

inferior to the coracoid process. The 3D measures were based on glenoid and humerus models, acquired through manual segmentation.

Results.– The impaired glenoid demonstrated posterior version (-7.0° , $p = 0.02$) with an accompanying inferior version of the same magnitude (-6.5° , $p = 0.02$). The humeral head migration was posterior, inferior, and medial (-5.4 , -3.6 , -3.2 mm, $p < 0.05$). Where direct comparisons could be made, there was good correspondence between 2D and 3D, yet the 3D measures demonstrated lower variability and better inter-rater reliability (ICC = 0.97–0.98 versus 0.66–0.73).

Discussion.– These novel findings regarding the inferior humeral migration and inferior glenoid version should be taken into account when planning interventions for children with OBPP. Specifically, given the multi-directional nature of glenoid-humeral deformation in OBPP, consideration should be given to adapting surgical techniques in order to provide a full 3D correction of the glenoid-humeral deformation, which may provide better functional outcomes.

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Three-dimensional humeral morphological changes in children with obstetrical brachial plexus palsy



F. Sheehan^{a,*}, A. Behnam^a, K. Alter^a, S. Brochard^b

^a *Functional and Applied Biomechanics Section, Rehabilitation Medicine Department, National Institutes of Health, Building 10 CRC RM 1-1469, 10 Center Drive MSC, 20892 Bethesda, MD, USA*

^b *CHRU de Brest, Brest, France*

*Corresponding author.

E-mail address: fsheehan@cc.nih.gov

Keywords: Obstetrical brachial plexus palsy; Humeral head; Three-dimensional analysis

Background.– Obstetrical brachial plexus palsy (OBPP) is a common birth injury, resulting in severe functional losses. Little is known about how OBPP affects the 3D humeral morphology. Thus, the purpose of this study was to measure the 3D humeral architecture in children with unilateral OBPP.

Methods.– Thirteen children (age = 11.8 ± 3.3 , 4F/9 M, Mallet score = 15.1 ± 3.0) participated in this IRB-approved study. A three-dimensional T1-weighted gradient-recalled-echo image set (resolution = $0.55\text{--}0.63\text{mm}^2$, slice thickness = 1.2 mm, imaging time = 4 min 22 sec) was acquired for both upper limbs (impaired/unimpaired) with the subject supine in a 3 T Siemens MRI (Verio, Germany). From these image sets 3D humeral models were created in order to measure humeral size, version, and inclination.

Results.– The humeral head (affected side) was less retroverted (-6.4°) and in declination (medial humeral head pointed anteriorly and inferiorly), relative to the unaffected side. Osseous atrophy was present in all three dimensions and affected the entire humerus. The inter-rater reliability of all parameters was excellent (ICC = 0.96–1.00).

Discussion.– This study is the first to evaluate 3D humeral shape changes in OBPP and the results indicated that planning for humeral or glenoid-humeral surgeries in OBPP should be guided by 3D, subject-specific glenoid-humeral shape analyses. The reduced retroversion is likely an osseous adaptation, which may help maintain glenoid-humeral congruency by partially compensating for the internal rotation of the arm, the typical posture reported in OBPP. The humeral head declination is a novel finding and is likely to become a key factor when developing management strategies for OBPP, because it leads to significant supraspinatus inefficiencies and increased required elevation forces.

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Effect of motor imagery on brain activation in children with unilateral cerebral palsy



E. Chinier^{a,*}, M. Dinomais^a, G. Lignon^b, A. Ter Minassian^c,

S. N'guyen^d, I. Richard^a

^a *LUNAM, EA4094, laboratoire d'ingénierie des systèmes automatisés (LISA), université d'Angers, département de médecine physique et de réadaptation, université d'Angers, CHU d'Angers, 4, rue Larrey, 49933 Angers, France*

^b *LUNAM, Service de radiologie, université d'Angers, CHU d'Angers, Angers, France*

^c *Pôle d'anesthésie réanimation, CHU d'Angers, Angers, France*

^d *LUNAM, Service de neuropédiatrie, université d'Angers, CHU d'Angers, Angers, France*

*Corresponding author.

E-mail address: eva.chinier@etud.univ-angers.fr

Keywords: Cerebral palsy; Motor imagery; Motor cortex; Brain mapping; Fonctionnel magnetic resonance imaging

Background.– Motor imagery (MI) is considered as a promising therapeutic tool for rehabilitation of motor planning problems in cerebral palsy [1]. However, motor planning problems may lead to poor motor imagery ability [2].

Aim.– The aim of this functional magnetic resonance imaging (fMRI) study was to examine brain activation in patients with hemiplegic cerebral palsy (HCP) during motor imagery of a simple hand movement.

Method.– Eighteen patients with clinical HCP (fourteen male, mean age 14 years and 2 months, aged 6 years 10 months to 20 years 10 months) participated in this study. Using block design, brain activation following MI of a simple opening-closing hand movement performed by either the affected or unaffected hand was examined.

Results.– Seventeen fMRI datasets were analyzed. During MI of the unaffected hand, activation included bilateral (Supplementary Motor Area), SMA bilateral premotor cortices, ipsilesional primary and second somatosensory areas, bilateral inferior parietal cortices, contralesional middle frontal and bilateral inferior frontal areas. During MI of the affected hand, activation included ipsilesional primary and second somatosensory area, bilateral inferior parietal lobes and ipsilesional superior parietal lobes and activation in the ipsilesional insular cortex. During both condition of MI, the visual and auditory cortices were activated. MI of the unaffected hand compared to MI of the affected hand activated more strongly the bilateral SMA, the ipsilesional primary motor cortex, the ipsilesional primary somatosensory cortex, the contralesional inferior frontal gyrus and middle frontal gyrus.

Conclusion.– Brain activations during MI of the affected and unaffected hand share different pattern of brain activation for children with HCP. Compared to the unaffected hand, MI of the affected hand seems to be difficult for HCP and activated less brain regions as expected in healthy people. Our study gives neural findings to indicate that MI of the affected hand for children with HCP is difficult.

References

[1] Steenbergen B, et al. Motor imagery training in hemiplegic cerebral palsy: a potentially useful therapeutic tool for rehabilitation. *Dev Med Child Neurol* 2012;51(9):690–6.

[2] Williams J, et al. Motor imagery ability in children with congenital hemiplegia: Effect of lesion side and functional level. *Res Dev Disab* 2012;32(2):740–8.

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Effect of video-guidance on passive movement: Could it be useful for cerebral palsy rehabilitation?



M. Dinomais^{a,*}, E. Chinier^a, M.G. Lignon^b, A. Ter Minassian^c,

S. N'Guyen The Tich^d, I. Richard^a

^a *Département de Médecine Physique et Réadaptation, Université d'Angers, CHU d'Angers, 3, rue des capucins, BP 40329, 49103 Angers, France*

^b *Département de radiologie, université d'Angers, CHU d'Angers, Angers, France*

^c *Département d'anesthésie réanimation, université d'Angers, CHU d'Angers, Angers, France*

^d *Département de neuropédiatrie, université d'Angers, CHU d'Angers, Angers, France*

*Corresponding author.

E-mail address: mickael.dinomais@gmail.com

Keywords: Cerebral Palsy; Action-observation; Motor cortex; Functional MRI; Passive movement

Aim.– The aim of this functional magnetic resonance imaging (fMRI) study was to examine brain activation in patients with hemiplegic cerebral palsy (HCP)