 DOI: 10.18231/2395-499X.2016.0005

Cervical vertebral maturation method-effect of clinical experience on the reproducibility

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Abstract

Objectives: To assess interobserver an intraobserver reproducibility of the cervical vertebrae maturation method (CVMM) among three panels of judges with different levels of orthodontic experience (OE).

Sample: Samples were collected from subjects from the Department of Orthodontics, who wanted to undergo fixed orthodontic therapy.

Materials and Methods: Twenty good quality individual lateral cephalograms of patients seeking orthodontic treatment, with complete visualization of cervical vertebrae 1 through 4, were selected for our sample.

- Age ranging from 11 to 25 years of both the sexes.
- Thirty clinicians, divided according to their orthodontic experience into three groups (junior group, JU, OE up to 1 year; postgraduate group, PG, 2 OE up to 3years ;specialist group, SP, OE up to 7 years) evaluated the cephalograms in two sessions (T1 and T2) at 3 weeks apart.

Results: The statistical assessment of inter-observer agreement at two time points (T1 and T2).

***P-value<0.001 (Statistically Highly Significant).

1. The Kendall's W coefficient for each group varied from 0.597 to 0.982 at T1 and varied from 0.779 to 0.975 at T2.
2. The inter-observer agreement was highest for Specialist followed by Post-graduates and it was lowest for the Juniors (P-value<0.001 for all) in both the time intervals.

- The statistical assessment of intra-observer agreement.
- ***P-value<0.001 (Statistically Highly Significant).

1. The Cohen's kappa coefficient for each group varied from 0.154 to 0.965 for all observers.
2. The intra-observer agreement was highest for Post-graduates followed by Specialists and it was lowest for the Juniors (P-value<0.001 for all).

Conclusion: The group with the highest level of OE had the best performance. Hence, high level of orthodontic experience does increase the reproducibility of the CVMM.

Introduction

When dealing with skeletal disharmonies, the precise identification of skeletal maturity, that is, the growth phase, with particular regard to the onset of the pubertal growth spurt, has major clinical implications in terms of treatment efficacy and efficiency.(3,4)

The reliable prediction of patient's mandibular and maxillary development could help in understanding the best therapeutic decision regarding treatment timing, appliance choice, and the possible need for surgery.(1)

As most orthodontic patients are growing individuals, orthodontists have to consider their craniofacial growth path for successful treatment planning[2].However, individuals with the same chronologic age may have different growth patterns regarding onset, duration, speed, direction, and amount of residual growth, as shown in several studies.(5-9)

Many indicators have been suggested to evaluate the timing of mandibular growth peak and skeletal maturation.(10-12)

Numerous authors investigated the relationship between mandibular growth and skeletal maturation estimated by means of hand-wrist bone analysis (HWBA) or the cervical vertebrae maturation method (CVMM).(1,13,14)

Several studies found a good correlation between CVMM and HWBA, suggesting the possibility to use the CVMM instead of the HWBA to reduce the radiation dose.(15,16)

Indeed, there is little information about the impact of judges' clinical experience on the CVMM, even though it should not be underestimated.

Aim

The aim of this study was to evaluate the inter observer and intra observer reproducibility of the CVMM among three judge panels with different levels of orthodontic experience (OE). The null hypothesis was that the orthodontic clinical experience did not have any influence on the reproducibility of the CVMM.

Objective

To assess interobserver and intraobserver reproducibility of the cervical vertebrae maturation method (CVMM) among three panels of judges with different levels of orthodontic experience (OE). The null hypothesis was that the orthodontic clinical experience did not have any influence on the reproducibility of the CVMM.

Material and Methods

- The study was approved by the Local Ethical Committee. Twenty good quality individual lateral cephalograms of patients seeking orthodontic treatment, with complete visualization of cervical vertebrae 1 through 4, were selected for our sample. Age ranging from 11 to 25 years of both the sexes.
- Thirty clinicians, divided according to their orthodontic experience into three groups (junior group, JU, OE up to 1 year; postgraduate group, PG, 2 OE up to 3years; specialist group, SP, OE up to 7 years) evaluated the cephalograms in two sessions (T1 and T2) at 3 weeks apart.
- Each observer was invited to perform two sessions of evaluation (Fig. 1) of cervical stage on the lateral cephalograms according to the method suggested by Baccetti et al.

