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Original Research Article

Reliability of Point M as landmark for analysis of sagittal relation of maxilla

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ABSTRACT

Introduction: Most of the several cephalometric analyses used for the diagnosis of sagittal dysplasia, Point A is the most widely used indicator for ascertaining of maxillary position. By the virtue of difficulty in locating point A in many cases, alternative methods had been proposed for precise location of point A but there are only few studies on the reliability of these alternative points. Point M is one such indicator for evaluating the sagittal position of maxilla. The objective of this study is to measure and compare the reliability of point A and point M.

Materials and Methods: Lateral cephalogram of 50 subjects (11-20 years) were included in the study consisting of all types of skeletal malocclusions. Point A and point M were identified by two different group of orthodontists. Linear and angular measurements through both the points were analysed and compared between the observers using interclass correlation.

Results: Interclass correlation coefficient of linear and angular parameters of point M was found to be higher than point A.

Conclusion: Point M may be considered as more reliable alternative for point A in two dimensional cephalometric analysis.

1. Introduction

The identification of cephalometric landmarks is an inevitable process for diagnostic and prognostic evaluation of orthodontic treatment. Thus, precise quantification and determining the anomaly in all three dimensions for various dentofacial discrepancies forms a baseline of satisfactory orthodontic treatment execution. Several cephalometric landmarks in linear and angular measurements are used for the determination of the maxillomandibular relationship in vertical, sagittal and transverse plane.

Plethora of indicators have been advocated in the literature to evaluate sagittal discrepancy. However, among all the analysis indicating sagittal dysplasia of maxilla, point A is the most widely used indicator of maxillary position. Point A was introduced by Downs as the deepest point on the alveolar projection between ANS and prosthion.[1] Later many cephalometric parameters have used point A as the basis of analysis such as - A-B plane angle, 'a' plane, AXD angle, A-D' distance, Quadrilateral analysis, WITS appraisal, AB linear distance, Anteroposterior Dysplasia indicator (APDI), maxillomandibular differential, AF-BF distance, Beta angle and APP-BPP distance.[2–7]

There is ambiguity in locating point A in many cases which resulted in various alternatives for point A as has been described by Jacobson, Tindlund and Bongaarts.[8–10] Moreover, point A being a maxillary dentoalveolar cephalometric landmark is influenced by upper incisor inclination and tends to change with proclination and retroclination.[11] Thus, the erroneous reproducibility of point A and eventual incorrect sagittal positioning of

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maxilla with respect to cranial base need to be reassessed and an alternative landmark need to found for easy identification and higher reproducibility for positioning the maxilla in sagittal dimension.

Nanda et al introduced Point M which is a cephalometric landmark in the premaxilla and is located as the midpoint of the circle that best fits within the superior, anterior and inferior walls of premaxilla.[12] Point M has been utilised in W angle, Pi analysis and Yen angle.[13–15] This point unlike point A is not a dentoalveolar landmark hence is unlikely to be influenced]from orthodontic tooth movement.Therefore, the present study aims to compare the reproducibility of point A and point M.

2. Materials and Methods

This cross sectional study was reported as per guidelines for reporting reliability and agreement studies (GRRAS). Ethical approval for the study was taken from the Institutional Ethical Committee. Pretreatment lateral cephalogram of patients who reported for seeking orthodontic treatment were retrieved from departmental archives of a tertiary care government dental hospital and research centre. The sample size of 50 was calculated on the basis of a small pilot study on 10 samples and also on assumption made from the existing literature with power of 85 % with 95% confidence interval. Pre treatment records of 65 subjects with good quality of radiographs were retrieved initially and exclusion criteria such as any history of maxillofacial trauma or pathology, syndromic cases or presence of any supernumerary teeth in maxillary anterior region were applied. Finally, 50 records were selected as samples for the study which included records of 18 males and 32 females.

All lateral cephalograms were obtained by a trained radiographer under standard conditions. Operating parameters were set at 3mA, 90KV, dose of 80-100 μSV and a scan time of 4.6 sec. The cephalograms were digitally printed after resizing to 1:1 magnification using a 2400 dpi colour laser printer (Model - DryPro Sigma, Serial No. 08987 Konica Minolta, Osaka, Japan). Radiographs obtained were manually traced by two group of investigators over an x ray view box using an acetate tracing sheet of thickness 0.003 with a 3H pencil. Group I consisted of two orthodontic senior residents and Group II consisted of two orthodontic faculties of more than 10 of clinical experience. Table 1 shows the various landmarks and parameters analysed in the study.

The landmarks were traced manually by both the groups and linear and angular measurements were recorded in the MS Excel spreadsheet. The inter observer reliability was analysed using Interclass correlation coefficient (ICC). The measurements were repeated at an interval of 2 weeks by both the group of investigators to rule out intra observer bias. The intra-class correlation analysis for all the parameters had significant values of 0.99, indicating statistically significantly intra-observer agreement for the various parameters.

