Internship proposition

Academic Year: 2023-2024

Acronym: 3DCEPH

Project title:
Three-dimensional cephalometric analysis of craniofacial CT scans

Supervisor:

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Collaborations: APHP, Materialise France

Project description:

The increasing use of three-dimensional (3D) imaging by orthodontists and maxillofacial surgeons to assess complex dentofacial deformities implies a critical need for 3D cephalometric analysis to help treatment planning. This standardized diagnostic method is based on the localization of landmarks on 3D imaging (CT Scans or Cone-Beam CT scans). Our multidisciplinary research team has been working on the automatization of the segmentation and landmarking of these 3D acquisitions, obtaining state-of-the art results on a database of CT scans [1,2].

Due to the lack of an easy-to-use 3D analysis, cephalometric analysis is still mainly performed clinically in 2D, based on standard linear and angular measurements performed on radiographic images (Figure 1A). This is detrimental to some patients which would benefit from a 3D analysis, particularly those exhibiting major deformities or asymmetries (Figure 1B).

Several 3D cephalometric methods have been proposed, mainly based on statistical norms or geometric morphometrics [3,4]. No approach has been broadly validated, and more studies are needed to propose a clinically meaningful 3D analysis. In order to do so, we have gathered a database of 200 patients who had a computer-assisted jaw surgery planning. For each patient, these retrospective data include the segmented and annotated CT scans and the surgery planning.

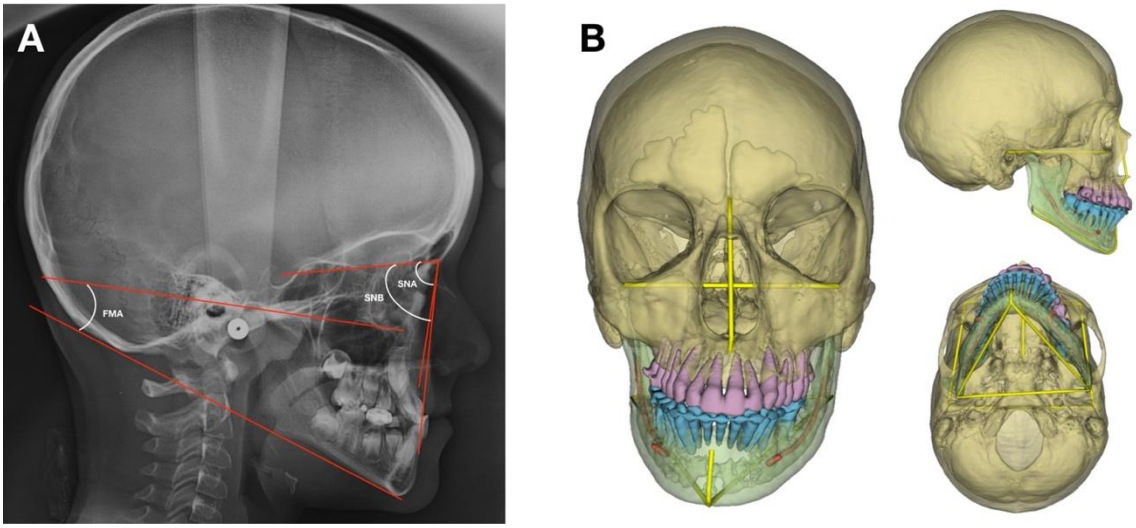

Figure 2: Example of cephalometric analysis. A: 2D analysis; B: 3D analysis.

Objective: The aim of this internship is to propose a method of 3D cephalometric analysis, based on our database of presurgical patients and their computer-assisted surgery planning.

Methods: Given our database of presurgical CT scans segmented and labelled by experts, you will have to propose a 3D cephalometric analysis. As a starting point, you will have access to a preliminary geometric analysis developed by our team. You will then have the opportunity to test your analysis proposal for the diagnosis and computer-assisted surgery planning of new patients. In order to understand the clinical context, you will be working with clinicians in orthodontics and maxillo-facial surgery.

Required skills:

Being comfortable with 3D visualization and interpretation (segmentation, geometric graphs)
Knowledge of 3D medical imaging
Interest in clinical issues

Start date: 01/02/2023
Duration: 5 months
Academic level : M2 in biomedical engineering or computer vision.
How to apply : Please send your CV and motivation letter to laurent.gajny@ensam.eu

References

[1] Dot G, Schouman T, Dubois G, Rouch P, Gajny L. 2022. Fully automatic segmentation of craniomaxillofacial CT scans for computer-assisted orthognathic surgery planning using the nnU-Net framework. Eur Radiol. 32(6):3639–3648.
[2] Dot G, Schouman T, Chang S, Rafflenbeul F, Kerbrat A, Rouch P, Gajny L. 2022 Aug 18. Automatic 3-Dimensional Cephalometric Landmarking via Deep Learning. J Dent Res.:00220345221112333.
[3] Gateno J, Xia JJ, Teichgraeber JF. 2011. New 3-Dimensional Cephalometric Analysis for Orthognathic Surgery. J Oral Maxillofac Surg. 69(3):606–622.
[4] Oueiss A, Treil J, Faure J. 2020. Biométrie cranio-faciale 3D: analyse complète d'un cas de classe II « limite chirurgicale ». Orthod Fr. 91(1):115–128.