Introduction

The orthodontic treatment is most favorable and effective during growth and hence the assessment of growth is significant in treatment planning for dental and maxillofacial malocclusion [1,2]. Several features such as body height, weight and sexual characteristics, dental and skeletal development are used to evaluate the pubertal growth. The stage of tooth maturation can determine the dental maturity and many studies have found an association between dental maturity and skeletal maturity. Yet very few studies [6,7] are done to evaluate the relationship between tooth calcification stage and cervical vertebra maturation stage. The purpose of this present study is to evaluate the correlation between the CVM stages method and dental maturity using tooth calcification stages.

Methods

The current study comprised of 405 subjects selected from Orthodontic patients of Saudi origin coming to clinics of the specialized dental centers in western region of Saudi Arabia. Dental age was assessed according to the developmental stages of upper and lower third molars and skeletal maturation according to the cervical vertebrae maturation stage method. Statistical analysis was done using Kruskal-Wallis H, Mann-Whitney U test, Chi-Square test; t-test and Spearman correlation coefficient for inter group comparison.

Result

The females were younger than males in all cervical stages. The CS1-CS2 show the period before the peak of growth, during CS3-CS5 it’s the pubertal growth spurt and CS6 is the period after the peak of the growth. The mean age and standard deviation for cervical stages of CS2, CS3 and CS4 were 12.09±1.72 years, 13.19±1.62 and 14.88±1.52 respectively. The Spearman correlation coefficients between cervical vertebrae and dental maturation were between 0.166 and 0.612, 0.243 and 0.832 for both sexes for upper and lower third molars. The significance levels for all coefficients were the same at 0.01 and 0.05.

Conclusion

The results of this study show that the skeletal maturity increased with the increase in dental ages for both gender. An early rate of skeletal maturation stage was observed in females. This study needs further analysis using a larger sample covering the entire dentition.

Keywords:
Cervical vertebra; Maturation; Third molar; Dental age
a. A high-quality digital panoramic radiograph and lateral cephalogram.

b. No history of any dental or medical disease affecting the normal development of third molar teeth.

c. The following Exclusion criteria were considered and those patients were excluded from the investigation.

d. Any congenital tooth anomalies or congenital anomalies of the 2nd, 3rd and 4th cervical vertebrae such as fusion between cervical vertebrae or presence of secondary possible were eliminated.

e. Patients having any systemic diseases that could affect growth (such as nutritional disturbance, endocrine disorders, syndromes, and long-term consumption of medication) were.

Dental maturation

The assessment of dental maturation was done according to the upper and lower third molar teeth calcification stages. The development of teeth was categorized into different groups, ranging from A (least development) to H (complete development) [8].

Skeletal maturation

The Skeletal maturity was evaluated by skeletal age using cervical vertebra maturation (CVM) stage method, assessing the morphology (shape and inferior border concavity) of three cervical vertebrae (C2, C3, and C4) consisting of six maturity stages (C1-C6) presented by Bacetti et al. [9,10].

Assessment of the sample

All OPGs and lateral cephalogram were viewed on the same computer screen. The assessment of stages of cervical vertebra development and tooth formation for each sample was done by one orthodontist without knowing of the age or gender.

Statistical method

Analysis was performed using the Statistical Package SPSS statistic V22.0 (IBM Corporation, New York, USA). Difference in proportion was tested using Kruskal-Wallis H followed by Mann-Whitney U test for inter group comparison, and Chi-Square tests. Difference in mean was tested using t-test. Molar stages were correlated with cervical vertebra developmental stages using Spearman’s correlation coefficient. All statistical tests were two-sided, and the significance level was set at p < 0.05.

Result

Table 1, 2 show the distribution of upper and lower third molar stages according to age and gender. In 9-12 years group the common upper third molar stages were C, B and D respectively, while the common lower third molar stages were C and D then B, there were no E, G and H stages in this age group. In 13-16 years group all third molar stages were present, the most common stage was stage D. In the age group more than 17 years, H stage of third molar was the most common in upper and lower third molars. In the female group of this Saudi sample the most common stage of third molar was stage D, while in the male group the common stages were stage D and H.

