

Three-dimensional geometric morphometrics applied to the study of children with cleft lip and palate from the North East of England

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Background: Cleft lip and palate has a worldwide incidence of about 1.4 per 1000 live births. Surgery is usually carried out early and there is considerable interest in the assessment of residual deformity and surgical outcome. Commonly used assessment techniques rely on interlandmark distances and angles and result in rather difficult to interpret tabulations of data (Farkas, 1994). The introduction of 3D non-invasive imaging systems, developments of statistical tools for evaluating variations in form and software implementations of these geometric morphometric methods have widened the opportunities for the objective evaluation of cleft lip and palate.

Objectives: This study aims to investigate 3D facial morphological variation among and between groups of 8-12 year old children with unilateral cleft lip and palate (UCLP), Unilateral cleft lip and alveolus (UCLA), bilateral cleft lip and palate (BCLP), cleft palate only (CP) and a sex and age matched control group.

Methods and data: 3D facial images were captured from 103 children aged 8-12 with non syndromic operated UCLP 40; UCLA 23; BCLP 19; CP 21; and 80 sex and age matched controls, all from the north east of England and of white English extraction. These images were acquired using stereophotogrammetry (manufacturer, 3dMD) and 39 landmarks chosen to characterise facial and particularly nasio-labial form were located on each scan using MorphAnalyser software (Tiddeman *et al.*, 2000). The landmark coordinates of all groups were submitted to generalised Procrustes analysis using morphologika software (O'Higgins and Jones, 1998). Principal components analyses were undertaken of all individuals together and by group to explore within and between group variability. MANOVA and permutation tests indicated significant differences between group means. The mean size and shape of each group was computed as was the reflected mean shape. Asymmetry was assessed in each group by computing Procrustes distances between means and their reflections. PCA was used to examine patterns of symmetric and asymmetric shape variability between groups. Shape differences of interest were visualised using warpings and transformation grids computed using thin plate splines.

Results: Statistically significant differences between the mean facial shapes of all the groups were found. The greatest difference was in the UCLP group and the second greatest in the BCLP. This outcome suggests that, post-repair, cleft lip and soft tissue defects have a greater effect on facial shape than does cleft palate alone. The study of asymmetry indicated different degrees and some differences in the nature of asymmetric deficits that characterize different cleft lip and palate deformities. The PCAs of form space and of means plus reflected means were informative with respect to the differences in facial size and shape between these groups.

The results highlight differences in the aetiology of cleft palate versus that of cleft lip and palate groups and underline the potential value of statistical shape analysis in assessing the outcomes of cleft lip and palate treatment.

References

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