Lat.ceph

No.	stages					
	CS1	CS2	CS3	CS4	CS5	CS6
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Fig. 1

- The cephalograms were presented in a file, randomly ordered for the two sessions.
- To avoid any additional information that might influence the observer during the evaluation of the CVMM (as stage of dentition), the lateral cephalograms were hided with the paper to just show cervical vertebrae from C1 to C4.(Fig. 2)

Fig. 2

- At the start of each session the observers also received a copy of the paper by Baccetti et al., and beside each cephalogram a schematic representation of the CVMM was shown as well.(Fig. 4)

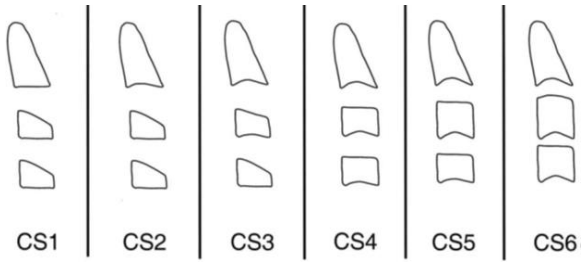

Fig. 4: Schematic representation of the stages of cervical vertebrae according to the newly modified method

Statistical Analysis: The statistical analysis was conducted to calculate Kendall's W coefficient for the interobserver agreement and weighted Cohen's kappa (k) coefficient for the intraobserver agreement.

Results

Table 1: The distribution of individual assessments by three groups of observers at two time points (T1 and T2)

Session	Stage	Juniors (n=400)		Post Graduates (n=400)		Specialists (n=400)	
		No. of images	% of images	No. of images	% of images	No. of images	% of images
T1 (n=600)	Stage 1	5	2.5	0	0.0	0	0.0
	Stage 2	26	13.0	12	6.0	1	0.5
	Stage 3	10	5.0	28	14.0	29	14.5
	Stage 4	18	9.0	6	3.0	19	9.5
	Stage 5	53	26.5	32	16.0	51	25.5
	Stage 6	88	44.0	122	64.0	100	50.0
T2 (n=600)	Stage 1	1	0.5	0	0.0	0	0.0
	Stage 2	1	0.5	13	6.5	3	1.5
	Stage 3	28	14.0	25	12.5	27	13.5
	Stage 4	30	15.0	6	3.0	19	9.5
	Stage 5	10	5.0	31	15.5	49	24.5

	Stage 6	130	65.0	125	62.5	102	51.0

Values are n (% of images).

Table 2: The statistical assessment of inter-observer agreement at two time points (T1 and T2)

Session	Observer group	Kendall's W Statistic	P-value	Interpretation
T1	Juniors	0.597	0.001***	Moderate
	Post Graduates	0.852	0.001***	Almost Perfect
	Specialists	0.982	0.001***	Almost Perfect
T2	Juniors	0.779	0.001***	Substantial
	Post Graduates	0.884	0.001***	Almost Perfect
	Specialists	0.975	0.001***	Almost Perfect
T1 and T2	Juniors	0.797	0.001***	Substantial
	Post Graduates	0.823	0.001***	Almost Perfect
	Specialists	0.932	0.001***	Almost Perfect

***P-value<0.001 (Statistically Highly Significant).

Comments

1. The Kendall's W coefficient for each group varied from 0.597 to 0.982 at T1 and varied from 0.779 to 0.975 at T2.
2. The inter-observer agreement was highest for Specialist followed by Post-graduates and it was lowest for the juniors (P-value<0.001 for all) in both the time intervals.

Table 3: The statistical assessment of intra-observer agreement.

Observer group	Cohen's Kappa	P-value	Interpretation
Juniors (n=400)	0.154	0.001***	Poor
Post Graduates (n=400)	0.965	0.001***	Almost Perfect
Specialists (n=400)	0.901	0.001***	Almost Perfect
All (n=1200)	0.684	0.001***	Substantial

***P-value<0.001 (Statistically Highly Significant).

Comments

1. The Cohen's kappa coefficient for each group varied from 0.154 to 0.965 for all observers.
2. The intra-observer agreement was highest for Post-graduates followed by Specialists and it was lowest for the juniors (P-value<0.001 for all).

Discussion

The aim of this study was to analyze the influence of the OE on the reproducibility of the CVMM using three judge panels with different levels of clinical experience.

The SP was the group with the highest clinical experience (OE up to 7 years), this group achieved the highest and second highest values of inter observer and intra observer agreement respectively.

Postgraduate group achieved the highest and second highest values of intra observer and inter observer agreement respectively.

The group with less than 1 year of clinical experience (JU), showed the lowest values for all of the parameters investigated.

These results suggest that the OE improve the reproducibility of the CVMM.

Specialist and postgraduate group use the CVMM in their daily clinical practice.

Hence, these findings highlight that, probably, the level of practice and knowledge of the CVMM might be an important factor for its reproducibility.

Therefore, to correctly use the CVMM there might be a need for multiple training sessions to understand how to assess the cervical stage and to acquire a consistent method of evaluation.

Conclusion

- The main finding of this research was the strong influence of orthodontic clinical experience on the interobserver and intraobserver reproducibility of the CVMM.
- The group with the highest level of OE had the best performance. Hence, high level of orthodontic experience does increase the reproducibility of the CVMM.

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