

EVALUATION OF MANDIBULAR LENGTH IN SUBJECTS WITH CLASS I AND CLASS II SKELETAL PATTERNS USING THE CERVICAL VERTEBRAE MATURATION

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ABSTRACT

The prevention, interception, and correction of dentofacial deformities also depend largely on a proper understanding of craniofacial growth and development. For growth modification to be successful, it is absolutely essential that its start at the right time.

The aim of the present study was to assess mandibular size and cervical vertebrae maturation in subjects of both genders with Class I and Class II malocclusions.

A total 100 patients; 50 males and 50 females having skeletal class I and II malocclusion were included in the study. Mandibular length was measured in millimeter on lateral cephalograms of each patient. Cervical Vertebral Maturation staging was done according to Baccetti et al. The comparison of mandibular length among gender and class of malocclusion was done.

Out of total 100 patients half were males and half females. The age ranged from 8 to 15 years ± 1.97 . The commonest age range was 10-13 years. Mandibular lengths were greater in males from females in skeletal class I malocclusion whole no difference in skeletal class II. The longest length was in CS5.. Statistically significant difference was found in mandibular among the gender but not among class of malocclusion.

Key Word: *Class II malocclusions, Mandibular length, Cervical Vertebral Maturation staging.*

INTRODUCTION

Successful orthodontic diagnosis, treatment planning, and clinical procedures require a thorough understanding of growth and development.¹ The prevention, interception, and correction of dentofacial deformities also depend largely on a proper understanding of craniofacial growth and development. The craniofacial region is a dynamic biologic continuum that begins in embryonic development and continues through senility,² and its growth patterns are even more complex.³

Prior knowledge of the amount of growth remaining would be extremely useful for forecasting treatment outcome, taking advantage of growth when necessary and trying to minimize growth when undesirable.⁴ For growth modification to be successful, it is absolutely essential that its start at the right time. Optimal timing for treatment is different in various malocclusions.⁵

The classical and most widely used method for skeletal age evaluation which is the highly reliable is Hand-wrist radiograph analysis.⁶ However, this analysis involved extra radiation exposure for the patients. Currently, the cervical vertebrae investigation method has been increasing in use, since it avoids further exposure to ionizing radiation in addition to the routine radiographic records required for an orthodontic treatment.⁷ This method has proved effective in assessing the adolescent growth peak both in body height and mandibular size. The appraisal of the biological aspects of mandibular growth is of fundamental importance in dentofacial orthopedics, especially with regard to the use of functional appliances to correct Class II skeletal

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discrepancies.⁸ The evaluation of mandibular skeletal maturation and growth potential in the individual patient provides essential information for the anticipation of treatment results. It is well known that the growth rate of the human mandible is not constant throughout development. A peak in mandibular growth velocity (pubertal growth spurt) has been described in many previous cephalometric studies.^{9,10} The intensity, onset, and duration of the pubertal peak in mandibular growth are characterized by great individual variations.⁸

Class II malocclusion is a commonly observed malocclusion, in many population.¹¹ Despite the substantial prevalence of Class II malocclusion as an orthodontic problem, review of the related literature showed no agreement for growth changes of the mandible in untreated subjects with Class II malocclusion, when compared with subjects with normal occlusion. Maria and co-workers¹² reported the relationship of cervical vertebral maturation and mandibular growth changes by assessing in annual lateral cephalometric radiographs of thirteen Caucasian females from 9 to 15 years of age. Statistically significant increases were found in mandibular length, corpus length and ramus height are associated with specific maturation stages in the cervical vertebrae. Stahl and colleagues¹³ carried out a longitudinal study to compare the craniofacial growth changes in untreated subjects with Class II Division 1 malocclusion with those in subjects with normal (Class I) occlusion from the prepubertal through the postpubertal stages of development, as defined by a biological indicator of craniofacial growth in subjects with untreated Class II malocclusion was essentially similar to that in untreated subjects with normal occlusion at all developmental intervals, with the exception of significantly smaller increases in mandibular length ($P < 0.001$) at the growth spurt (interval CS3-CS4) and during the overall observation period (intervals CS1-CS6). In contrast, Bisara¹⁴ found no difference in mandibular growth in Class II subjects from the deciduous dentition through the permanent dentition. However, the results in most of these studies were based on longitudinal growth changes related to the subjects' chronologic ages or the dentition stages, which according to many authors, are not reliable predictors.

The aim of the present study was to assess mandibular size and cervical vertebrae maturation in subjects of both genders with Class I and class II malocclusions.

METHODOLOGY

This cross-sectional study was undertaken in the Orthodontic Department, Khyber College of Dentistry, Peshawar from January 2014 to November 2014. A total 100 cephalometric radiographs were obtained from record of the department. Lateral cephalometric

radiograph of each individual was taken with a universal counter balancing type of cephalostat at Radiology Department of Khyber College of Dentistry, Peshawar. Kodak' X-ray films (10 × 12") were exposed to 70 KVP, 10 mA for an average of 1.8 sec, with a tube to film distance of 6 feet. All lateral cephalograms were placed on illuminator and determination of CVM stages were done by two examiners.

