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Late treatment of obstetrical brachial plexus palsy by humeral rotational osteotomy and lengthening with an intramedullary elongation nail

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ABSTRACT

To date, all the authors who have recommended external rotation osteotomy (ERO) in the late treatment of obstetrical brachial plexus palsy (OBPP), have neglected upper limb length discrepancy, which is an another sequelae of OBPP. In this paper, a new technique is reported for the late treatment of OBPP patients with upper limb length discrepancy, in which both humeral external rotation osteotomy (ERO) and lengthening are applied with an intramedullary elongation nail. With this technique, upper limb function is improved through re-orientation of the shoulder arc to a more functional range, and further improvements will be seen in the appearance of the upper limb with the elimination of length discrepancy. It is also advocated that there is a potentiating effect of the humeral lengthening on shoulder movements gained by ERO when the osteotomy is applied above the deltoid insertion, as this allows more lateralized placement of the deltoid insertion.

Introduction

The incidence of obstetric brachial plexus palsy has been reported to range from 1 to 4 cases per 1000 live births, with higher rates in underdeveloped countries.[1] The classical injury is Erb's palsy (involving C5, C6 ± C7 roots), but all roots can be involved in total paralysis with a worse prognosis.

Spontaneous complete recovery is seen in most children during the first months of life, but a degree of residual dysfunction is present in 5%–19%.[2] Fixed adduction and internal rotation deformity of the shoulder is the most common sequela of OBPP, seen at varying severity and usually together with a degree of fixed pronation of the forearm with elbow flexion contracture.[3] Shoulder deformities result from a failure in neuromuscular recovery which causes an imbalance between antagonist muscles which dominate the internal rotators and adductors of the shoulder and this may cause progressive glenohumeral dysplasia and/or joint instability in the long-term.[4]

Older children with long-standing brachial plexus palsy and moderate-to-severe glenohumeral deformity (Waters IV, V, VI) are good candidates for external rotation osteotomy (ERO) to improve upper extremity function with re-orientation of the arc of the shoulder into a more functional range and position.[3,5] Historically, external rotational osteotomies are stabilized with external cast immobilization, interosseous or periosteal sutures, or staples.[3] Nowadays, an open approach and rigid internal fixation with a plate is recommended. Recently, Aly et al reported a new technique of percutaneous humeral osteotomy with osteosynthesis using a Hoffmann external fixator.[6] To date, no surgical technique has been defined to deal with the upper limb length discrepancy which is also a sequela of OBPP and contributes to the appearance of the affected limb.[7,8] In this paper, a new technique is presented for the late treatment of OBPP, using humeral rotational osteotomy and lengthening with an elongation nail.

Case

A 33 year-old male was admitted to our clinic suffering from right OBPP sequelae with C5 and C6 injury. The patient presented with internal rotation contracture of the right-side shoulder,

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pronated forearm and 5 cm limb length discrepancy. Together with the functional limitations, the patient was experiencing low self-esteem because of the appearance of the arm. He had no previous operations. The shoulder range of motion was recorded preoperatively as external rotation −80° in adduction, internal rotation 100°, abduction 20°, and flexion 20°. Preoperative plain radiographs demonstrated the osseous deformity of the glenohumeral joint (Fig. 1a, b). A score of 1 was obtained in the preoperative shoulder function assessment using the modified Mallet scoring system.

Surgical technique

The procedure was performed under general anesthesia in the beach chair position. The flouroscopy machine was placed on the opposite side of the table to ensure a good AP and axillary view. The entire affected upper extremity was then prepared and draped for the surgical field. A standard deltopectoral approach was applied. Under fluoroscopy guidance, the entry point for the nail was determined through the sulcus between the greater tuberosity and the articular surface. The medullary canal was reamed to 12.5 mm with elastic reamers in 0.5 mm increments under flouroscopy guidance control to obtain 1.5–2 mm overreaming. A transverse osteotomy between the insertion of the deltoid and pectoralis major muscles was performed with a small oscillating blade under continuous irrigation to avoid thermal necrosis. Then, a 10.7 mm × 255 mm antegrade tibial lengthening nail (ISKD, Orthofix Inc, Lewisville, TX, USA) with a 5 cm lengthening capacity was implanted (Fig. 2a, b). Proximal locking was performed with a drill guide. Prior to the distal locking of the nail, adequate rotation of the humerus was decided intraoperatively by ascertaining that the ipsilateral hand could be placed to the mouth while putting the flexed elbow to the side of trunk. Once the desired amount of rotation was achieved, the distal locking screws were placed using a free hand technique with a radiolucent gear drive using a mini open approach to protect the radial nerve. Finally, fixation was checked under fluoroscopy.

