

BAOMS Endowments Grant Report



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Title of project: Assessment of Facial Symmetry Index (FSI) and Facial Averageness Index (FAI) in cleft lip patients using 3D photography

Award year: 2016

Amount: £4705

Introduction

- The ability to quantify the improvement in facial appearance of operated cleft lip and palate (CLP) patients as a result of their surgery would clearly aid the objective assessment of treatment quality.
- In this regard, 3D photographic technology, in conjunction with automatic facial analysis software, has emerged as a highly versatile, safe and suitable tool for assessing post-operative outcomes in cleft care.
- For the last decade a 3D photographic database has been collected at the South Thames Cleft Service based at St. Thomas hospital (and various spoke units) of cleft patients undergoing various primary and secondary operations.
- This database provides the unique opportunity to analyse a single surgeon's data by operative intervention over a substantial time period.
- South Thames Cleft Unit is well established in the field of 3D photographic analysis because it is the national designated centre for the annual Cleft 3D workshop responsible for co-ordinating the development of nationalized 3D photographic protocols in cleft care. It has been involved in the development of the *facial symmetry index* and *facial averageness score* as a post-operative outcome measure

Objective of this study

1. To assess the *facial symmetry index* of primary repair of Unilateral Cleft Lip & Palate (UCLP) as compared to a control population
2. To assess the impact both individually and collectively of a series of operative procedures (both primary and secondary) on the *facial averageness index* as a measure of facial attractiveness
3. To relate these measured changes through surgery to clinical judgment.

Research Design

- Audit (as defined by the MRC Research toolkit) using patient level data accumulated over the last 5-10 years (“secondary data analysis”)

Population

- Non-syndromic UCLP patients undergoing both primary and secondary cleft operations

Intervention:

- *Facial Symmetry Index*: Primary cleft lip repair
- *Facial Averageness Index*: Secondary cleft lip repair

Setting

South Thames Cleft Service – based at St. Thomas Hospital

Project 1: Facial Symmetry Index as a Measure of Post-Operative Outcome in complete Unilateral Cleft Lip Patients using 3D Photographs

Objectives:

To analyse the facial symmetry in a cohort of UCL patients:

1. Without alveolar involvement
2. Without alveolar involvement

Inclusion Criteria:

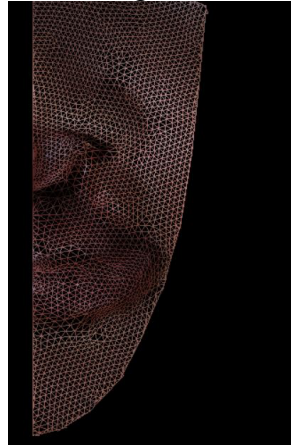
1. Children presenting with a UCL (whether incomplete / complete / accompanied by a palate)
2. All cases undertaken by a single surgeon
3. Good quality 3D photographs taken at both baseline (pre-op) and post-op
4. Non-syndromic
5. No history of facial trauma

n = 35

Photographic analysis:

Stage 1	Removal of extraneous components
Stage 2	Standardisation of image
Stage 3	Confirmation of non-syndromic status
Stage 4	Placement of facial symmetry plane
Stage 5	Cropping of Region Of Interest (ROI)
Stage 6	Calculation of index
Stage 7	Statistical Analysis

Each photograph analysed as a mesh view using an automated Root Mean Square methodology:



Conclusions:

1. We designed a novel cleft-specific template to measure FSI
2. There is a significant difference in FSI between the pre-op and post-op states for UCL patients overall
3. There is a significant change in FSI status for the UCL patients with alveolar involvement but not without alveolar involvement
4. The relative change in FSI can be characterised by a linear regression model

Project 2: Facial Averageness Index as a Measure Facial Attractiveness in Evaluating a Sequence of Secondary Cleft Surgeries

Objectives / Questions:

In a sample of cleft patients undergoing secondary surgeries and using the Facial Averageness Index (FAI):

1. Can we measure objectively facial appearance relative to the 'average'?
2. Can we measure objectively how much we improve facial appearance?
3. Can we measure objectively the relative contribution of an operation to the improvement in facial appearance?

Inclusion Criteria:

1. Adults presenting for secondary cleft surgeries with all primary surgeries completed
2. All cases undertaken by a single surgeon
Good quality 3D photographs taken at:
baseline i.e., *before* any secondary surgery
post-surgery i.e., *after* surgery
3. Non-syndromic
4. No history of facial trauma

Method Overview:

Retrospective cohort study for which 3D photography was the standard of care:

Selection of patient photographs compliant with inclusion criteria

Analysis of photographs by landmarking – manually done

Calculation of Proportion Indices from landmarks – automated

Calculation of a Facial Averageness Index (FAI)- automated

Statistical analysis of data

Conclusions:

1. Orthognathic surgery disproportionately accounts for FAI improvement.
2. Rhinoplasty alone does not significantly change facial averageness
3. Facial contouring including orthognathic surgery and paramedian correction such as malar implants and paranasal implants lead to the biggest improvement of FAI, demonstrating that the cleft deformity involves indeed all facial structures and not only the midline

Therefore, perhaps we should not aim for compensation of occlusion by orthodontics only.

Presentations resulting from this work, directly and indirectly :

1. American Cleft Palate Conference (ACPA) 2016 (Atlanta): 2 x oral presentations
2. BAOMS 2016 (Brighton): 1 x oral presentations + 1 x poster
3. EACMFS 2016 (London): 3 x oral presentations

Other outputs:

The data from these studies provided preliminary data to form the basis of the following fellowships that were procured in partial funding for my PhD since this award was made:

1. Winston Churchill Memorial Trust Fellowship
2. Royal College of Surgeons One Year Research Fellowship
3. Faculty of Dental Surgery, RCS Research fellowship

Award no. 3 was accepted as honorary status.

Professor Haers and I wish to reiterate our immense gratitude to the BAOMS endowment committee for their financial assistance for these two audits which have been immensely fruitful in both their own right and in helping to secure fellowships for other related work as part of my PhD thesis. We are also grateful to 3dMD Imaging systems for their support.