# Development of a clinical decision support system for facial growing analysis by the cervical vertebral maturation method

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**Abstract and Objective**

*Thinking about prevention and early treatment of dentofacial deformities, which require care, as correct diagnosis and proper planning, determine the stage of skeletal maturation is very important to identify the growth phase of the patient. New Cervical Vertebral Maturation (CVM) method was used as a foundation to build a clinical decision support system (CDSS). One of the advantages of this method is that there is no need for additional x-ray exposure, once the cephalogram is already part of the orthodontic documentation of the patient. This study presents a CDSS under development, that helps the orthodontist determining the optimal timing to treat a series of dentofacial deformities. To build this system, classifiers were evaluated using a open-source software package. A preliminary assessment showed that the CDSS inference engine (IE) presented 81.88% of accuracy, indicating that the CDSS can have better precision, quality and productivity on CVM analysis.*

***Keywords:***

Clinical decision support systems, Cervical vertebrae, Cephalometry, Dental informatics, Orthodontics

## Methods

This study presents a CDSS based on the new CVM method [1], which assesses the skeletal maturity by means of a single cephalogram, analyzing only the second, third, and fourth cervical vertebrae (C2, C3 and C4). According to the method, maturity phases divided into six cervical stages (CS), CS1-CS6. As first step, 60 digitized cephalograms (10 at each cervical stage) were used. Reference points of the vertebrae were marked by an orthodontic specialist, using a specialized software, for calculating measures based on the reference points marked. This data set was submitted to the Weka 3.6.1 software to evaluate the most accurate classifier rule. The inference engine was built based on a set of 6 classifiers, each of them representing one of the 6 CSs. A web-based system is been developed for visual analysis of the same set of digitized cephalograms. A group of orthodontic specialists and a group of master students will be invited to do this evaluation. For each cephalogram, they will visually identify the presence or absence of concavity at the lower border of the body of C2, C3 and C4, and the shape of the body of C3 and C4. Then, they will inform the CS found. Intraexaminer and interexaminer evaluations will be done to verify the agreement between groups, within each group and between the groups and the IE.

## Results

The desktop software proved that can be useful for the orthodontist, as it improves productivity, can store data over a long period of time and stored data can be reproduced exactly. A preliminary assessment showed that the IE presented 81.88% of accuracy.

## Conclusion

This preliminary assessment indicates that it will be possible to obtain a CDSS with improved accuracy, once there will be a set of 180 images to evaluate the classifier rules to the inference engine. The next steps are the development of a web service to expose the methods of the engine. Also, an accuracy evaluation will be done, and then submitted to a usability evaluation by orthodontic specialists.

No reports on a similar clinical decision support system were found on literature. A published work based on the Tanner-Withehouse (TW3) method [2] was found, showing that the automatic bone age assessment (ABAA) had no significant difference compared with manual method ($P > 0.05$).

## References

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