Table 1: Landmarks and parameters used in the study

Landmark	Description
Point A	The most posterior midline point in the concavity between the ANS and the prosthion
Point M	Midpoint of premaxilla in the midsagittal plane. It is located according to the superior, anterior and palatal outlines of the premaxilla and midpoint is identified with concentric circles that best fit the outline of premaxilla.
N (Nasion)	The most anterior point on the frontonasal suture in the midsagittal plane
Or (Orbitale)	The lowest point on the inferior rim of the orbit
Po (Porion)	The most superiorly positioned point of the external auditory meatus located by using the ear rods of the cephalostat (mechanical Po)
SNA	Angular measurement between SN plane and point A
SNM	Angular measurement between SN plane and point M
A to N perpendicular	Projection of Point A to N perpendicular line
M to N perpendicular	Projection of point M to N perpendicular line

2.1. Statistical analysis

Statistical analysis was performed with Microsoft Excel 2010 (Microsoft corp, Redmond, USA) IBM Statistical Package for Social Studies (SPSS version 23.0 IBM, New York, USA) for Microsoft windows. The parameters SNA, SNM, A to N perpendicular and M to N perpendicular measured by the two group of investigators were subjected to Interclass correlation coefficient (ICC) with 95% confidence interval and a level of significance of 0.05.

3. Results

The inter-class correlation (ICC) analysis for angular parameter SNA and SNM showed highly significant values of 0.939 (p=0.005) and 0.991 (p= 0.005) respectively. The linear parameter including A to N perpendicular and M to N perpendicular also had a highly significant correlation of 0.911 (p=0.005) and 0.985 (p=0.005) respectively. The statistical evaluation is summarized in Table 2.

4. Discussion

Point A or subspinale was introduced by Downs in 1948.[1] Since then, Point A has been utilised in many cephalometric analysis for assessment of spatial position of maxilla. SNA

Table 2: Statistical evaluation

Parameters	ICC	95% Confidence interval		F test with true value
SNA	0.939	Lower Bound	Upper Bound	0.005**
		0.892	0.965	
SNM	0.991	Lower Bound	Upper Bound	0.005**
		0.984	0.995	
A to N vertical	0.911	Lower Bound	Upper Bound	0.005**
		0.843	0.949	
M to N vertical	0.985	Lower Bound	Upper Bound	0.005**
		0.973	0.991	

**p ≤ 0.005 (highly significant)

angle, A to N perpendicular plane have been used as a maxillary anteroposterior dysplasia indicator. However, at times locating point A on the cephalogram is difficult due to overshadows of soft tissues, conflicting anatomical details of the region and conceptual judgement of locating the landmark. Point A is the deepest point on the alveolar projection between ANS and Prosthion and is influenced by the head position. Hence, many alternatives to point A have been described in the literature. Linden V[16] suggested the use of point L which is located on the anterior surface of image of labial lamella at the region of apex of maxillary incisors. Authors have redefined point A for its better localisation by using various means. Jaraback and Fizell[17] identified a point 2 mm ahead of the root apex as a redefinition of point A. Jacobson[8] had introduced Point A revisited which takes Point A as 3 mm labial to a point between upper third and lower two third of long axis of root of maxillary central incisor. Later, Tindlund[9] suggested point A alternative as the intersection between a line parallel to the palatal plane, 7 mm below, and the anterior contour of the maxilla Point A alternative 2 while Bongaarts[10] suggested alternative to be a projection of point prosthion on a line parallel to the palatal plane 7mm below the palatal plane. Despite of the introduction of these alternatives for point A, they are underutilized and subspinale as introduced by Downs is still the most commonly used landmark over its newer alternatives.

Although Point A has been suggestive of position of maxilla however, it is a dentoalveolar landmark which is influenced by orthodontic tooth movement such as retroclination or proclination of maxillary incisor teeth thus even though maxillary position being unchanged Point A would change following orthodontic correction of upper incisors.[11] Therefore, a more stable landmark representative of maxillary position is required. Nanda et al.[12] introduced point M which is located in the geometric centre of premaxilla. Point M is easy to be located in the lateral cephalogram. Thus in the present study, reliability of point M has been compared to point A.

The present study intends to the evaluate and compare the reproducibility of the location of two cephalometric landmarks i.e. point A and M. Therefore, two angular and two linear parameters were selected for measurements. The two groups in the present study comprised of senior residents with minimal experience of one year in Orthodontic department and group of experienced orthodontists with more than 10 years of clinical experience. Although the interobserver reliability for both the linear and angular parameters measured by both the groups were highly significant but all the parameters measured with respect to M point showed more reliability compared to the parameters measures with A point as reference.

Further, no literature reviews could be found for norms being established for various cephalometric parameters with respect to M point as reference. Therefore, keeping in view of the findings of the present study the authors recommend for making norms for SNM and M to N perpendicular for population groups with varied ethnicity and race.

5. Conclusion

Point M is found to be more reliable cephalometric landmark than point A for both linear and angular two dimensional cephalometric analysis.

6. Source of Funding

None.

7. Conflict of Interest

None.

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