Table 1: Distribution subjects with upper third molar stages according to age and gender.

| Age in Years | Upper Third Molar Stages | Total |
|--------------|--------------------------|-------|
|              | A | B | C | D | E | F | G | H | NA |       |
| 12-Sep       | 6 | 32 | 38 | 28 | 8 | 0 | 0 | 0 | 28 | 140   |
| 13-16        | 0 | 12 | 52 | 138 | 72 | 38 | 8 | 10 | 12 | 342   |
| ≥ 17         | 0 | 0 | 0 | 34 | 28 | 76 | 66 | 122 | 2 | 328   |

Kruskal-Wallis H, p value 0.0001

Chi-square, p value 0.0001

Table 2: Distribution subjects with lower third molar stages according to age and gender.

| Age in Years | Lower Third Molar Stages | Total |
|--------------|--------------------------|-------|
|              | A | B | C | D | E | F | G | H | NA |   |
| 12-Sep       | 6 | 28 | 48 | 34 | 8 | 0 | 0 | 0 | 16 | 140 |
| 13-16        | 4 | 16 | 48 | 148 | 90 | 12 | 4 | 14 | 6 | 342 |
| ≥ 17         | 0 | 0 | 4 | 30 | 40 | 72 | 60 | 122 | 0 | 328 |

Kruskal-Wallis H, p value 0.0001

Chi-square, p value 0.0001

Table 3 shows the distribution of chronological ages for all subjects grouped by cervical vertebra developmental stages. The mean age and standard deviation for cervical stage 3 and 4 were 13.19±1.62 and 14.88±1.52 respectively; the females were younger than males in these cervical stages.

Table 3: Distribution of chronological ages for all subjects grouped by CVS.

| Cervical Vertebra Developmental Stages | N | Age (Mean ± SD) | Gender | N | Age (Mean ± SD) | P Value T-Test |
|--------------------------------------|---|-----------------|--------|---|-----------------|---------------|
| CS1                                  | 34 | 10.62 ±1.2     | Male   | 22 | 10.73 ±1.31    | 0.12         |
|                                      |   |                 | Female | 12 | 10.42 ±1.06    |               |
| CS2                                  | 34 | 12.09 ±1.72    | Male   | 21 | 12.14 ±1.67    | 0.16         |
|                                      |   |                 | Female | 13 | 12 ±1.85       |               |

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Discussion

Many biological indicators such as hand-wrist maturation [11], cervical vertebrae [9,10] and dental development [12] have been used to evaluate for developmental age estimation. In addition to hand-wrist radiographs, the evaluation of CVM is used for assessing the skeletal maturation. On cephalometric radiographs, the developmental changes of cervical vertebrae are used to evaluate the degree of physiological maturity of a growing individual and also to calculate the bone age. Many researchers agree that the evaluation of cervical vertebrae in routine lateral skull cephalogram can be used to predict mandible growth [9,13-15]. CVM explains the complete pubertal growth period by recording significant phases in craniofacial growth during adolescence and young adulthood for both genders [9,10,16]. Few suggests a slight association between dental maturation and skeletal maturity [16,17]. According to few studies, dental maturity with levels of calcification of teeth is a significant biologic factor [18]. Studies have found that CVM is a reliable method for skeletal maturity assessment [5,9,16,17,19]. Furthermore, it doesn't require additional x-ray exposure more than the routine lateral cephalogram.

This study investigated the relationship between cervical vertebrae maturation and 3rd molar dental maturation of Saudi sample. Some authors found that the developmental stages of certain teeth such as canines and second molars having a high correlation with skeletal maturity [3-5,19]. However, the timing of third molar development showed the highest variability compared to all other developing teeth [20].

In the present study, assessment of skeletal maturity was done using the CVM on lateral cephalogram, a routine diagnostic radiograph used for orthodontic treatment. The study investigated the interrelationship of the dental age using the third molars and skeletal maturity by assessing the maturity stages of cervical vertebrae. A recent study by Chen J et al. [6] dental calcification stages were used to determine dental maturation stage, while skeletal maturation was evaluated by CVM stages, there was a significant correlation between tooth calcification stage and cervical vertebrae maturation stage [6].

