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RESEARCH ARTICLE

COMPARISON OF HAND- WRIST RADIOGRAPH AND CERVICAL VERTEBRAL ANALYSIS IN MEASURING SKELETAL MATURATION

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ABSTRACT

Understanding of growth events is of importance in orthodontics. To know the exact status of growth, for treatment planning and treatment prognosis skeletal maturity indicators are used. The most widely used method for skeletal maturation analysis is hand wrist bone radiograph. The assessment of degree of cervical bone maturation is another method for assessing skeletal maturation. The present study is to find the possible concordance between hand wrist bone radiograph and cervical vertebral analysis using lateral cephalograph.

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INTRODUCTION

Understanding facial growth velocity and percentage of growth remaining is important in orthodontics to correct skeletal discrepancies (Carlos Flores-Mir, 2004). The effectiveness of orthodontic and orthopaedic appliances is associated with skeletal maturation (Carlos Flores-Mira, 2006). To determine the skeletal maturation various indices have been proposed (Hellman, 1923; Nanda, 1955; Greulich, 1959; Lewis, 1960; Tanner, 1962; Hunter, 1966; Bjork, 1967; Tofani, 1972; Hagg, 1980; Fishman, 1987). The various biological indicators are that have been used to identify the stages of growth are chronological age, dental development, sexual maturation characteristics, height and weight measurements and skeletal age. As there is variations in duration, timing and velocity of growth, skeletal age assessment is considered essential for orthodontic treatment plans (Hassel, 1995). The most widely used method for skeletal age assessment is the Hand-wrist bone analysis performed by a radiograph (Paola Gandinia, 2006). The validity of hand-wrist radiographs has been confirmed by Bjork (1967), Rakosi *et al*. (1989), Grave and Brown (1976) and Gianni (1986). The skeletal maturation is determined by the ossification of the bones of the hand and wrist. This can be determined by two methods: The first method is comparing the hand wrist bone maturation to the atlas (Greulich, 1959; Tanner, 1983).

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The second method uses specific indicators to relate skeletal maturation to the pubertal growth curve. Thus in hand wrist radiographs the horizontal and vertical facial growth velocity has been shown to be related to skeletal maturity indicators (Flores-Mir, 2004). However there have been concerns about the radiation exposure by the Hand-wrist radiograph (Hessa Abdulla Alkhala *et al*., 2008). Another method of assessing the skeletal maturation is the analysis of cervical vertebral maturation (Hassel *et al*., 1995; Bench, 1963; Franchi, 2000). Lamparski first introduced the use of cervical vertebrae to determine skeletal maturity (Hassel, 1995). Hassel, farman (1995) and Garcia-Fernandes *et al*. (1998) found a high correlation between cervical vertebral maturation and the skeletal maturation of the hand-wrist area.One advantage of cervical maturity evaluation is that no extra radiation exposure is implied (Carlos Flores-Mira, 2006) and it is taken routinely in orthodontics for diagnosis and treatment planning (Hessa Abdulla Alkhala *et al*., 2008). In this study we assess the correlation between cervical vertebrae maturity and hand-wrist bone maturity.

MATERIALS AND METHOD

The sample of this study consists of hand wrist Radiographs and lateral cephalograms of 25 patients obtained from Saveetha Dental College, Saveetha University, Chennai. The criteria includes: no developmental anomaly, no cervical vertebral bone anomaly, and possession of good quality hand-

wrist radiographs and lateral cephalograms. The skeletal maturity in hand wrist radiographs is evaluated by visible changes in the epiphyseal capping of MP3. They are MP3-F, MP3-FG, MP3-G, MP3-H, MP3-HI, MP3-I (27-29)

MP3-F

Epiphysis is as wide as metaphysis.
Ends of epiphysis are tapered and rounded.
Metaphysis shows no undulation.
Radiolucent gap between epiphysis and metaphysis is wide.

MP3-FG

Epiphysis is as wide as metaphysics.
Distinct medial and/or lateral border of epiphysis forms line of demarcation at right angle to distal border.
Metaphysis begin to show slight undulation.
Radiolucent gap between epiphysis and metaphysis is wide.

