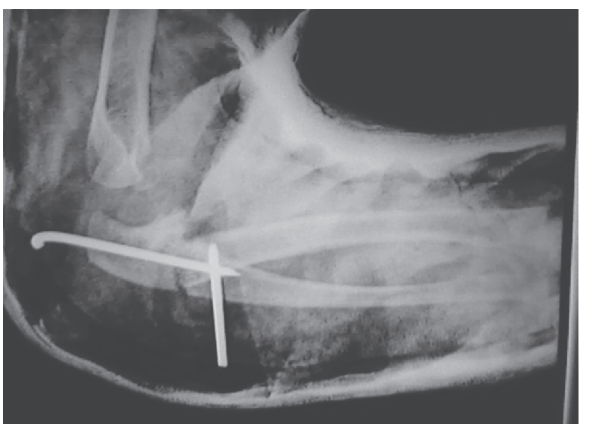

Fig.III. Post Operative X ray

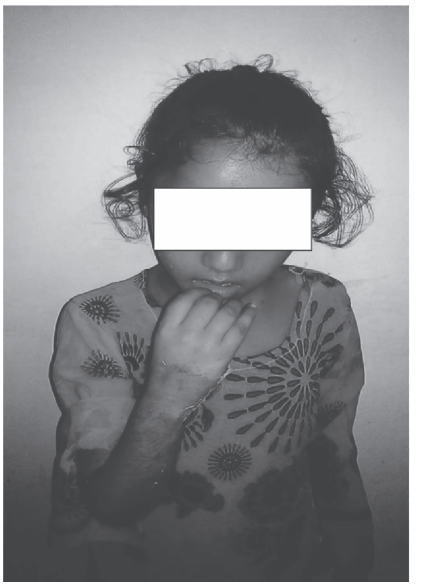

Fig.IV. post operative clinical Picture

was applied for protection for 4 weeks. The stitches were removed after 2 weeks. The patients were followed up after that every month to check the union. The functional assessment is done to see the ability of child to perform activities of daily living like picking objects from others, holding a glass or bowel, and being able to eat with right hand.

RESULTS

All patients completed at least 6 months follow up. Bony union after osteotomy was achieved in all patients. The mean time of union was 7 weeks (range 5–12 weeks). In patient with severe pronation deformity, acute correction was achieved intraoperatively to reach the final position of 10°-20° supination. The mean correction achieved in the all patients was 77.91° (range 45–100°). All patients were satisfied and showed improvements in the ability to perform the activity of daily life (Fig. IV). We noted neurological complication (posterior interosseous nerve) in one patient which resolved within four weeks time. One patient had swelling of hand and compromisation of vascularity in forearm and hand. We had to reverse the supination back about 30 degree. This child developed grade I Volkmann's ischemic contracture later. She has some improvement with physiotherapy but the result was considered poor and the parents were also not satisfied. The results of surgery shown in table I.

DISCUSSION

Congenital radioulnar synostosis is a rare anomaly of the upper limb. It may cause significant disability

When the deformity is severe or bilateral. With respect to the proper age for surgery, most authors recommended that the operation is best carried out between the age of 3 and 8 years[15-16]. At this age, the osteotomy will be easy with sufficient remodeling of the

radius and ulna. In addition, the fixation of osteotomy could be accomplished by K-wire and cast or even a cast alone. In older patients, the risk for neurovascular complications may increase. In our series the indication for surgery was limitation in performing the activities of daily life secondary to pronation deformity. Simmones et al.[3] considered that pronation deformity of 60° or more was a definite indication for derotation osteotomy. Yammine et al.[17]

Proposed two main indications for surgery, which were hyperpronation more than 90° and bilateral synostosis. Ramachandran et al.[18] reported that a pronation deformity of 60° or more was the indication for osteotomy in unilateral cases and less than that in bilateral. Hung[14] showed that the indication for osteotomy was pronation deformity more than 65°. This obvious from the literature that the most disabling position for dominant hand is pronation deformity. Generally, there are two surgical options to treat congenital radioulnar synostosis. The first option is to separate the radioulnar synostosis to restore forearm rotation, but the reports of other authors are disappointing with high rate of recurrent synostosis[8,9]. The second surgical option is derotation osteotomy to realign the forearm in a suitable functional position. We did the osteotomy through the synostosis in all cases. The procedure was adopted due to its simplicity, single stage and versatility. None of our patients showed loss of correction during postoperative follow-up. Murase et al.[15] described osteotomies in the distal third of the radius and the proximal third of the ulna through two separate incisions in four patients.

The osteotomies were fixed by K-wire. Hung described osteotomies in the distal third of the ulna and the proximal third of the radius through two separate incisions in 39 patients[14]. The osteotomies were fixed by K-wire which is essential to maintain the correction postoperatively. In our study the position of derotation osteotomy was 10-20 degree supination all the patients. The best position of the forearm after derotation osteotomy is controversial. Murase et al.[15] and Hung[14] preferred to correct the forearm position in the dominant hand between 0 and 30° of pronation and neutral position was preferred for no dominant hand in a unilateral case, as well as bilateral case. Green and Mital[19] recommended that, for bilateral cases, the dominant hand should be placed 20–35° of supination and the no dominant hand in 30–45° of pronation. In unilateral cases, the ideal position was 10–20° of supination. Ramachandran1[18] and colleagues preferred a position of 10° supination in all cases as the compensatory movement of the shoulder and wrist will allow proper positioning of the forearm. In our series we also kept 10-20° supination in all the cases. All our patients were satisfied with surgical outcome. The principal advantages of this method are the ease of the surgical approach, no loss of rotational correction during follow-up and ability to reverse the derotation when needed.

There is some discussion in literature that keeping the dominant forearm in more supination may result in some functional problems. As compensation is with extension of elbow and abduction of shoulders for writing and use of computer key board it may lead to increasing fatigue of arm. But it needs further studies and follow up in adults to reach a conclusion. For the time being most authors recommend that the best position is 10-20 degree of supination.[14,15,18]

CONCLUSION

Derotation osteotomy through the synostosis mass is a good option to manage congenital radioulnar synostosis. The preferred position is slight supination (10°-20°) as the compensatory movement of the shoulder and wrist will allow proper positioning of the forearm.

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