A Critical Evaluation of Cephalometric "A" Point and Proposal of a More Significant Landmark

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INTRODUCTION

Cephalometric evaluation of patients has become an essential adjunct to a complete and accurate orthodontic diagnosis and treatment plan. To the practitioner and researcher the value of cephalometrics can be no greater than the accuracy of locating cranial landmarks on the cephalometric film in all stages of development by all investigators.

One of the cranial landmarks common to many cephalometric analyses is the "A" point, or subspinale. Many investigators have utilized "A" point as one of the essential landmarks in their analyses.[1-8] The exact location and definition of this point, however, has been the subject of considerable controversy; its anatomical definition is not universally acceptable, nor is its location universally specific.

The purpose of this investigation was to evaluate some of the present concepts concerning the location and definition of "A" point. In accordance with current cephalometric procedures, films of orthodontic patients and dried skulls were utilized for this study, and a method for accurate location and superimposition of a new landmark is described.

MATERIALS AND METHODS

In this investigation twenty-five dried skulls were used, the majority of which had adult dentitions. Only those skulls in which the left maxillary central incisor tooth was present were utilized. Studies were conducted on fifteen children whose ages ranged from 9 to 13 years, all of whom had the maxillary central incisor teeth in position. Fifteen pre and posttreatment records were studied to demonstrate and define a new concept for the location of maxillary anterior apical base.

To outline the profile of the midline of the maxilla, a strip of aluminum dry foil approximately two millimeters wide and twenty millimeters long was moistened and attached to each dried skull. The strip of foil extended from the tip of the anterior nasal spine downward to prosthion. By means of transparent tape a thirty-gauge needle was fixed in contact with the bone directly over the root of the maxillary left central incisor tooth. The needle extended well over the apex, thus outlining the bony covering over the tooth. The skull was placed in the cephalostat and a lateral radiograph was taken. This same procedure was utilized for each of the dried skulls (Fig. 1).

Each of the children was seated and positioned in the cephalostat after the area of the left central incisor was anesthetized. A thirty-gauge needle attached to a metal syringe was inserted into the mucobuccal fold over the left central incisor tooth at an angle of approximately 60 degrees to the long axis of the tooth. Each subject was instructed to hold the syringe and press

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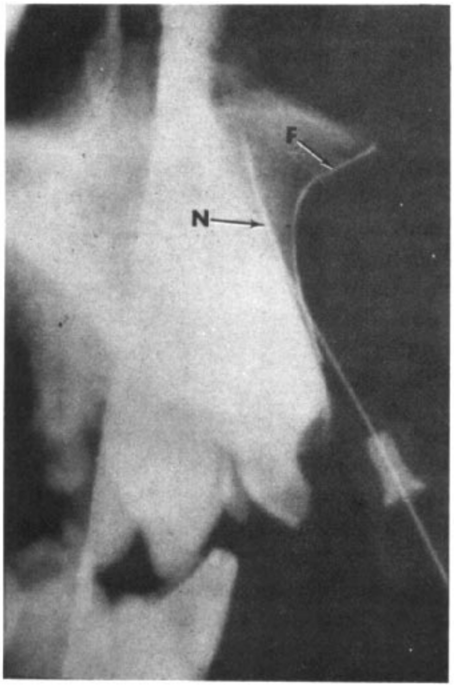


Fig. 1 Dried skull film with needle (N) and foil (F) in place.

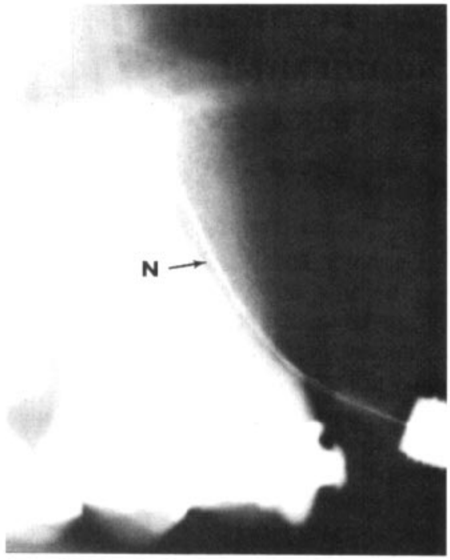


Fig. 2 Child's film with needle (N) in place.

it toward himself while keeping the needle in position to assure contact of the needle against the bone in this area. The labial bone over the central incisor was thus demarcated after which a lateral cephalograph was taken (Fig. 2).