MP3-G stage

Sides of epiphysis have thickened and cap its metaphysis, forming sharp distal edge one or both sides.
Marked undulation in metaphysis give it "cupid's bow" appearance.
Radiolucent gap between epiphysis and metaphysis is moderate.

MP3-H stage

Fusion of epiphysis and metaphysis begins.
One or both sides of epiphysis form obtuse angle to distal border.

Epiphysis is beginning to narrow

Slight convexity is seen under central part of metaphysis. Typical "Cupid's bow" appearance of metaphysis is absent, but slight undulation is distinctly present.
Radiolucent gap between epiphysis and metaphysis is narrower.

MP3-HI stage

Superior surface of epiphysis shows smooth concavity.
Metaphysis shows smooth, convex surface, almost fitting into reciprocal concavity of epiphysis.

No undulation is present in metaphysis.

Radiolucent gap between epiphysis and metaphysis is insignificant.

MP3-I stage

Fusion of epiphysis and metaphysis is complete.

RESULTS

Comparison of MP3 and cervical vertebrae maturation indices

	HAND-WRIST MATURATION STAGE						TOTAL
CVMS	MP3-F	MP3-FG	MP3-G	MP3-H	MP3-HI	MP3-I	
CVMS I							
CVMS II							
CVMS III				6(24%)	1(4%)		7((28%)
CVMS IV			2(8%)	4(16%)	4(16%)	1(4%)	11(44%
CVMS V					4(16%)	2(8%)	6(24%)
CVMS VI					1(4%)		1(4%)

MALE

	HAND-WRIST MATURATION STAGE						TOTAL
CVMS	MP3-F	MP3-FG	MP3-G	MP3-H	MP3-HI	MP3-I	
CVMS I							
CVMS II							
CVMS III				4 (26%)			4(26%)
CVMS IV			2(14%)	2(14%)	4(26%)		8(54%)
CVMS V					2(14%)		2(14%)
CVMSVI							

FEMALE

	HAND-WRIST MATURATION STAGE						TOTAL
CVMS	MP3-F	MP3-FG	MP3-G	MP3-H	MP3-HI	MP3-I	
CVMS I							
CVMS II							
CVMS III				2(18%)	1(9%)		3(27%)
CVMS IV				2(18%)		1(9%)	3(27%)
CVMS V					2(18%)	2(18%)	4(36%)
CVMS VI					1(9%)		1(9%)

No radiolucent gap exists between metaphysis and epiphysis. Dense, radiopaque epiphyseal line forms integral part of proximal portion of middle phalanx.

The cervical vertebral maturation stages were done according Baccetti *et al*'s (30) definition and describes as

CVMS I—flat C2, C3 and C4 inferior vertebral body borders, as well as bodies of both C3 and C4 being trapezoid in shape.

CVMS II—concavities present at the lower border of C2, flat lower borders of C3 and C4, and both C3 and C4 being trapezoid in shape.

CVMS III—concavities present at the lower borders of C2 and C3, no concavity present at the lower border of C4, and C3 and C4 being either trapezoid or rectangular, horizontal in shape.

CVMS IV—concavities present at the lower borders of C2, C3 and C4, as well as both C3 and C4 being rectangular, horizontal in shape.

CVMS V—concavities present at the lower borders of C2, C3 and C4, as well as both C3 and C4 being rectangular, horizontal to square in shape.

CVMS VI—concavities present at the lower borders of C2, C3 and C4, as well as both C3 and C4 being square to rectangular, vertical in shape.

DISCUSSION

Orthodontic treatment plan is successful when the remaining craniofacial growth in velocity, direction and quantity is taken into consideration (Damian Verma, 2009). Chronological age has been considered as a poor indicator of skeletal maturity level (Adel Al-Hadlaq, 2007). Assessing the skeletal maturity from radiograph is a widely used method to predict the timing of pubertal growth, to estimate the growth velocity and to estimate the amount of growth remaining (Carlos Flores-Mir, 2004). Skeletal maturity is usually determined using stages in the ossification of bones of hand and wrist because of the quantity of different types of bones available in the area (Bowden, 1976; Fishman, 1976). In recent times, cervical vertebral maturation method has gained more attention which serves as a potential and valid replacement to the conventional hand-wrist radiograph method (Garcia-Fernandes, 1998; San Roman, 2002). The orthodontists are familiar with the diagnostic reading of lateral cephalometric radiographs and no special training is needed as in the case of hand-wrist radiographic interpretation (Grave, 2003).

