EDITORIAL

CONSIDERATIONS FOR SURGICAL APPROACHES TO DEROTATIONAL HUMERAL OSTEOTOMY IN BOTH OBSTETRIC AND ADULT TRAUMATIC BRACHIAL PLEXUS INJURIES

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In brachial plexus birth palsy (C5-C6/C5-C6-C7), about 66–92% of patients will have a spontaneous recovery, but the remaining patients may develop some grade of structural or functional sequela, or it can even impact on neuronal plasticity. But in adults after high-energy accidents such as motor-vehicle accidents, in which there can be devastating consequences. A derotational humeral osteotomy is an option for dealing with the sequelae of obstetric and traumatic brachial palsy in adults with external rotation deficit. Three approaches have been described: deltopectoral, medial, and percutaneous. However, to the best of our knowledge, no previous research has investigated the differences among the surgical approaches. We aim to highlight the characteristics of each issue that is described above and discuss our preference. In conclusion, the literature reports that all three approaches provide good functional outcomes to restore hand-face plane of movement. We suggest that the selection of each access should depend on previous nerve reconstruction surgeries, muscle tropism, and the severity of soft tissue retraction.

Keywords: Brachial plexus; Iatrogenic injuries; Shoulder; Surgical exposures; Humeral Osteotomy; Deltopectoral approach

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The incidence of obstetric brachial plexus injury (C5-C6/C5-C6-C7) is 0.5–3.0 for each 1000 live births in the United States. This number is decreasing because of the increase in caesarean deliveries, but the predominant risk factor is still shoulder dystocia.[1] About 66%–92% of patients will have spontaneous recovery, but the remaining patients may develop some grade of structural[2] or functional sequela, or it can even impact on neuronal plasticity[3]. There is a different outlook in adults after high-energy accidents such as motor-vehicle accidents, in which there can be devastating consequences and associated thoracic and head injuries, as well as clavicle and long bone fractures.[4] A variety of surgical techniques have been widely developed for nerve reconstruction. Derotational humeral osteotomy is an option for dealing with the sequelae of obstetric and traumatic brachial palsy in adults with external rotation deficit. For this procedure, the following three approaches have been described: deltopectoral[5] medial[6] and percutaneous[7]. We have previously discussed some surgical considerations for planning a derotational osteotomy base on humeral retroversion and intraoperative parameters to achieve the best correction possible.[2] However, to the best of our knowledge; no previous research has investigated the differences among the surgical approaches. The deltopectoral approach is the most widely used by orthopaedic surgeons, although other approaches, such as the percutaneous and medial approaches, had a satisfactory functional outcome in each case. Thus, what are the benefits and difficulties of each approach? We consider this to be an important issue for improving surgical planning, decreasing complications, and improving the functional outcome. Our aim is to highlight the characteristics of each issue that is described above and discuss our preference.

The deltopectoral approach is an intermuscular and extensible access between the deltoid and biceps brachial muscles/pectoralis major, from the coracoid process to the lateral borders of the biceps. The deltoid muscle is reflected laterally and the biceps brachial muscle is reflected medially. This allows the release of deltoid retractions from the tuberosities and pectoral and scapular tenoplasty along with the wide visualisation area of the humerus to perform the osteotomy between the pectoralis major muscle and deltoid insertions. Waters *et al*., in a series of 43 patients, used this approach and reported significant improvements in the average Mallet scale of 13 to 18 points.[8] However, the deltopectoral approach is not exempt from complications such as radial neuropraxia, musculocutaneous nerve injury during the osteotomy, prosthetic fracture, and hypertrophic scarring.[6,9]

The medial approach is a second approach that was described by Abzug *et al*, and it is also an intermuscular access among the brachial biceps, coracobrachial and triceps brachii. The medial side of the arm is the location for nerve reconstruction such as intercostal–musculocutaneous, cubital–cutaneous, or cubital–extrinsic motor-associated cutaneous muscle on the medial side to neurotise the branch for the anterior

brachial muscle, which were popularised as Oberlin I and II, respectively.[10]

However, the osteotomy is performed at the shaft location because of the proximity of the ulnar nerve, median nerve, and brachial artery, and the benefit of this access is that at the shaft location, the humerus is prismatic and the hypertrophic scarring rate is lower compared to the deltopectoral. The risk of musculocutaneous nerve injury is higher when reflecting the biceps because it is deep to the biceps brachial and biceps brachii muscles after crossing the coracobrachial muscle. Abzug et al. used this access in a group of 23 patients, and they showed significant improvements in the Mallet scale score from 13.8±2.8 to 16.1±2.5; the complications reported were similar to the deltopectoral approach.[6] However, none of the patients in the case series had previous nerve reconstruction procedures or required soft tissue release.[6] We consider the presence of previous medial approaches by nerve reconstruction would limit their use for performing osteotomies. However, there are no studies that confirm this thought

The third approach is the percutaneous technique, which was described by Aly *et al*. It has the benefit of being a mini-access, which is the same as the medial approach. It performs the diaphyseal osteotomy, but through lateral entry, as opposed to the other approaches, it conserves the periosteum. The percutaneous technique uses correction under the radioscopic guidance, and it is stabilised by external fixation for 6 weeks. Although the description of the original technique is presented for patients from 10–12 years old with a good short-term functional outcome, the patient selection criteria were not defined. It does not have the complications of a peri-implant fracture or hypertrophic scars, but there are no comparative studies with other techniques for long-term functional results.[7] In our perspective, the only limitation of this approach is that it does not release the soft tissue that is present in most obstetric secular injuries.

We prefer the deltopectoral approach because this allow us to combine a tendon transfer through one surgical site as well as allowing soft tissue release, and an osteotomy can be performed proximally between the pectoralis major muscle and deltoid insertion; this location has a lower incidence of non-union compared to middle shaft osteotomy.[11] However, it would be interesting to conduct comparative studies to define the most appropriate criteria for patient selection.

In conclusion, the literature reports that all three approaches provide good functional outcomes to restore hand-face plane of movement. We suggest that the selection of each access should depend on previous nerve reconstruction surgeries, muscle trophism, and the severity of soft tissue retraction.

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