EDITORIAL

CONSIDERATIONS FOR SURGICAL PLANNING OF HUMERAL OSTEOTOMY IN BRACHIAL PLEXUS BIRTH PALSY BASED ON THE ELBOW CREASE AND HUMERAL RETROVERSION MEASUREMENT

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In obstetric brachial plexus, injuries are characterized by contractures, weakness and an association with different bone deformities, such as elongation of the coracoid process and/or acromion, retroversion of the glenoid cavity, flattening of the humeral head and Scapular Hypoplasia with Elevation and Rotation (SHEAR). Another humeral deformity is the retroversion of the humeral head, cases of which are increased in the presence of plexus lesions. The purpose of the current manuscript is to highlight two aspects of this latter deformity. First, the importance of taking into consideration the reduction of a humeral retroversion as a quantifiable bone deformity (by medical imaging technique) along with the other bone deformities previously mentioned. Finally, the complementation of these measurements by the clinical measures of the anterior crease of the elbow to rebuild the plane of motion to a level comparable to that of the healthy side, thereby avoiding excessive exorotation, would facilitate and improve the planning of surgical strategies for each patient.

Keywords: Brachial plexus birth palsy; Bone deformity; Humeral retroversion; Surgical planning; Humeral osteotomy

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The prevalence of brachial plexus birth palsy, widely known as Erb's palsy, is reported to range from 0.4 to 4 per 1000 births in the US, but in other countries, the rates are higher. The injury mechanism is stretching of the upper cervical roots C5–C6/C5–C6–C7 during vaginal delivery[1], which leads to imbalanced toning of the muscles of the upper limb. The clinical findings are characterized by the shoulder in adduction and internal rotation position, the elbow in extension, pronated forearm, and the wrist in extension. If C7 root is involved, the elbow is slightly flexed along with the wrist in flexion and ulnar deviation position. Brachial plexus birth palsy achieves a high rate of spontaneous recovery, but one-third of affected patients require surgery, which depends on the time and cervical roots involved, along with the patient's age. Moreover, if this imbalance persists, shoulder bone deformities will develop. Humeral rotational osteotomy is an alternative to both correct the deformity and retrieves external rotation of the shoulder.[2] However, this surgery might endanger the function of the midline of the hand. For this reason, improving surgical planning would decrease the complications.

The bone deformities reported in Erb's palsy combine elongation of the coracoid process and acromion, increasing the retroversion of the glenoid fossa, flattening of the humeral head, and scapular hypoplasia along with elevation and rotation.[3] However, we should also consider changes in the humeral retroversion in this disorder. *Humeral retroversion* is the angle between the surface axis of the humeral head and the distal joint line. The reference value is variable, from 7° to 47°, and differs between dominant and non-dominant limbs.[4]

Van de Bunt *et al* quantified *humeral retroversion* by comparing the retroversion angles measured on nuclear magnetic resonance (NMR) imaging of both healthy and injured shoulders and described bone structural changes at the proximal location and both humeral retroversion and glenoid increase in these lesions, indicating that both acquire greater negative values, causing a notable reduction in the external rotation of the shoulder. However, distally, the humeral retroversion amalgamated in the transepicondylar axis decreases, indicating that it tends to be more parallel to each other.[5]

This deformity can be treated by humeral osteotomy (HO). This procedure corrects the humeral axis to regain the hand–face motion plane; however, the midline function for carrying out daily life activities, such as buckling of a belt, knotting of a tie, buttoning of a shirt, or grasping of items with both hands, is threatened[6], particularly in those cases in which C7 is involved due to it innervating the subscapularis and pectoralis major. Another indication for HO is to correct the excess rotation resulting from tendon transfer-wide dorsal-

infraspinatus.[7] Unfortunately, controversy persists regarding the use of anatomical parameters for determining the degree to which external rotation can be corrected without negatively affecting the midline function. As a counterpoint, measurement of the retroversion could be limited by inter-observer variation, according to the pre-measurement manual tracing of angle lines.