Postoperative care

The shoulder activity was limited by immobilization with a shoulder abduction orthosis and bed rest in the first 5 days after surgery. Using a magnetic control device, it was confirmed that there was no lengthening in the first 5 days. Distraction was initiated on postoperative day 5 with a 0.25-mm distraction rate every 6 h and prior to the patient being discharged, radiographs were taken. The patient was instructed in the need to perform the lengthening process 4 times a day and it was explained how to use the magnetic monitor after every lengthening. Follow-up radiographs were taken weekly during the distraction period of the lengthening to be able to check the lengthening process. During the distraction period, the upper limb was kept in a shoulder abduction orthosis to avoid excessive rotational movements and only passive shoulder and elbow movements were permitted in a controlled way. After completion of the planned 5 cm lengthening in 6 weeks, active-assisted movements were permitted and the distracted osteotomy site consolidation was monitored with radiographic follow-up every 4 weeks (Fig. 3a, b). Three months after the operation, the weight limitation was removed as all four cortices at the osteotomy site were visualised on the radiographs (Fig. 4a, b). At 9 months, bone healing was completed (Fig. 5a, b). At 15 months post-operatively, the nail was extracted in a second operation. At the 3-year follow-up examination, shoulder range of motion was recorded as active external rotation 0° and passive external rotation 40° in adduction, internal rotation 70°, abduction 100°, and flexion 120°. A modified Mallet score of 4 was obtained. The patient's hand was able to reach to the occiput with the absence of the trumpet sign, and the palm rather than the dorsum was facing the mouth, which he could not do before the operation (Fig. 6).

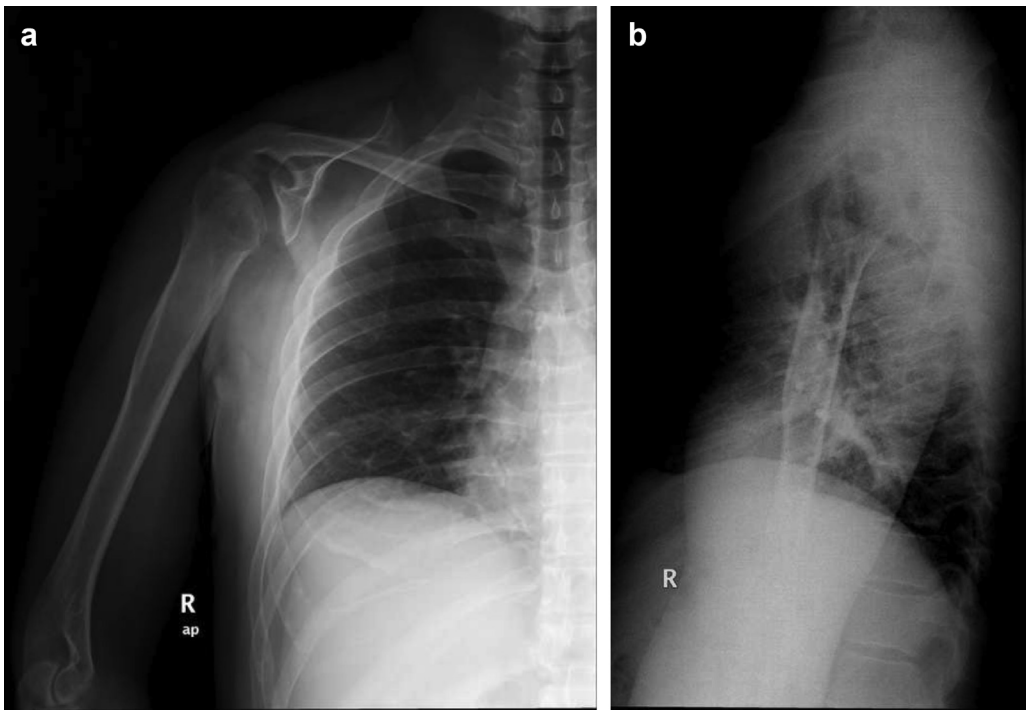

Fig. 1. a, b: Pre-operative AP and Lat. X-rays.

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