

introduction and objective

Patients with isolated cleft lip and/or palate (CLP) have an anatomical defect that may occur during the 4th and 12th week of pregnancy^{1,2}. Some studies demonstrate that CLP is not a localized phenomenon and that a deviant morphology could be observed in various basic structures of the craniofacial complex^{3,4}. The speno-occipital synchondrosis (SOS) is a cartilaginous union between the body of the sphenoid and the basilar part of the occipital bone⁵. The SOS is an endochondral growth center in the craniofacial skeleton that has a late ossification, therefore growth on this synchondrosis will influence the anteroposterior dimension of the cranial vault and the height and depth of the upper

face^{3,5-8}. Maturational age of a subject can be estimated by analyzing the fusion stage of the SOS. The literature suggests complete fusion for girls between 11 to 14 years and 13 to 16 years for boys^{6,8-11}. Despite the great usefulness of the information that can be gathered through the study of the SOS, there is a lack of studies in children with cleft lip and palate.

The **aim** of this study was to evaluate the time of complete ossification of the speno-occipital synchondrosis, in patients with cleft lip and palate and a control group, using cone-beam computed tomography (CBCT) scans, in a Portuguese caucasian population.

materials and methods

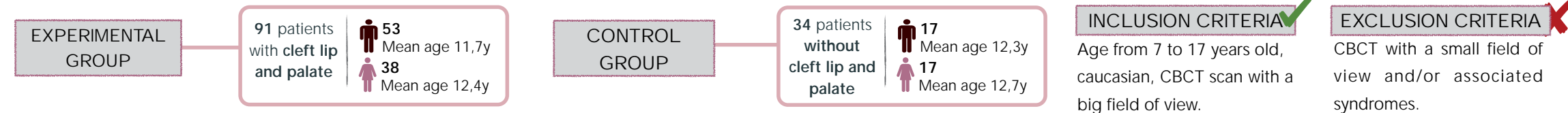


image analysis

All CBCT images were standardised as follows:

- Axial view:** by positioning the vertical plane in the middle of the anterior border of the foramen magnum (Fig. 1, A);
- Frontal view:** by levelling the horizontal plane with the occlusal plane (Fig. 1, B).

A **mid-sagittal section** of the skull base was considered as the view of choice to assess the SOS (Fig. 1, C). Each patients synchondrosis fusion stage was assessed by using a 5-stage system, proposed by Bassed et al.¹² modified from that developed by Powell and Brodie⁶. The definition of the staging system is shown in Table I.

statistical analysis

Mann-Whitney and chi-square test were respectively used to compare age and sex between groups. Kolmogorov-Smirnov test was used to assess normal distribution between the two independent groups. In order to evaluate the median time to reach the complete closure of SOS, corresponding to stage 4 of the staging system, a Kaplan-Meyer analysis was performed. All statistical analysis was performed using the IBM SPSS v.24 software. A P value of <0.05 was considered statistically significant.

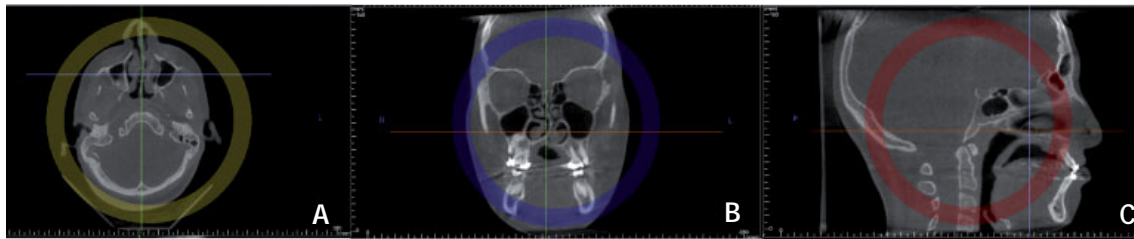


Fig. 1 - Example of a CBCT record. A: Axial view, B: Frontal view, C: Sagittal view



STAGE	DEFINITION
1(A)	The synchondrosis is completely open and unfused.
2(B)	The superior border has fused while the remaining fusion site is patent.
3(C)	Superior half of the synchondrosis is fused.
4(D)	Complete fusion with a fusion scar in the site still visible.
5(E)	Synchondrosis has been completely obliterated with the appearance of normal bone in site.