Distribution of the chronological ages of all patients according to CVM stages is described in Table 3. The mean chronologic age of girls according to CVMs was slightly lower than boys, with each stage being earlier in females than in males. In stage CS2 and CS4, the mean chronologic age was 12.09±1.72 years and 14.88±1.52 years respectively (Table 3). In CVM method, CS1, CS2 show the period before the peak of growth, during CS3-CS5 it’s the pubertal growth spurt and CS6 is the period after the peak of the growth (Table 3). These results are in accordance with earlier studies by Baccetti et al. [9,10]. Results of Spearman correlation coefficients between cervical vertebrae and dental maturation were between 0.166 and 0.612, 0.243 and 0.832 for both sexes for upper and lower third molars respectively. The significance levels for all coefficients were the same at 0.01 and 0.05 (Table 4).

According to few researchers, a higher correlation coefficients between dental and skeletal maturity when studying a fewer teeth since the probability of accidental errors will be reduced [17,21,22]. The association between the dental and skeletal maturity also appear to be vary among different geographic regions and ethnic groups [23].

In the current study, dental calcification stages were used to determine dental maturity and the skeletal maturity was evaluated by CVM method which is the widely used. A low but statistically significant correlation was found between tooth calcification stage and cervical vertebrae maturation stage. The correlation coefficients between calcification stages of upper third molars and skeletal maturity was a weak positive and ranging from 0.166 to 0.0287, except for CS5 stage there was a moderate
positive correlation (Table 4). For lower third molars, there was a moderate positive correlation between cervical vertebra (CS4, CS5 and CS6) and the developmental stages, ranging from 0.471 to 0.832.

A study by Chen et al, the CVM and dental calcification stages of the teeth except the third molars showed correlations ranging from 0.601 to 0.911. Kralassiri et al. [24] and Uysal et al. [17] have reported weak correlations, while Engstrom et al. [25] found a strong correlation. In this Saudi sample, there was a weak positive correlation between CVM stages and upper molar ranging from 0.166 to 0.0287, except for CSS stage there was a moderate positive correlation. For lower third molar stages, there was a moderate positive correlation between cervical vertebra developmental stages CS4, CSS and CS6, ranging from 0.471 to 0.832. It has been recommended by many researchers that the maturation of the mandible canine is strongly associated with the pubertal growth spurt [4] and some investigators have suggested that the second premolar has the highest correlation with skeletal maturation [24]. It is concluded that the second molar has an advantage because of its longer period of development till a later age over other teeth [5,26,27].

Skeletal maturity increased together with the increase in dental ages for both gender. A constantly earlier occurrence for each skeletal maturation stage was observed in females. At some stage, in the peak growth period, these differences were more marked. All correlations between skeletal and dental stages were statistically significant. There is a need for further investigation using a larger sample of Saudi children for greater conclusions.

Conclusion

Due to its practical applications, the CVM stage method appears to be a powerful diagnostic tool. The CVM stage method may be helpful for the assessment of period active growth for long term effects of orthodontic/orthopedic treatment approach. It can be used to identify the sufficient time for intervention for the late correction of facial deformities. Tooth calcification stage was significantly correlated with CVM stage in study of Saudi sample. When planning the orthodontic treatment, it is useful to consider both dental and skeletal maturity.

