Complications and Outcomes Following Humerus Lengthening – An Illustrative: Case Report

Saktthi Sellayee Shanmuganathan[1], JK Giriraj Harshavardhan[1], Gopinath Menon[1]

Learning Point of the Article:

Radial Nerve palsy can be prevented or at least if palsy occurs post operatively; recovery can be anticipated; if Schantz screws are inserted carefully – preferably by open technique in the supracondylar region of distal humerus and by carefully performing the corticotomy again through a generous incision.

Abstract

Introduction: Upper limb physeal injuries are dealt with differently simply because they do not hinder with the functional abilities of an individual. Humerus lengthening was first attempted in 1978 after which it encouraged many surgeons to safely perform the procedure. Radial nerve palsy occurring as a complication of humeral lengthening was a major concern.

Case Report: We report a case of a 17-year-old girl with physeal arrest at the proximal physis of the humerus with etiology of post-trauma/post-infection. She presented with a shortening of 8 cm and restricted shoulder movements. We performed a lengthening of the humerus based on the principle of distraction osteogenesis. We used the paediatric limb reconstruction system to distract the corticotomy. However, postoperatively, she developed radial nerve palsy, despite our intraoperative precautionary measures. Distraction was started at 1mm/day. She then showed the progress of radial nerve recovery and full recovery was noted by 5 months post-operatively. The length of the distraction compression assembly had to be changed twice to longer sizes to accommodate the required amount of lengthening. After consolidation of regenerate was confirmed with serial radiographs, external fixator was removed. She was then maintained on a functional brace. We were able to achieve 8cm of lengthening following distraction, and the cosmetic appearance of the patient improved to the patient's and attenders' satisfaction.

Conclusion: Humeral lengthening can safely be performed. Careful insertion of the distal pins and performance of the corticotomy will ensure the safety of the radial nerve. Even if radial nerve palsy occurs after all precautions are taken, recovery can be expected.

Keywords: Humerus lengthening, limb reconstruction system LRS, radial nerve palsy.

Introduction

Physis is the growing end of the bone. Physeal injuries, in general, can vary from trauma to infection, and they are notorious for causing physeal arrests [1, 2]. About 80% of growth takes place in the proximal physis of the humerus and only 20% takes place in the distal physis [3]. The need to address limb length discrepancy differs in the lower and upper limb, wherein the former causes functional disability and the latter raises a more cosmetic concern as it is not weight bearing.

In the history of orthopedic literature, there exists many painful attempts to restore length in the bone [4]. Distraction osteogenesis first described by Gavrill Ilizarov was a breakthrough revolution to address limb length discrepancies [5, 6]. With the basis of this very principle, the major concepts used for the last three decades were ring fixators, intramedullary devices, and monolateral/multiaxial frames [4, 5]. Computer navigation and hybrid techniques are the newer advances used over the past decade [5, 7].

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Author's Photo Gallery

Dr. Saktthi Sellayee Shanmuganathan

Dr. JK Giriraj Harshavardhan

Prof. P. Gopinath Menon

[1]Department of Orthopedics, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, Tamil Nadu, India.

Address of Correspondence:
Dr. J K Giriraj Harshavardhan,
Department of Orhtopedic Sri Ramachandra Institute of Higher Education and Research, Porur–600 116, Chennai, Tamil Nadu, India.
E-mail: menon2002@gmail.com

Figure 1.1: Clinical photo of the shortening of the limb at the time of presentation.

Figure 1.2: Clinical photo showing restricted shoulder abduction.

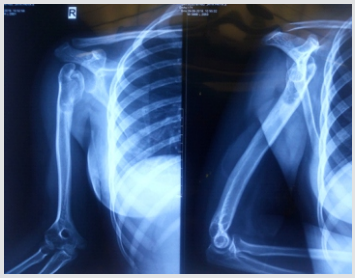

Figure 2: Pre-operative X-ray anteroposterior and lateral views of the humerus with shoulder joint.

Figure 3: Clinical photo of post-LRS fixation and distraction.