Table I - Spheno-occipital synchondrosis fusion based on a five-stage system proposed by Bassed et. al 2010 and corresponding CBCT images of each stage.

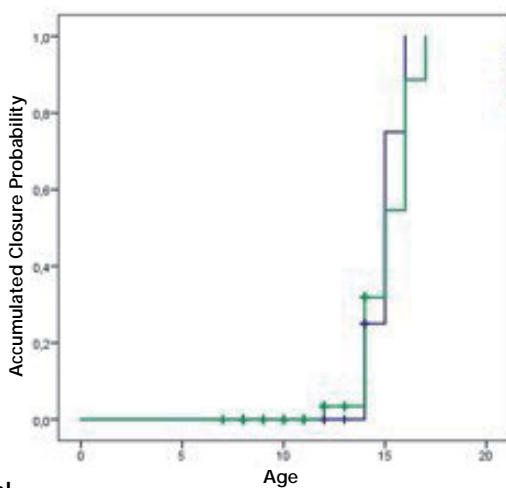
RESULTS

A total of 125 patients were included in this study. There was no statistical significant differences regarding age (p=0.238) and sex (p=0.409), showing adequate comparability.

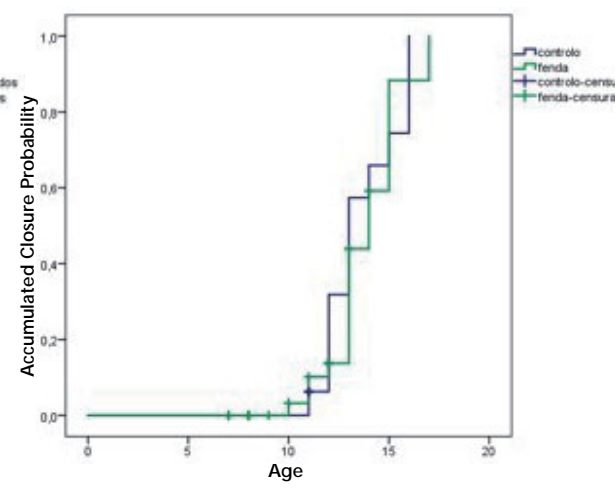
In this study the median time for complete ossification of the SOS was:

- For **boys**, **15 years** for both the **experimental** (IC95%[14.0, 16.0]) and **control groups** (IC95% [14.2; 15.8]) (Graph. 1). No statistical significant differences between both groups were found (P=0.806).
- For **girls**, **14 years** for the **experimental group** (IC95%[12.7, 15.3]) and **13 years** for the **control group** (IC95%[11.9; 14.1]) (Graph. 2). There were no statistically significant differences between both groups (P=0.565).

Regarding sex, there **were statistical significant differences in fusion time in the experimental group** (p=0.019) and no statistical significant differences in the control group (p=0.104)



Graphic 1 - Kaplan-Meyer Graphic: Median age for complete ossification of the SOS: experimental group vs control group in males



Graphic 2 - Kaplan-Meyer Graphic: Median age for complete ossification of the SOS: experimental group vs control in females

discussion

Previous studies reported that the fusion of this synchondrosis occurred 2 or 3 years earlier in females than in males^{6,8-11}. However, the timing of complete ossification of the synchondrosis is still controversial in the literature. This inconsistency is probably due to a difference in criteria, population, and assessment methods¹³. The only study that evaluated the SOS in patients with CLP were Molsted *et al*, who examined the synchondrosis in lateral cephalograms in children with major complete and minor incomplete clefts¹⁴. They concluded that children with major complete clefts had a broader SOS that could indicate a delayed maturation or deviant growth in the early development of the cartilaginous cranial base¹³. The present

study compared patients with and without CLP and found that the median time for complete ossification of the SOS occurs earlier in girls than in boys, which is in line with the age range described in the literature. No statistically significant differences were found regarding sex in the control group, which may be explained by the fact that the group had fewer individuals.