Cervical vertebral maturation staging (CVMS) was evaluated on lateral cephalometric radiographs, according to the method described by Baccetti et al.¹⁵ This method has been proved useful in the evaluation of skeletal maturation in a single cephalogram. This method analyzes the morphology of the second (C2), third (C3), and fourth (C4) cervical vertebrae and the patient is classified into one of six stages; CVMS I, CVMS II, CVMS III, CVMS IV, CVMS V and CVMS VI which are given below.

Stage 1 (Initiation): Great amount of pubertal growth expected (80 to 100 %). Inferior borders of C2, C3 and C4 are flat at this stage. The vertebrae are wedge shaped, and the superior vertebral borders are tapered from posterior to anterior.

Stage 2 (Acceleration): Growth acceleration begins at this stage. Significant pubertal growth expected (65% to 85%). Concavities are developing in the inferior borders of C2. The inferior border of C3 and C4 is flat. The bodies of C3 and C4 are trapezoidal in shape.

Stage 3 (Transition): Moderate pubertal growth expected (25% to 65%). Distinct concavities are seen in the inferior borders of C2 and C3. A concavity is beginning to develop in the inferior border of C4. At least one of C3 or C4 bodies still retains a trapezoidal shape.

Stage 4 (Deceleration): Reduced expectation of pubertal growth (10 to 25%). Distinct concavities are seen in the inferior borders of C2, C3 and C4. The vertebral bodies of C3 and C4 are rectangular horizontal in shape.

Stage 5 (Maturation): Final maturation of the vertebrae took place during this stage. Insignificant pubertal growth expected (5 to 10%). More accentuated concavities are seen in the inferior borders of C2, C3 and C4. The bodies of C3 and C4 are square in shape.

Stage 6 (Completion): Pubertal growth completed at this stage (little or no growth expected) Deep concavities are seen in inferior border of C2, C3 and C4. The bodies of C3 and C4 are square or are greater in vertical dimension than in horizontal dimension. Sampling was performed according to the convenient sampling method.

The inclusion criteria were:

- Pakistani Nationality
- Both genders
- No systemic disease that could affect general development like hormonal diseases
- Age range from 8 to 15 years
- Lateral cephalometric radiographs available with high clarity
- No history of trauma or surgery in the neck or dentofacial region.

- No orthodontic treatment at the time of study

All the participants were divided in Class I or Class II skeletal patterns, according to the ANB angle and WITS appraisal. Class II subjects had the ANB angle greater than 4° and the linear distance between AO and BO (WITS appraisal) greater than 1 mm. Class I subjects had the ANB angle between 0 and 4°, with normal distance between AO and BO (-1 to 1 mm). The Class I sample consisted of 50 subjects (25 males, 25 females). The Class II sample also consisted of 50 subjects (25 males, 25 females). This study was approved by ethical committee of Khyber hospital.

TABLE 1: AGE DISTRIBUTION OF PATIENTS

| Age (years) | Frequency | Percent |
|-------------|-----------|---------|
| 8 | 4 | 4.0 |
| 9 | 10 | 10.0 |
| 10 | 13 | 13.0 |
| 11 | 14 | 14.0 |
| 12 | 17 | 17.0 |
| 13 | 14 | 14.0 |
| 14 | 20 | 20.0 |
| 15 | 8 | 8.0 |
| Total | 100 | 100.0 |

Total mandibular length from Condylion to gnathion (Co-Gn) was measured on Cephalograms traced by 1 investigator and verified for landmark location and anatomical contours by another. To examine the intra-observer reliability, 20 subjects were reevaluated by both methods. The agreement was assessed by weighted kappa statistics. Kappa was (0.87 ± 0.07) for determination of tooth calcification stages and (0.94 ± 0.09) for cervical maturation. The results revealed that the reproducibility of the diagnosis in our rater was almost perfect. All assessments were performed in a darkened room with a radiographic illuminator to ensure contrast enhancement of the bone images.

TABLE 2: MANDIBULAR LENGTH AMONG SKELETAL CLASS I AND II

| | | Class of Malocclusion | | | | | | | |
|-------------|--------|-----------------------|----|---------|---------|-------------------|---|---------|---------|
| | | Class I | | | | Class II | | | |
| | | Mandibular Length | | | | Mandibular Length | | | |
| CVM staging | Gender | Mean | n | Maximum | Minimum | Mean | n | Maximum | Minimum |
| CS1 | Male | | | | | | | | |
| | Female | 77.00±11.31 | 2 | 85.00 | 69.00 | 92.67±4.51 | 3 | 97.00 | 88.00 |
| CS2 | Male | 97.33±2.08 | 3 | 99.00 | 95.00 | 96.50±9.90 | 8 | 114.00 | 80.00 |
| | Female | 88.00±12.29 | 7 | 105.00 | 72.00 | 88.75±4.86 | 8 | 98.00 | 84.00 |
| CS3 | Male | 106.75±8.54 | 4 | 112.00 | 94.00 | 101.33±4.13 | 6 | 105.00 | 96.00 |
| | Female | 90.00±8.53 | 6 | 99.00 | 78.00 | 88.75±4.43 | 4 | 93.00 | 84.00 |
| CS4 | Male | 108.70±6.93 | 10 | 119.00 | 96.00 | 96.67±12.22 | 3 | 110.00 | 86.00 |
| | Female | 92.11±8.30 | 9 | 104.00 | 76.00 | 91.25±5.62 | 4 | 96.00 | 85.00 |
| CS5 | Male | 113.00±3.46 | 3 | 115.00 | 109.00 | 96.00±0.0 | 1 | 96.00 | 96.00 |
| | Female | 121.00±0.00 | 1 | 121.00 | 121.00 | 110.17±9.75 | 6 | 119.00 | 93.00 |