The present study assessed the stages of skeletal maturation through cervical vertebrae and MP3 stages. A sample of 25 subjects were taken in the study with 14 boys and 11 girls. There was good correlation between CVMI and MP3 scores (Table 1). There was 24% similarity in MP3-H and with a CVMI score of 3 , 4% similarity in MP3-HI stage and with a CVMI score of 3, 8% similarity in MP3-G stage and with a CVMI score of 4, 16% similarity in MP3-H stage and with a CVMI score of 4, 16% similarity in MP3-HI stage and with a CVMI score of 4, 4% similarity in MP3-I stage and with a CVMI score of 4, 16% similarity in MP3-HI stage and with a CVMI score of 5, 8% similarity in MP3-I stage and with a CVMI score of 5, 4% similarity in MP3-HI stage and with a CVMI score of 6. Females are in advanced maturity stages when compared to males. This indicates the faster maturation occurring in females as compared to males (Rajagopal, 2002).

Conclusion

There was a good concordance between six stages of CVMI and six stages of MP3. Chronological age is not a reliable indicator of assessing the skeletal maturity. Skeletal maturity is earlier in females when compared to males. The CVMI is as good as hand-wrist radiograph and can be used as an alternative. This can also reduce the radiation exposure by hand-wrist radiographs.

REFERENCES

Adel Al-hadlaq, Mohammed al-Qarni, Abdullah Al-Kahtani, Adel Al-Obaid, 2007. Comparative study between hand-wrist method and cervical vertebral maturation method for evaluation of skeletal maturity in saudi boys, *Pakistan Oral & Dental Journal,* Vol 27, No. 2

Bench R. 1963. Growth of the cervical vertebrae as related to tongue, face and denture behavior. *Am J Orthod.,* 19(3):183–214.

Bjork A, Helm S. 1967. Prediction of the age of maximum puberal growth in body height. *Angle Orthod*., 37:134–143.

Bowden BD. 1976. Epiphysial changes in the hand/wrist area as indicators of adolescent stage. *Aust Orthod J*., 4:87–104.

Carlos Flores-Mir, Brian Nebbe, Paul W. Major, 2004. Use of Skeletal Maturation Based on Hand-Wrist Radiographic Analysis as a Predictor of Facial Growth: A Systematic Review, *Angle Orthodontist*, Vol 74, No 1.

Carlos Flores-Mira, Corr A. Burgessb, Mitchell Champneyc, Robert J. Jensend, Micheal R. Pitchere, Paul W. Major, 2006. Correlation of Skeletal Maturation Stages Determined by Cervical Vertebrae and Hand-wrist Evaluations, *Angle Orthodontist*, Vol 76, No 1.

Damian Verma, Timo Peltomäki, Andreas Jäger, 2009. Reliability of growth prediction with hand – wrist radiographs, *Eur J Orthod*., Aug;31(4):438-42.

Fishman LS. 1987. Maturation patterns and prediction during adolescence. *Angle Orthod*., 57:178–193.

Fishman LS. 1979. Chronological versus skeletal age, an evaluation of craniofacial growth. *Angle Orthod*., 49:181–189.

Flores-Mir C, Nebbe B, Major PW. 2004. Use of skeletal maturation based on hand-wrist radiographic analysis as a predictor of facial growth: a systematic review. *Angle Orthod*., 74:118–124.

Franchi L, Baccetti T, Mc Namara Jr. 2000. Mandibular growth as related to cervical vertebral maturation and body height. *Am J Orthod Dentofacial Orthop*., 118(3):335–340.

Garcia-Fernandes P, Torre H, Flores L, Rea J. 1998. The cervical vertebrae as maturational indicators. *J Clin Orthod*., 32(4):221-5.

Giann`E. La Nuova Ortognatodonzia.ed. Padova, Italy: Piccin, 1986;1:539–551.