Case Report

A 17–year-old developmentally normal girl born to a non-consanguineous marriage had come to the outpatient department with complaints of shortening of her right arm (Fig. 1.1 and 1.2). Developmental milestones were normal at the age of about 5 years. She had a history of trauma to the right shoulder which was treated indigenously for 45 days in the form of massage and bandaging. There was a significant history of fever during the same period which was treated with intravenous medications. She developed affection of the proximal humeral physis as sequelae of infection/trauma. The child recovered and remained asymptomatic for 2 years, after which her parents noticed the stunted growth in the right arm. The child's longitudinal growth of the arm did not progress and also complained of difficulty in using her upper limb. Her stiffness and arrest in growth remained status quo for the past 10 years since the time of manifestation, and all attempts of treatment were in vain. She had difficulty in reaching out to objects and lifting her right shoulder. Her mother's concern was the shortening of the right arm as she was in her late teens about to enroll into a college. Shortening of the humerus was noted (Table1). Movements of the right shoulder were significantly reduced (Table 2). Range of motion of the right elbow was 0–110° with full forearm rotation. There was a wasting of the right arm and forearm muscles (Table1). There were no distal neurovascular deficits. X-ray showed an abnormality of the development of right proximal humerus (hypoplastic) (Fig. 2). She had presented with 8-cm shortening in the humerus as a result of premature arrest of the proximal physeal plate. We diagnosed her as a case of post-traumatic/post-infective sequelae of the right proximal humerus physeal injury. The decision was made to treat her using the principle of distraction osteogenesis. The patient was insistent on lengthening her right arm. She was clearly explained that lengthening would not improve her shoulder function in any way. The possible complications such as peripheral nerve palsy and elbow stiffness were also explained and documented. Pediatric limb reconstruction system (LRS) was used to perform the distraction osteogenesis. Proximally, LRS was fixed with two anterolateral conical (3.5/4.5) Schantz screws that were inserted just anterior to anterior margin of deltoid in the proximal one-third of diaphysis. Distally, an anterolateral longitudinal incision was made over the supracondylar region of the distal humerus. Blunt dissection was used to reach down to the bone. Insertion of drill bit and Schantz screw was done through sleeves to avoid injury to the radial nerve. Rail was fixed to Schantz screws. Corticotomy was done in the middle-third of humerus using the anterolateral approach (Fig. 3 and 4). Postoperatively, the patient was noted to have right radial nerve palsy. We were perplexed as to whether it was an injury at the corticotomy site or at the distal Schantz screw site. However, as we had taken extreme precautions during the dissection and insertion of Schantz screws and while performing the corticotomy, we remained optimistic toward recovery. Distraction of 1mm/day (divided into 4 times/day) was started on July 20, 2016 (post-operative day 6). Radial nerve palsy recovery was first noted at around 2 months' follow-up (September 2016). At 5th month follow-up (December 2016), radial nerve palsy had fully recovered. Distraction was stopped on January 30, 2017. It should be noted that 194 days of

Table 1: Measurements of the upper limb (arm and forearm)

Circumferential	RT	LT
Arm	26cm	26cm
Forearm	16cm	19cm
Longitudinal		
Arm	2cm	30cm
Forearm	26cm	26cm
Carrying angle	5°	15°

Table 2: ROM of Right shoulder

Movement	Degree of Movem
Flexion	0–90°
Extension	0–40°
Abduction	0–90°
Internal rotation	0–60°
External rotation	0–90°
ROM: Range of motion	

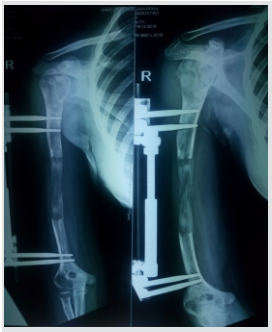

Figure 4: Clinical photo of post-LRS fixation and distraction.

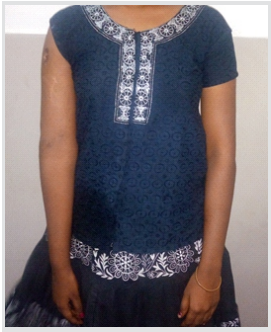

Figure 5: Clinical photo after completion of distraction and functional bracing.

Figure 6: Final functional outcome with restoration of limb length.

Figure 7 : Clinical photo showing restricted shoulder abduction .

Table 3: Comparison of outcomes of humerus lengthening using distraction osteogenesis principle [10-15]

Authors	Number of cases	Number of infective	Type of lengthening	Number of radial N palsy	Recovery	Lengthening (cm)
Francis *et al.*	19	6	Unilateral ex fix/Ilizarov	3	Full	5
Sander *et al.*	11	3	Unilateral Wagner	1	Full	6.2
Jane *et al.*	1	1	-	1	Full	-
Gauger *et al.*	12	21.50%	-	-	-	-
Ruette *et al.*	17	4	Ilizarov frame	6	Full	8.85
Hosny	56	11	Ilizarov frame	2	Full	9
Author *et al.*	1	1	LRS	1	Full	8

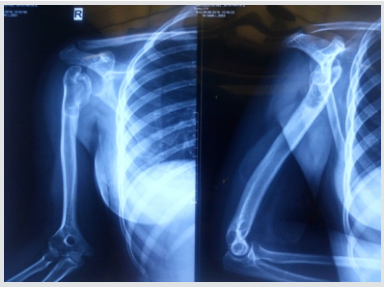

Figure 8: X-ray after consolidation of humerus post-lengthening.

distraction were required to correct the shortening of about 80mm. This is because LRS being a uniplanar fixator leads to lots of bending stresses on the pin. Hence, 1mm of distraction on the DC assembly produces less distraction at the corticotomy site. Even though we did not consider this principle initially, we were fortunate to escape from a premature consolidation of the regenerate. Distraction compression assembly initially used was an assembly which allowed 3cm of distraction. This had to be changed twice (to 5cm and then to 7cm)during the distraction period. LRS was removed on June 15, 2017 after the consolidation of regenerate. Functional cast was applied and changed to a brace on July 3, 2017 which was continued for 2 months. Serial X-rays were taken at immediate post-operative, 1 week after distraction, end of distraction, and consolidation, respectively. There was a full recovery of right elbow flexion; however, shoulder function remained status quo(Fig. 5-8).