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References

1. Baccetti T, Franchi L, Toth LR, McNamara JA (2000) Treatment timing for Twin-block therapy. Am J Orthod Dentofacial Orthop 118(2): 159-170.
2. Faltin K, Faltin RM, Baccetti T, Franchi L, Ghiozzi B, et al. (2003) Long-term effectiveness and treatment timing for Bionator therapy. Angle orthod 73(3): 221-230.
3. Coutinho S, Buschang PH, Miranda F (1993) Relationships between mandibular canine calcification stages and skeletal maturity. Am J Orthod Dentofacial Orthop 104(3): 262-268.
4. Chertkov S (1980) Tooth mineralization as an indicator of the pubertal growth spurt. Am J Orthod 77 (1): 79-91.
5. Kumar S, Singlu A, Sharma R, Virdi MS, Anupam A, et al. (2011) Skeletal maturation evaluation using mandibular second molar calcification stages. Angle Orthod 82(3): 501-506.
6. Chen J, Hu H, Guo J, Liu Z, Liu R, et al. (2010) Correlation between dental maturity and cervical vertebrae maturity. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 110(6): 777-783.
7. Heravi F, Imanimoghaddam M, Rahimi H (2011) Correlation between cervical vertebra and dental maturity in Iranian subjects. J Calif Dent Assoc 39(12): 891-896.
8. Demirjian A, Goldstein H, Tanner JM (1973) A new system of dental age assessment. Hum Biol 45(2): 211-227.
9. Baccetti T, Franchi L, McNamara JA (2002) An improved version of the cervical vertebrae maturation (CVM) method for the assessment of mandibular growth. Angle orthod 72(4): 316-323.
10. Baccetti T, Franchi L, McNamara JA (2005) The cervical vertebrae maturation (CVM) method for the assessment of optimal treatment timing in dentofacial orthopedics. Seminars in Orthodontics 11(3): 119-129.
11. Fishman LS (1982) Radiographic evaluation of skeletal maturation: a clinically oriented method based on hand-wrist films. Angle orthod 52(2): 86-112.
12. Perinetti G, Contardo L, Gabrielli P, Baccetti T, Di Lenarda R, et al. (2012) Diagnostic performance of dental maturity for identification of skeletal maturation phase. Eur J Orthod 34(4): 487-492.
13. O’Reilly MY, Yanniello GI (1988) Mandibular Growth Changes and Maturation of Cervical Vertebrae: A Longitudinal Cephalometric Study. Angle orthod 58(2): 179-184.
14. Franchi L, Baccetti T, McNamara JA (2000) Mandibular growth as related to cervical vertebrae maturation and body height. Am J Orthod Dentofacial Orthop 118(3): 335-340.
15. Graue K, Townsend G (2003) Cervical vertebra maturation as a predictor of the adolescent growth spurt. Aust Orthod J 19(1): 25-32.
16. Flores Mir C, Burgess CA, Champney M, Jensen BJ, Pitcher MR, et al. (2006) Correlation of skeletal maturation stages determined by cervical vertebrae and hand-wrist evaluations. Angle orthod 76(1): 1-5.
17. Uysal T, Sari Z, Ramoglu S, Bascifelti FA (2004) Relationships between dental and skeletal maturity in Turkish subjects. Angle orthod 74(5): 657-664.
18. Demirjian A, Buschang PH, Tanguay R, Patterson DK (1985) Interrelationships among measures of somatic, skeletal, dental and sexual maturity. Am J Orthod 88(5): 433-438.
19. Goyal S, Goyal S, Gugnani N (2014) Assessment of skeletal maturity using the permanent mandibular canine calcification stages. Journal of Orthodontic Research 2(1): 11-16.
20. Liversidge HM (2008) Timing of human mandibular third molar formation. Ann Hum Biol 35(3): 294-321.
21. Başaran G, Özer T, Hamamco N (2007) Cervical vertebra and dental maturity in Turkish subjects. Am J Orthod Dentofacial Orthop 131(4): 447.e13-1.e20.
22. Różylo Kalinowska I, Kolasa Rączka A, Kalinowski P (2011) Relationship between dental age according to Demirjian and cervical vertebrae maturity in Polish children. Eur J Orthod 33(1): 75-83.
23. Chaillet N, Nyström M, Demirjian A (2005) Comparison of dental maturity in children of different ethnic origins: international maturity curves for clinicians. J Forensic Sci 50(5): 1164-1174.

24. Knialassiri S, Anuwongnumroh N, Dechkunakorn S (2002) Relationships between dental calcification stages and skeletal maturity indicators in Thai individuals. Angle Orthod 72(2): 155-166.

25. Engström C, Engström H, Sagne S (1983) Lower third molar development in relation to skeletal maturity and chronological age. Angle Orthod 53(2): 97-106.

26. Al Emran S (2008) Dental age assessment of 8.5 to 17 Year-old Saudi children using Demirjian’s method. J Contemp Dent Pract 9(3): 64-71.

27. Grover S, Marya CM, Avinash J, Pruthi N (2012) Estimation of dental age and its comparison with chronological age: accuracy of two radiographic methods. Med Sci Law 52(1): 32-35.

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