Short visit report:
The assessment of residual dysmorphology and distorted animations following surgical repair of cleft lip & palate using 3D dynamic imaging

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I visited University of Bologna, Italy from 27 March 2014 to 2 April 2014, which is hosted by Dr Alberto Bianchi, S. Orsola-Malpighi University Hospital, University of Bologna, Italy. The visits aim to strengthen collaboration with European colleagues to improve the capacity for continuing research throughout Europe; and to prepare a joint application for European funding under the Horizon 2020.

Background:

Children of cleft cases are at an elevated risk of teasing and bullying because of the visible scar tissue and abnormalities of facial animations. It is notable that the significant negative association between scar visibility and self esteem seen in the UCLP. It is the aim of surgeons repairing the cleft to achieve facial symmetry and minimize facial distortion in facial expressions. Despite the attempts for improving the quality of cleft care in UK, the visible stigmata of facial scarring in cleft children still a major concern. Loss of pliability of the upper lip is a major cause of functional impairment. Scar stiffness may result in a limited range of muscle movements which affects the full expression of facial animations. Assessments of lip scarring are usually carried out using semi-quantitative scales which are subjective and have limits on applications due to personal opinions and individual perceptions of facial beauty. There is a lack of objective outcome measures of the quality of facial aesthetics and the associated animation and there is still insufficient information on the dynamics of facial muscle movement.

Recently, a non-invasive four dimensional (4D) soft tissue imaging system (Di4D) developed by D using 3D i3D Ltd, Glasgow, the UK, has been used for the capture of facial animations, the technology uses a combination of passive stereophotogrammetry and dense optical flow tracking to recover a sequence of 3D models from a stereo pair of synchronised video streams, and also to track every pixel from one image frame to frame through the video streams with sub-pixel precision. This world leading DI4D™ facial animation capture system recovers high fidelity facial motion data at a rate 60 3D facial frames per second. Dimensional Imaging's proprietary DI4Dcapture™ software then uses an advanced "passive stereo photogrammetry" algorithm to recover automatically a 3D model of the subject per frame. This allows a user to place 3D landmarks on the recovered 3D surface in any one frame of the captured sequence then uses the pre-computed Pixel Track data to sequentially track the 3D positions of those landmarks from frame to frame through the animation sequence. The automatic tracking of facial landmarks demonstrated a satisfactory accuracy and has been used on clinical cases (Al Anzie et al., 2012, Ju et al., 2012, Shujaat 2012).

The aim of this study is to investigate the abnormalities of facial animations by objectively quantifying the magnitude, speed, symmetry and bilateral motion similarity of facial expressions and to explore the relationship between altered facial animations and the 3D shape of lip scarring.

Aim of the visits

The aim of the visits is to demonstrate the potential application of 4D imaging for the assessment of facial animations of the surgically managed cleft children. The visit will allow the visitors and hosts to share ideas, explore potential difficulties and agree on the details of the proposed methodology to conduct this collaborative study.

Activities of the visit

The visits provided a unique opportunity to share the views and ideas with Dr Bianchi and his team. We are proposing to improve the quality of care to the disadvantaged patients who suffer from oro-facial deformities through the funding of the Horizon 2020 for a multi European centre single cohort control study.

A workshop was organized to present the newest development of 4D imaging techniques, data analysis of 4D data and its clinical applications to our European colleagues. I presented the 4D data analysis of facial animations in details such as the measurements of magnitude, speed, similarity and asymmetry score of the facial animations on individual landmarks and facial motion colour pattern illustration of facial animations.

Dr Bianchi's team gave a live presentation of their maxillofacial surgery using the newest surgical navigation technique, a novel surgical navigation approach was illustrated by making use of laser printed titanium plate for bone allocation. Further details of surgical navigation system were discussed with the technical team of Stryker.

I also visited Dr Bianchi's surgical theatre and observed a maxillofacial surgery carried out by Dr Bianchi's team. I further discussed with Dr Bianchi regarding our collaboration in 4D imaging to establish data collection protocol and agree on the mechanism of 4D facial captures; also to make use their surgical navigation techniques to improve the health care quality. Dr Bianchi thought that the 4D imaging would have a great benefit on facial image captures for cleft palate children due to its dynamic advantages. We agreed to strengthen collaboration with European colleagues to improve the capacity for continuing research throughout Europe; and to prepare a joint application for European funding under the Horizon 2020.

A research student was arranged to visit Dr Bianchi's team again in July to exchange our expertise in 4D imaging and surgical navigation; to establish our collaboration in care for cleft palate children.