

Addressing challenges to enable better use of routinely collected clinical photographs: describing the largest cleft dataset for machine learning analysis



THE UNIVERSITY of EDINBURGH

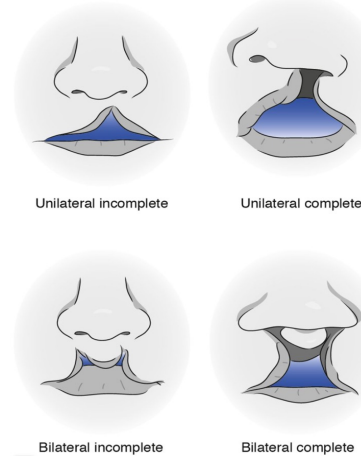
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Background

Orofacial clefts are the commonest type of congenital anomaly to affect the face

Surgical repair is usually performed in infancy

There are concerning inequalities in access to and quality of surgical care



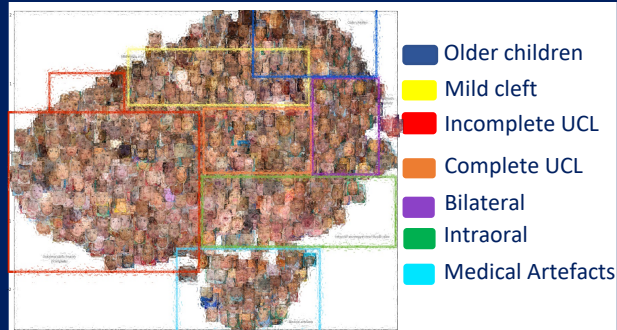
- Currently, there are **few global outcome studies**.
- **Scoring aesthetic results** after surgery is **crucial** when determining the **success of a repair**.
- A **reliable and accurate scoring system** utilising **large numbers of unstandardised 2-dimensional photographs of ethnically diverse patients**, which is **inexpensive**, widely **accepted** and **easily applicable**, **does not exist**.
- Artificial Intelligence (AI) has yet to be used in cleft care.
- AI lends itself to **big data** and **limits human bias**

Objectives

To evaluate the value of routinely collected 2D photographs of patients with an orofacial cleft

Determine if non-standardised data could be used for machine learning analysis in cleft research.

Preliminary AI Analysis



The results of visual assessment of a dataset of images to determine the severity of the cleft lips using an attention-enabled DenseNet model. Coloured boxes identify patterns and clusters in the image.

Methods + Results

Database The data set comprised of over **5 million photos** collected across **90 countries** in a **20 year** period

Data Description Data were **described** using **RStudio + Microsoft Excel**

Data Analysis Analysis showed the **dataset** is the **largest** + most **ethnically diverse**

500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0

Type of Orofacial Cleft

Cleft Palate Unilateral Cleft lip Unilateral Cleft Lip + Palate Bilateral Cleft Lip Bilateral Cleft Lip + Palate

An **isolated unilateral cleft lip** was the **most frequent** orofacial cleft recorded, along with a unilateral cleft lip and palate. Patients who had a **bilateral cleft lip** without a cleft palate were **less frequent**

Key Numerical Data	Total number
Number of photos	5,349,000
Unique patient IDs	1,589,080
Treatment photographs	1,605,980

Ethnicity of Patient	Total number of patients
Asian	728,456
Indian	625,220
Black	122,846
Latino	52,788
White	35,552
Mixed	21,416
Other	19,504
Pacific Island	139



There were **9 types of image** in the dataset, with **5 types of view** (examples to the left.) **Pre-operative frontal images** were the **most common**

Two data sets (training and teaching) were created for both supervised and unsupervised ML analysis

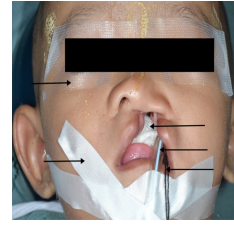
Data were chosen based on inclusion criteria (left)

Photos of patients with a cleft palate only (left) were used as control images and AI analysis was run

5 main criteria:
Pre-op photo, frontal/worms eye image, ≤ 36 months, unilateral cleft lip only

Key Points

1. A **global need** for an updated and **ethnically inclusive post-op aesthetic scoring system** exists + we need to **utilize 'real world' data**
2. The dataset is the **largest global dataset** comprising **routinely collected photographs** of patients with an orofacial cleft that exists.
3. Some data were mislabeled, varied in quality and **lack of minimum standardization**
4. The data are **ethnically inclusive**
5. Numerous photos contained **'medical artefacts'** (right) complicating AI analysis



Conclusions

The **quality of data** is **suboptimal** for research, but can be used with **success**, yielding results that are more **globally applicable** and **representative** of the **global burden** of disease.

Recommendations for future research:

- Pre-op + post-op frontal and worms eye view photography should be a minimum
- Medical artefacts should be excluded in the photographs if possible

References

Mossey, P.A., Little, J., Munger, R.G., Dixon, M.J., Shaw, W.C., 2009. Cleft lip and palate. *The Lancet* 374, 1773–1785.
Sharma, V.P., Bella, H., Cadier, M.M., Pigott, R.W., Goodacre, T.E.E., Richard B.M., 2012. Outcomes in facial aesthetics in cleft lip and palate surgery: A systematic review. *J. Plast. Reconstr. Aesthet. Surg.* 65, 1233–1245. Caitriona Turnbull – s1991357@ed.ac.uk

