

CT-Based Orbitometrics in Crouzon Syndrome: Establishing Normative Data and Surgical Implications

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INTRODUCTION

Crouzon Syndrome

- Crouzon syndrome causes premature cranial suture fusion and orbital hypoplasia, leading to proptosis.
- Surgical correction relies on understanding bony and soft tissue relationships surrounding the globe.
- Prior studies are often limited to two-dimensional measurements, lack normative control data, and do not provide comprehensive preoperative analysis of both bony and soft tissue orbital structures.

Objectives

- Quantify bony and soft tissue anterior-posterior (AP) projection of orbital rims and soft tissue relative to the cornea, as well as interocular distances (IOD, ICD, IPD).
- Establish normative orbital reference data in a pediatric population.
- Inform surgical planning and anticipated advancement needs in Crouzon syndrome.

METHODS

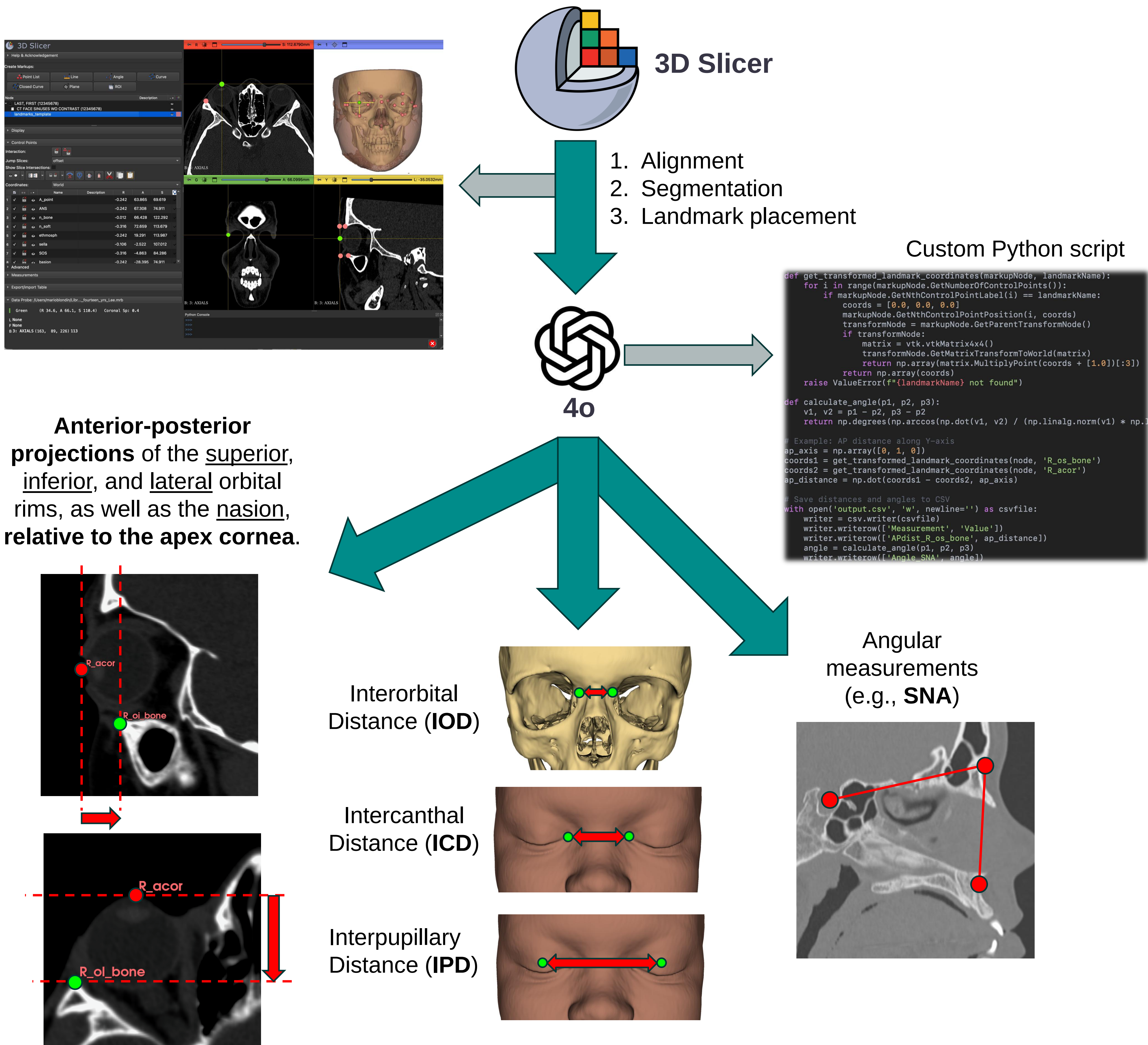
Patients

- Crouzon group:** 42 unoperated patients with Crouzon Syndrome from the Wake Forest Craniofacial Imaging Database (WFCID)
- Control group:** 45 age-matched pediatric CT scans

Inclusion Criteria

- High-resolution CT scans with axial slice thickness ≤ 2 mm to ensure accurate landmark identification and measurement.
- Anatomical coverage extending from the supraorbital rim to A-point, enabling comprehensive analysis of the orbit and midface.
- No bony or soft tissue abnormalities in the facial region.

