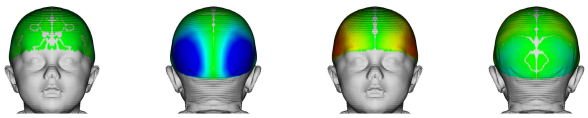
A Method for Evaluating Treatment in Infants with Deformational Plagiocephaly

Stéphanie Lanche[1,2,3], Tron A. Darvann[1], Hildur Ólafsdóttir[2,1], Nuno V. Hermann[4,1], Andrea Van Pelt[5], Daniel Govier[5], Marissa J. Tenenbaum[5], Sybill Naidoo[5], Per Larsen[1], Sven Kreiborg[4,1], Rasmus Larsen[2], and Alex A. Kane[5]

[1] 3D-Laboratory (University of Copenhagen; Copenhagen University Hospital; Informatics and Mathematical Modelling, Technical University of Denmark), Denmark
[2] Informatics and Mathematical Modelling, Technical University of Denmark, Denmark
[3] Ecole Supérieure de Chimie Physique Electronique de Lyon, Lyon, France
[4] Department of Pediatric Dentistry and Clinical Genetics, School of Dentistry, University of Copenhagen, Denmark
[5] Division of Plastic & Reconstructive Surgery, Washington University School of Medicine, St. Louis, MO, USA

Deformational Plagiocephaly (DP) is a term describing head asymmetry and deformation commonly seen in infants. DP affects the back of the head and, to a lesser extent, the forehead. The deformity is thought to result from protracted external pressure to the skull in one position. Treatment is non-surgical and involves parental education on infant repositioning to avoid pressure on the flattened side, and, in many cases, orthotic molding helmet therapy. The purpose of this work was to develop a method for assessment of helmet therapy employing a statistical analysis of change in head asymmetry.
The clinical population consisted of 37 infants for whom 3D surface scans of the head had been obtained both before and after their helmet treatment.
Detailed point correspondence between all head surfaces was established by tps-transforming a symmetric template to each of the head surfaces. This also ensured full left-right point correspondence. Asymmetry was quantified by the ratio of distances between sides, measured from a midpoint between the ears to corresponding surface points on opposite sides of the midsagittal plane. The method was able to quantify and localize the asymmetry, which occurred predominantly in the back and/or the front of the head. Change in asymmetry was determined by computing the difference between measurement before and after the therapy. The results revealed that the head asymmetry was, in most cases, corrected in the posterior and/or anterior regions. The values of asymmetry change were statistically analyzed using Principal Components Analysis. The model localized the two major improvements to the posterior and anterior regions of the head, respectively, where also the main head asymmetries had been detected (and clinically observed). Results deem this method suitable for treatment evaluation. In addition, results establish helmet therapy as an effective treatment for improving head asymmetry in infants with DP.



a) b) c) d)

Figure 1. Modes of variation of the change in asymmetry shown as a variation at -3 standard deviations from the mean. Within the same mode, regions colored by values at the opposite ends of the color range (e.g.,red and blue) vary in opposite directions. a) Front and b) Back views of mode 1. c) Front and d) Back views of mode 2.