

## Evaluation of accuracy and reproducibility in manual point picking during 3D cephalometry on CBCT data

Valentina Pucciarelli<sup>1</sup>, Marina Codari<sup>1</sup>, Arianna Girardi<sup>2</sup>, Carlo Giustinetti<sup>2</sup>, Gianluca Martino Tartaglia<sup>1</sup>, Matteo Caffini<sup>3</sup>, Giuseppe Baselli<sup>2</sup>, [Chiarella Sforza](#)<sup>1</sup>

<sup>1</sup> Dipartimento di Scienze Biomediche per la Salute, Università degli Studi di Milano, Milano, Italy -

<sup>2</sup> Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, Italy - <sup>3</sup> CIMEC, Università degli Studi di Trento, Rovereto, Italy

Three-dimensional cephalometry is currently emerging as an innovative diagnostic tool, due to accessibility and radiation low dose of Cone Beam CT (CBCT) scanners (1). Despite annotation made by specialists is now considered the gold standard in clinical practice and research, reliability of manual point picking can be biased by intra and inter-operator differences (2). In order to estimate the variability of the manual procedure, in this study an evaluation of accuracy, precision and reproducibility was performed. Three experienced operators analyzed ten CBCT images, retrospectively selected from the SST Dentofacial Clinic database. They annotated 9 chosen landmarks on all the images for three times, under the same conditions and at least one week of distance. Accuracy and precision were calculated as the median and the interquartile range of the distances from each landmark to the corresponding barycenter, calculated as the mean of all operator annotations. Kruskal-Wallis test was performed to evaluate reproducibility, and post-hoc tests were carried out to assess whether the significance depended from operators. A remarkable difference was found in accuracy between anatomic and geometrical landmarks, in both the intra and inter-operator repetitions. The intra-operator analysis showed higher accuracy and precision values than the inter-operator one. Statistical analyses revealed significant differences in reproducibility ( $p < 0.05$ ) for all landmarks except for Sella turcica, but the post-hoc tests did not show a clear pattern between operators. Results demonstrate that both accuracy and reproducibility may vary, depending on the operators, suggesting the need for automatic or semiautomatic tools that will help the operator during annotation.

### References

- [1] Tyndall et al. (2012) Position statement of the American Academy of Oral and Maxillofacial Radiology on selection criteria for the use of radiology in dental implantology with emphasis on cone beam computed tomography. *Oral Surg Oral Med Oral Pathol Oral Radiol* 113(6): 817-826;
- [2] Fuyamada et al. (2014) Reproducibility of maxillofacial landmark identification on three-dimensional cone-beam computed tomography images of patients with mandibular prognathism: Comparative study of a tentative method and traditional cephalometric analysis. *Angle Orthod.* 84(6):966-973 e54321.

### Keywords

3D cephalometry; CBCT; accuracy; reproducibility.