TABLE 3: COMPARISON OF MANDIBULAR LENGTH BY GENDER AND CLASS OF MALOCCLUSION

| Test values | Mandibular length among gender | Test values | mandibular length among malocclusion group |
|-------------------------|--------------------------------|-------------------------|--|
| Chi-Square ^b | 9.285 | Chi-Square ^c | 2.21 |
| Df | 1 | Df | 1 |
| Asymp. Sig. | 0.002 | Asymp. Sig. | 0.137 |

RESULTS

Out of total 100 patients 50(50%) were males and 50(50%) females. The age ranged from 8 to 15 years ± 1.97 . The common age rang was 10-13 years (Table 1) Mandibular lengths were greater in males from females in skeletal class I malocclusion whole no difference in skeletal class II. The longest length was in CS5. (Table 2). Statistically significant difference was found in mandibular length amongst the gender but not amongst various classes of malocclusion.(Table 3).

DISCUSSION

Serial headfilms have been used by many researchers to evaluate human mandibular growth, with the analysis typically based on regional superimposition of serial lateral cephalograms on stable anatomical structures. The sequential growth and remodeling of the mandible in children has been of interest due to its important role in orthodontic treatment.¹⁶ An understanding of the normal growth processes enables us to differentiate the effects of orthodontic and orthopedic treatments from the changes occurring during normal growth and development.¹⁷

In orthodontics and dentofacial orthopedics, each patient's skeletal maturation period is an important factor to be considered in order to better take advantage of his/her growth potential. In recent years, many authors have supported the efficacy of the cervical vertebrae analysis to assess skeletal age, which would represent a valid instrument to calculate the speed of growth and skeletal maturation.¹⁸⁻²¹ in the current study, we use CVM for evaluation of mandibular length in skeletal class I and II patients.

In the current study mandibular length showing no statistically difference between the skeletal class I and II with p-value= 0.137. Stahl et al²² compared the longitudinal craniofacial growth changes in untreated subjects with Class II malocclusion with those in subjects with normal occlusion from the prepubertal through the postpubertal stages of development, as defined by the cervical vertebrae maturation method. These authors found that the deficiency in mandibular growth in Class II subjects is significant not only at the growth spurt, but that it is also maintained at a postpubertal observation. The present study is cross-sectional as opposed to Stahl et al²², whose result are not in accordance with the present study. Ethnic factors, small sample size, and cross-sectional study design may be responsible for variation in the results. Other factors which are responsible for class II other than mandibular length; are vertical rotation of mandible²³ and position of condyle in glenoid fossa.²⁴

Sexual dimorphism was found in skeletal class I and not in skeletal class II. Generoso et al²⁵ conducted

a study to Evaluation of mandibular length in subjects with Class I and Class II skeletal patterns using the cervical vertebrae maturation on 80 skeletal class I and 80 skeletal class II with equal males and female in each malocclusion group. The mandibular length differed between skeletal patterns only at the earlier stages of development. In the Class I pattern, the mandibular lengths of boys were greater than those of girls at stages CS2, CS4 and CS5, whereas in the Class II pattern, the mandibular lengths of boys were greater than those of girls at stages CS2, CS3 and CS4. The present results indicate a sexual dimorphism in the mandibular length at almost all stages of bone maturation, in exception of the CS5 stage in Class II. In skeletal class I the current results are supported by Generoso et al but show variation in skeletal class II.

Bishara et al²⁶ in a study compared longitudinally the changes that occur in dentofacial structures from the deciduous to the permanent dentitions in untreated Class II division 1 and normal individuals. Sixty five subjects at three stages of development: at the completion of the deciduous dentition, after the first permanent molars had erupted completely, and after the permanent dentition had erupted completely (third molars excluded) were assessed. On a cross-sectional basis, only mandibular length (Ar-Pog) differed significantly in the two groups, and then only during the earlier stages of development; by the later stage, the difference was not significant, indicating that some "catch up" growth may occur in Class II individuals. Longitudinal comparisons of the curve profiles, i.e., growth trends between Class II division 1 and normal subjects, indicated that there were no significant differences between the two groups except in upper lip protrusion. Comparisons of the total change from the deciduous to the permanent dentition indicated the presence of a number of significant differences between Class II division 1 and normal subjects, including larger magnitude of maxillary and mandibular lengths in the normal group and greater skeletal and soft tissue convexities in the Class II group. no difference was found in between class I and class II patients in the current study.

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