Each lateral cephalometric x-ray film was examined on a viewer. On the films of the dried skulls the distance between the needle and the most anterior portion of the central incisor root was measured. This was an indication of the amount of alveolar bone covering the incisor root labially. The position and the course of the needle was noted. The relationship between the deepest incurvation on the outline of the foil strip and the closest point on the needle outline was also measured.

The same procedure was repeated on the films of the children but, since the foil strip was not employed, a measurement was made between the deepest incurvation on the shadow of bone located below ANS and the closest point on the outline of the needle.

Landmarks

Familiar landmarks such as a nasion, ANS, PNS and point A were used as well as point TA, a point located one millimeter anterior to the central incisor root on a parallel from point A to the ANS-PNS plane, and point S, the point of intersection on the ANS-PNS plane of a perpendicular from point TA.

Angle ANS, the angle formed at point ANS by the intersection of the ANS-PNS plane line and a line from point TA to ANS, and S-ANS, the distance in millimeters between point S and point ANS, were measured on each film.

Utilizing the pretreatment cephalometric films, the landmark specified as TA point was determined in the following manner: the palatal

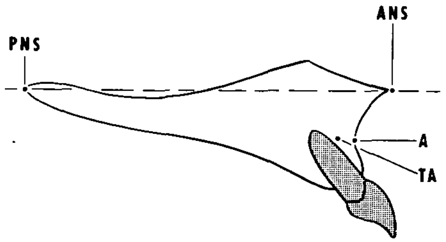


Fig. 3 Palatal plane and landmarks.

plane was drawn, and point A (according to Downs) was located by inspection and marked. On a line paralleling the ANS-PNS plane through point A, a mark was placed one millimeter anterior to the root of the maxillary central incisor tooth. This mark was designated TA point (Fig. 3). A perpendicular was drawn from TA to the ANS-PNS plane intersecting at S′ (TA-S′). A third line was scribed between the tip of the anterior nasal spine and TA point forming a triangle (TA-S′-ANS). The length in millimeters of S′-ANS was recorded, as was the angle in degree at ANS (Fig. 4). This triangle located accurately in distance and direction point TA in relation to ANS.

The posttreatment lateral cephalic x-ray film of the same patient was then examined on the viewer. The triangle (TA-S′-ANS) formed on the original film was transposed to the second film

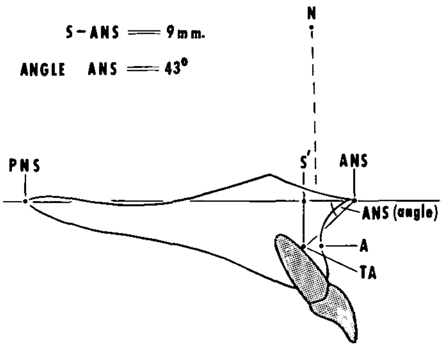


Fig. 4 Pretreatment tracing with triangle and measurements.

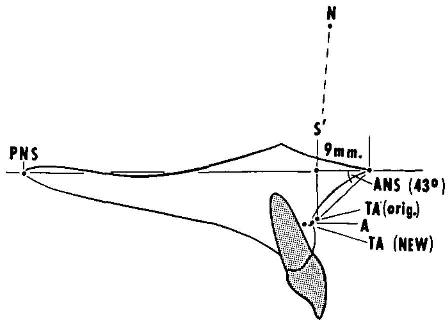


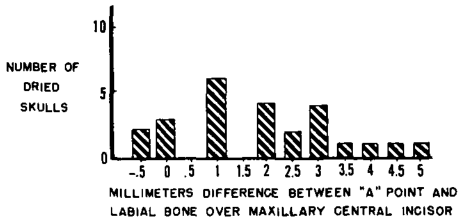
Fig. 5 Posttreatment tracing with superimposed triangle.

and superimposed at ANS with the leg S′-ANS upon the palatal plane. This located the original TA point on the posttreatment film. The after-treatment TA point was then determined and the difference between the two points indicated change due to treatment or growth (Fig. 5).