In our centre, we performed 12 derotational HOs between 2016 and 2018. Using a deltopectoral approach, the osteotomy is performed between the *pectoralis major* and *deltoids* humeral insertions, using the anterior crease of the elbow as the realignment parameter to retrieve the hand–face motion plane.[8] In all cases, this plane of movement was recovered, although the midline function decreased in only 2 cases. These two patients, aged 12 and 15 years, represented cases of upper-type obstetric brachial plexus palsy in which C7 was involved, concomitant with moderate to severe glenohumeral dysplasia (Waters types III and IV, respectively).[9] Despite our small sample population, we observed that greater age, severe glenohumeral dysplasia, and C7 traction injury may be negative prognostic factors of the functional outcome of HO.

For this reason, we cautiously suggest considering the measurements of *humeral retroversion* (by magnetic resonance imaging or computed tomography (CT) scanning)[10] in combination with the topographic location of the anterior crease of the elbow pointed upward.[8] These two parameters could be a useful strategy for achieving a more accurate grade of alignment for osteotomies to restore the plane of movement.[11] To our understanding, with greater retroversion, a greater intraoperative exorotation of the distal fragment may be required.

The purpose of the current article was to highlight the following two aspects of the *humeral retroversion elbow crease*: first, the importance of considering the reduction in humeral retroversion as a quantifiable bone deformity (on CT or NMR) as the other bone deformities previously mentioned; and second, the complementation of these measurements along with the intraoperative parameter of the anterior elbow crease to rebuild the plane of motion comparable to that of the healthy side, thereby avoiding excessive exorotation, to improve the planning of surgical strategies for each patient.

REFERENCES

1. Yarfi C, Elekusi C, Banson AN, Angmorterh SK, Kortei NK, Ofori EK. Prevalence and predisposing factors of brachial plexus birth palsy (BPBP) in a regional hospital in Ghana: a five year retrospective study. Pan Afr Med J 2019;32:211.
2. O'Berry P, Brown M, Phillips L, Helen Evans S. Obstetrical Brachial Plexus Palsy. Curr Probl Pediatr Adolesc Health Care 2017;47(7):151–5.
3. Pearl ML, Edgerton BW. Glenoid deformityretrieves secondary to brachial plexus birth palsy. J Bone Joint Surg Am 1998;80(5):659–67.
4. Öztuna V, Öztürk H, Eskandari MM, Kuyurtar F. Measurement of the humeral head retroversion angle. A new radiographic method. Arch Orthop Trauma Surg 2002;122(7):406–9.
5. van de Bunt F, Pearl ML, van Essen T, van der Sluijs JA. Humeral retroversion and shoulder muscle changes in infants with internal rotation contractures following brachial plexus birth palsy. World J Orthop 2018;9(12)292–9.
6. Greenhill DA, Trionfo A, Ramsey F V, Kozin SH, Zlotolow DA. Postoperative Loss of Midline Function in Brachial Plexus Birth Palsy. J Hand Surg Am 2018;43(6):565.e1–565.e10.
7. Abzug JM, Wyrick-Glover TO, Case AL, Zlotolow DA, Kozin SH. Loss of Midline Function in Brachial Plexus Birth Palsy Patients. J Pediatr Orthop 2019;39(3):232–5.
8. Ivalde FC, Miguens GN, Socolovsky M. Using the main elbow flexion skin crease as an intraoperative parameter to determine the degree of exorotation needed for humeral derotational osteotomies in upper-type brachial plexus patients. J Orthop Surg (Hong Kong) 2018;26(3):230949901879271.
9. Mattar Júnior R, Kimura LK, Oviedo RM, Silva BL de S, Cho ÁB, Crepaldi BE. Role of early shoulder tomography on the obstetric brachial plexus palsy. Acta Ortop Bras 2015;23(1):22–5.
10. Pearl ML, Batech M, Van De Bunt F. Humeral retroversion in children with shoulder internal rotation contractures secondary to upper-trunk neonatal brachial plexus palsy. J Bone Joint Surg Am 2016;98(23):1988–95.
11. Itamura JM, Papadakis SA, Vaishnav S, Gurmet R. The relationship between main elbow flexion skin crease and osseous anatomy of the elbow joint. Surg Radiol Anat 2009;31(1):55–8.

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