Because of the small sample size and lack of references in the literature, further studies should be conducted to determine the age of complete SOS ossification in patients with and without CLP in the Portuguese population.

conclusion

There are no differences regarding the ossification of the speno-occipital synchondrosis between individuals with and without cleft lip and palate. The complete ossification of this synchondrosis in individuals with cleft lip and palate occurs earlier in females than in males.

clinical implications

Dentofacial orthopedic treatment may be started earlier in female children, than in males, in the search for the best therapeutic results.

Bibliografia: 1. Shoukani MA, Chen M, Vong A. Cleft Lip - A Comprehensive Review. *Front Pediatr* [Internet]. 2013;(December):1-10. 2. Watkins SE, Meyer RE, Strauss RP, Aylsworth AS. Classification, epidemiology and genetics of orofacial clefts. *Clin Plast Surg* [Internet]. 2014;41(2):149-63. 3. Harris EF. Size and form of the cranial base in isolated cleft lip and palate. [Internet]. Vol. 30. *The Cleft palate-craniofacial journal: official publication of the American Cleft Palate-Craniofacial Association*; 1993. p. 170-4. 4. Molsted K, Kjaer I, Dahl E. Cranial base in newborns with complete cleft lip and palate: radiographic study. *Cleft Palate-Craniofacial J*. 1995;22(3):200-5. 5. Driessen G, Ripken BF, Douma PJ, Dremmen MH, Joosten KZ, Mathijssen IM. The effect of early fusion of the speno-occipital synchondrosis on midface hypoplasia and obstructive sleep apnea in patients with Crouzon syndrome. *J Cranio-Maxillofac Surg* [Internet]. 2017;45(7):1069-73. 6. Powell T V, Brodie AG. Closure of the speno-occipital synchondrosis. *Anat Rec*. 1963;147(1):15-23. 7. Scott JH. The cranial base. *Am J Phys Anthropol*. 1958;16(3):319-48. 8. Kanchan T, Krishan K. Evaluation of speno-occipital synchondrosis: A review of literature and considerations from forensic anthropologic point of view. *J Forensic Dent Sci* [Internet]. 2013;5(2):72. 9. Taheri Y, Paliga JT, Vosough A, Bartlett SP, Taylor JA. The speno-occipital synchondrosis fuses prematurely in patients with Crouzon syndrome and midface hypoplasia compared with age- and gender-matched controls. *J Oral Maxillofac Surg* [Internet]. 2014;72(6):1173-9. 10. Ingervall B, Thilander B. The human speno-occipital synchondrosis I. The time of closure appraised macroscopically. *Acta Odontol Scand*. 1972;30(3):349-56. 11. Lottering N, Macgregor DM, Alston CL, Gregory LS. Ontogeny of the speno-occipital synchondrosis in a modern Queensland, Australian population using computed tomography. *Am J Phys Anthropol*. 2015;157(1):42-57. 12. Bassed RB, Briggs C, Drummer OH. Analysis of time of closure of the speno-occipital synchondrosis using computed tomography. *Forensic Sci Int* [Internet]. 2010;200(1-3):161-4. 13. Yang J et al. Time and pattern of the fusion of the speno-occipital synchondrosis in patients with skeletal Class I and Class III malocclusion. *Angle Orthodontist*. 2019;89(3):470-479. 14. Molsted K, Kjaer I, Dahl E. Spheno-Occipital Synchondrosis in Three-Month-Old Children with Clefts of the Lip and Palate: A Radiographic Study. *Cleft Palate-Craniofacial J* [Internet]. 1993 Nov;30(6):569-73.