Grave K, Townsend G. 2003. Hand-wrist and cervical vertebral maturation indicators: how can these events be used to time Class II treatments? *Aust Orthod J*, 19(2): 33-45.

Grave KC, Brown T, 1976. Skeletalossicationandtheadoles-centgrowthspurt. *Am J Orthod*., 69(6):611–619.

Greulich WW, Pyle SI. 1959. Radiographic Atlas of Skeletal Development of the Hand and Wrist. Stanford, Calif: Stanford University Press.

Hagg U, Taranger J. 1980. Skeletal stages of the hand and wrist as indicators of the pubertal growth spurt. *Acta Odontol Scand*., 38:187–200.

Hagg U, Taranger J. 1980. Menarche and voice changes as indicators of the pubertal growth spurt. *Acta Odontol Scand*., 38:179186.

Hassel B, Farman AG. Skeletal maturation evaluation using cervical vertebrae. *Am J Orthod Dentofacial Orthop*. 1995; 107(1):58-66.

Hellman M. 1923. The process of dentition and its effects on occlusion. Dent Cosmos. 65:1329–1344.

Hessa Abdulla Alkhala; Ricky W. K. Wongb; A. Bakr M. Rabie, Correlation between Chronological Age, Cervical Vertebral Maturation and Fishman's Skeletal Maturity Indicators in Southern Chinese, *Angle Orthodontist*, Vol 78, No 4, 2008.

Hunter CJ. 1966. The correlation of facial growth with body height and skeletal maturation at adolescence. *Angle Orthod*., 36:4454.

Lamparski D G. 1972. Skeletal age assessment utilising cervical vertebrae [Master of Science dissertation]. Pittsburg, Pa: The University of Pittsburg;1972.In:

Lewis AB, Garn SM. 1960. The relationship between tooth formation and other maturation factors. *Angle Orthod*., 30:70–77.

Nanda RS. 1955. The rates of growth of several facial components measured from serial cephalometric roentgenograms. *Am J Orthod.,* 41:658–673.

O'Reilly M, Yanniello GJ. Mandibular growth changes and maturation of cervical vertebrae: alongitudinal cephalometric study. *Angle Orthod*., 1988;58:179–184.

Paola Gandinia; Marta Mancinib; Federico Andreani, 2006. A Comparison of Hand-wrist Bone and Cervical Vertebral Analyses in Measuring Skeletal Maturation, *Angle Orthodontist*, Vol 76, No 6.

Rajagopal SK. 2002. A comparison of modified MP3 stages and the cervical vertebrae as growth indicators. *J Clin Orthod*., 36:398–406

Rakosi T, Jonas I, Rateitschak KH. 1989. Farbatlantender Zahn-medizin: Kieferorthopaedie Diagnostik. Stuttgart, Germany: Georg Thieme Verlag.

San Roman P, Palma JC, Oteo MD, Nevado E. 2002. Skeletal maturation determined by cervical vertebrae development. *Eur J Orthod*., 24: 303-311.

Shally Mahajan, Evaluation of skeletal maturation by comparing the hand wrist radiograph and cervical vertebrae as seen in lateral cephalogram, *Indian Journal of Dental Research,* 22(2), 2011.

Tanner JM, Whitehouse RH, Cameron N, Marshall WA, Healy MJR, Goldstein H. 1983. Assessment of Skeletal Maturity and Prediction of Adult Height (TW2 Method). London, UK: Academic Press.

Tanner JM. 1962. Growth at Adolescence. 2nd ed. Oxford: Blackwell Scientific Publications.

Tiziano Baccetti, Lorenzo Franchi, James A. McNamara Jr, An Improved Version of the Cervical Vertebral Maturation (CVM) Method for the Assessment of Mandibular Growth, *Angle Orthodontist*, Vol 72, No 4, 2002.

Tofani M. 1972. Mandibular growth at puberty. *Am J Orthod*., 62: 176–194.

Torun O, Jalen DL, Senem YO. 2006. A practical method for determining pubertal growth spurt. *Am J Orthod Dentofacial Orthop*.,130:131–6.

Urban H, John T. 1982. Maturation indicators and the pubertal growth spurt. *Am J Orthod Dentofacial Orthop.,* 82:299–309.

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