APPLICATION FOR A GOSHCC SURGICAL SCIENTIST PHD STUDENTSHIP

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1. Title.

Analysis of the effect of surgical parameters on the outcome of maxillar and mandibular surgery

2. Portfolio summary.

**Aims:**
Understanding the changes in craniofacial soft tissue morphology induced by osteotomies of the mandible and maxilla to correct craniofacial anomalies.

Development of statistical modelling for surgical planning of maxillary and mandibular osteotomies.

**Background:**
Growth anomalies of the mandible and maxilla are a feature of many craniofacial anomalies, lead to deformity and interfere with the normal functioning of the upper aerodigestive tract\(^1\).

Surgical correction of bony deformity must achieve normalisation of soft tissue morphology in order to be successful. The relationship between bony and soft tissue change is complex and is poorly described by current two and three-dimensional cephalometric techniques\(^2\). These complex changes make surgical outcome difficult to predict\(^3\).

Geometric morphometric analysis using principle component analysis can create statistical models of the changes in facial morphology induced by osteotomies to correct deformity\(^1\). These models have the advantage over traditional sparse modelling techniques in that they are able to predict detailed three dimensional changes induced by complex surgical movements of facial bones, but have the disadvantage that a large amount of detailed 3D data on large sample sizes must be processed to create them. The concept has been validated for craniofacial osteotomies that make very simple bony alterations, but current techniques require further analysis and refinement to be useful in the complex morphological changes induced by common osteotomies of the maxilla and mandible.

**Proposed methodology to be adopted:**

1. Existing Pre and post-operative CT data from craniofacial osteotomies undertaken at Great Ormond Street Hospital and the University of Bologna a statistical model of bony and soft tissue changes associated with Le Fort I mandibular osteotomies and I will be created. Existing software packages used at ICH/GOSH will be used to  
   a. Extract 3D surface information of bone and soft tissue from pre and post-operative CT data.  
   b. Create statistical models of pre and post op facial form
c. Create a statistical model of soft tissues changes induced by osteotomies of the mandible and maxilla

2. Test predictive model in the clinical environment. - Patient CT data will be processed by the new predictive tool and compared to existing planning and predictive methods

**Skills to be achieved by the PhD trainee:**

The PhD candidate will be trained in the use of Deformetrica® and MIMICS® and will need to gain an understanding of image processing, statistical modelling techniques whilst working alongside engineers currently involved in the face value project. They will acquire the fundamentals of bioengineering research relating to craniofacial surgery. They will collect data in the clinical environment and acquire surgical planning skills and an understanding of the clinical problems associated with the introduction of new analytical and predictive methodologies.

**Relevance to the area of paediatric surgery:**

Changes in soft tissue form associated with correction of bony deformity are a major determinant of surgical outcome in craniofacial surgery. They determine the quality of deformity correction and have a major impact on function, including speech, feeding, upper airway obstruction and oral continence.

These soft tissue changes are difficult to predict clinically and current commonly used 3D predictive techniques have limited application (particularly in the area of mandibular and maxillary osteotomies.

A success predictive tool would improve outcome, reduce the need for secondary procedures' to address incomplete corrections of deformity and would allow the development of more complex osteotomies to further refine outcome. The development of a successful statistical model would form the basis of IP for the development into a commercially produced predictive surgical tool.

**References:**