Quantifying the Dynamic Smile: A Novel 3-D Technology for Precise Facial Analysis

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Background:

Facial reanimation provides patients with facial palsy the ability to generate facial movement and therefore communicate emotions; however, results are often criticized as incomplete or unnatural. There is little reliable objective data for outcomes analysis of facial reanimation. This is largely secondary to a lack of means of objectively and quantitatively evaluating the dynamic face. This pilot study introduces Digital Image Correlation (DIC) and speckle tracking as a novel technology for precisely quantifying the re-animated face during dynamic activity.

Methods:

A prospective pilot study of children aged 4-20 years with and without facial motion pathology was conducted at a tertiary referral children's hospital. After complete facial coverage with speckle make-up, patients were asked to make an "open-mouthed" smile for 5 seconds. Average major (vertical) and minor (horizontal) strain was calculated for each side of the face using DIC. Each hemiface was then compared with the contralateral side and a precise percentage of facial asymmetry between sides was determined.

Results:

A total of 10 patients were recruited into the pilot phase of this study, 6 cases and 4 controls. In the affected group there was a 45.9% minor (horizontal) strain asymmetry and 45.94% major (vertical) strain asymmetry. In control patients there was an 8.78 % minor (horizontal) strain asymmetry and 8.56 % (vertical) asymmetry. The difference between affected group and controls were strongly statistically significant between the minor strain ($p < 0.01$) and the major strain ($p < 0.01$) during smiling.

Conclusions:

We present DIC with speckle tracking as a novel mechanism of objectively and precisely quantifying facial motion of the animated face. As our surgical and medical approaches towards facial palsy expand, it is essential we have a means to compare results and improve patient outcomes.