Data Processing



RESULTS

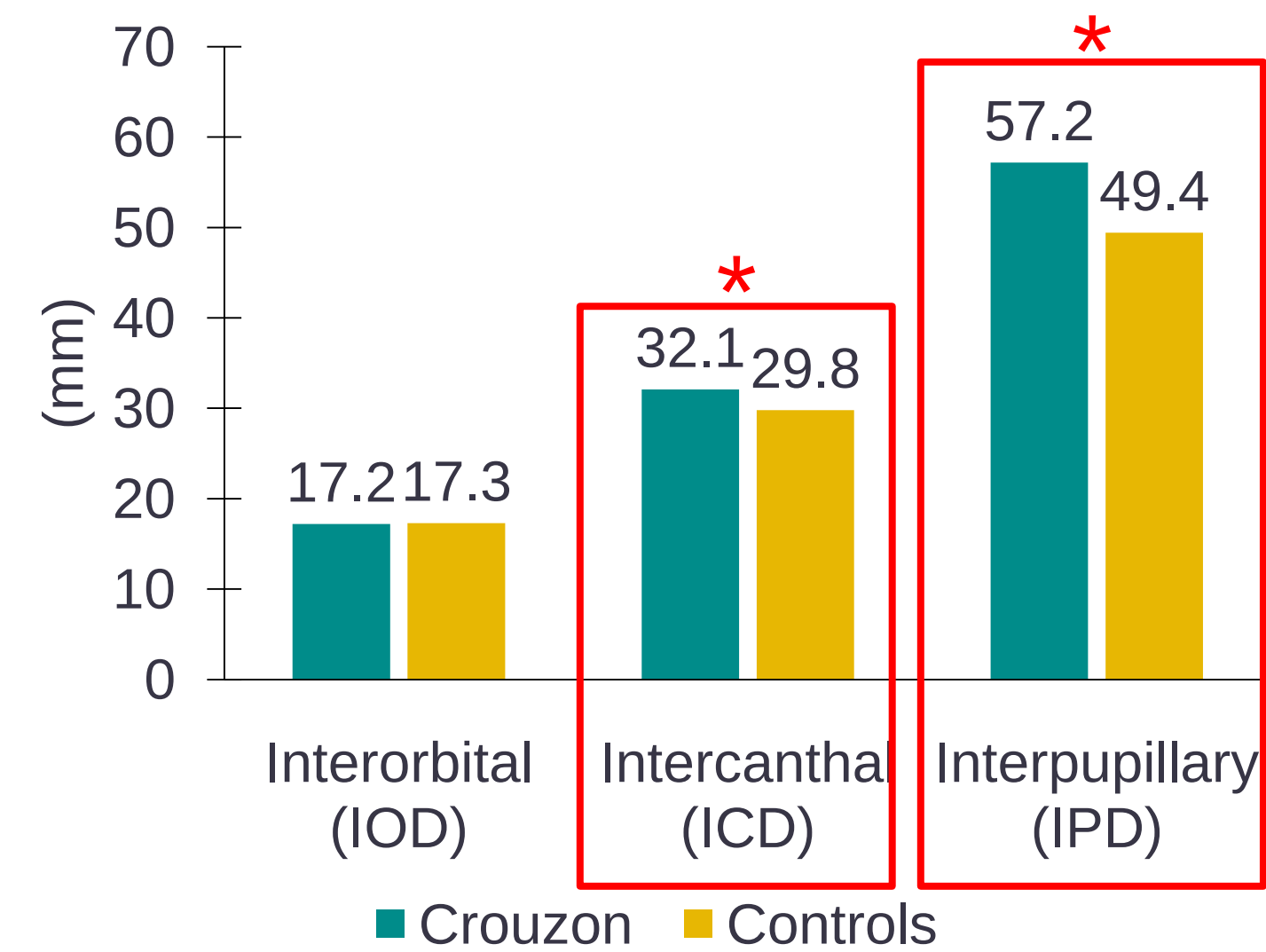
- Mean age: 2.5 years (Crouzon) vs. 3.0 years (Controls)
- Mean SNA: 75.1° (Crouzon) vs. 84.4° (Controls)*

Bone landmarks relative to apex cornea

	Crouzon (mm)	Control (mm)	Δ (Crouzon - Control)
Superior Rim	-7.5	-1.0	-6.4*
Inferior Rim	-14.5	-5.6	-8.9*
Lateral Rim	-18.6	-12.1	-6.5*
Nasion	-2.1	2.9	-5.0*

Soft tissue landmarks relative to apex cornea

	Crouzon (mm)	Control (mm)	Δ (Crouzon - Control)
Superior Rim	-0.5	5.5	-6.0*
Inferior Rim	-5.2	2.9	-8.2*
Lateral Rim	-15.7	-10.4	-5.3*
Nasion	3.2	8.7	-5.5*



Soft tissue vs. Bone landmarks difference

	Crouzon (mm)	Control (mm)
Superior Rim	7.0	6.5
Inferior Rim	9.3	8.5
Lateral Rim	2.9	1.7
Nasion	5.3	5.8

*= P < 0.05

CONCLUSIONS

- Crouzon patients show consistent retrusion of orbital rims and soft tissue relative to the cornea, most notably at the inferior rim.
- Findings support average advancement targets of 9 mm (infraorbital), 7 mm (superior/lateral), and 5 mm (nasion) for surgical planning.
- This work highlights the utility of 3D Slicer, a free, open-source platform that enables accessible and detailed orbitometric analysis.

REFERENCES