Discussion

Lower limb physeal arrests are being managed with limb lengthening procedures to treat the functional disability. However, upper limb length discrepancies have not been aggressively addressed, as there was no significant functional impairment. The need for surgical correction was sought when a cosmetic concern was raised. A discrepancy of >5cm was significant for surgical correction [4].Dick and Tietjen in 1978 reported their first case of humeral lengthening for septic growth arrest [8]. Before this, there did exist a paucity in literature with respect to humerus lengthening procedures. What was then an uncharted territory became a commonly performed procedure. The incidence of peripheral nerve injuries following limb lengthening procedures varies from 3% to 30%. It is imperative to identify and treat at the earliest to restore the complete function of the limb. The use of nerve conduction studies and ultrasonography has gained popularity to localize these lesions following surgery [9]. Lee et al. performed distraction osteogenesis in 19 humeri, of which 31.6% were due to infective causes. Radial nerve palsy was reported in only 15.8% of the cases [10]. Kiss et al. performed limb lengthening using Wagner fixation in 11 humeri, of which only 27.3% were due to infection causing physeal arrest. Only one case had radial nerve palsy complication [11]. In our study, the patient presented with a wrist and thumb drop, but the condition was painless. Halliday et al. reported a case of painful radial nerve palsy post-limb lengthening and the cause of pain was due to compression at the distal pin site [12]. Our patient had complete recovery of radial nerve palsy 5 months following surgery even before the course of distraction was completed. Radial nerve palsies can occur in both ring and monolateral fixators [13] (Table 3).

Conclusion

Humerus lengthening can be safely performed using principles of distraction osteogenesis.

Clinical Message

Radial nerve palsy can be prevented or at least if palsy occurs postoperatively; recovery can be anticipated; if Schantz screws are inserted carefully – preferably by open technique in the supracondylar region of distal humerus and by carefully performing the corticotomy again through a generous incision.

References

1. Ecklund K, Jaramillo D. Patterns of premature physeal arrest. AmJ Roentgenol 2002;178:967-72.
2. Ogden JA. Injury to the growth mechanisms of the immature skeleton. Skeletal Radiol 1981;6:237-53.
3. Binder H, Schurz M, Aldrian S, Fialka C, Vécsei V. Physeal injuries of the proximal humerus: Long-term results in seventy two patients. Int Orthop 2011;35:1497-502.
4. Farr S, Mindler G, Ganger R, Girsch W. Bone lengthening in the pediatric upper extremity. J Bone Joint Surg Am 2016;98:1490-503.
5. Birch J. A brief history of limb lengthening. J Pediatr Orthop 2017;37:S1-8.
6. Ilizarov GA. Clinical application of the tension-stress effect for limb lengthening. Clin Orthop Relat Res 1990;250:8-26.
7. Sabharwal S, Rozbruch S. What s new in limb lengthening and deformity correction. J Bone Joint Surg Am 2011;93:2323-32.
8. Dick H, Tietjen R. Humeral lengthening for septic neonatal growth arrest. Case report. J Bone Joint Surg 1978;60:1138-9.
9. Rozbruch S, Fryman C, Bigman D, Adler R. Use of ultrasound in detection and treatment of nerve compromise in a case of humeral lengthening. HSS J 2010;7:80-4.
10. Lee FY, Schoeb JS, Yu J, Christiansen BD, Dick HM. Operative lengthening of the humerus: Indications, benefits, and complications. J Pediatr Orthop 2005;25:613-6.
11. Kiss S, Pap K, Vízkelety T, Terebessy T, Balla M, Szoke G, et al. The humerus is the best place for bone lengthening. Int Orthop 2008;32:385-8.
12. Halliday J, Hems T, Simpson H. Beware the painful nerve palsy; Neurostenalgia, a diagnosis not to be missed. Strat Traum Limb Recon 2012;7:177-9.
13. Ruette P, Lammens J. Humeral lengthening by distraction osteogenesis: A safe procedure? Acta Orthop Belg 2013;79:636-42.
14. Gauger E, Casnovsky L, Gauger E, Bohn D, Van Heest A. Acquired upper extremity growth arrest. Orthopedics 2016;40:e95-103.
15. Hosny GA. Humeral lengthening and deformity correction. J Child Orthop 2016;10:585-92.

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