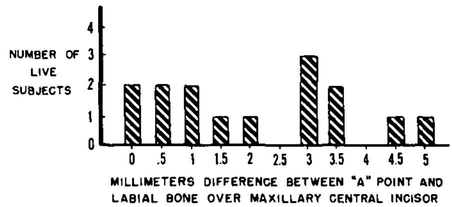
Findings

One of the objectives of this investigation was to determine a possible relationship between a midline A point and an A point over the central incisor tooth. This study demonstrated that there was no correlation between the two points. Using the films of dried skulls, the distance between the thirty-gauge needle and the strip of dry foil varied from minus .5 millimeters (the needle was anterior to the foil) to 5 millimeters (the needle was posterior to the foil). An evaluation of the measurements is shown in Graph 1. The position and course of the needle demonstrated the fact that there was no curvature of bone in the area directly over and above the apex of the maxillary central incisor tooth. The position of the needle also demonstrated an average of 0.92 millimeters of bone covering the labial surface of the root of the central incisor tooth. These findings are illustrated in Graph 2—right.

The lateral cephalic x-ray films of



Graph 1 Distribution of labial bone, A point differences in dried skulls.



Graph 3 Distribution of labial bone, A point differences in children.

the children again demonstrated no constant relationship between the two A points. The distance between the two points ranged from 0 to 5 millimeters, as seen in Graph 3 which shows the individual measurements. The position and course of the thirty-gauge needle indicated no curve in the bone over and above the root of the central incisor tooth. The thickness of labial bone over the maxillary central incisor teeth averaged 1.13 millimeters. These findings are illustrated in Graph 2—left.

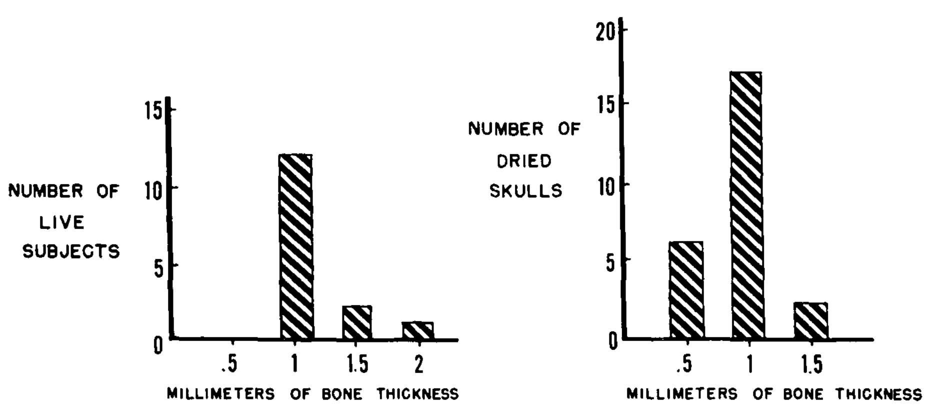
By using the method of superimposition described, movement of point TA during treatment was shown clearly, and on each of the fifteen cases the distance could be measured accurately.

Discussion

A controversy exists in locating A point at either the midline or labial to the root of the maxillary central incisor tooth. One of the purposes of the present study was to investigate the shape and position of the labial bone covering the incisor tooth, as well as the thickness of this bone.

The original definition of point A by Downs,[1] and many definitions subsequent to his, stressed the fact that A point was a *midline* landmark. It was also stressed that it was located at the deepest point on a curve. From visual examination of dried skulls and their lateral cephalometric x-ray films with the needle outlining the anterior limit of bone over the maxillary central incisor, it was readily apparent that no crescent-shaped curve occurred in the area directly over the incisor tooth. The evaluation of lateral films of orthodontic patients disclosed this same fact; a point at the deepest part of an incurvation did not, in fact, exist.

The various definitions further stated



Graph 2 Distribution of incisal labial bone thickness in children and skulls.

that point A was the demarcation between basal and alveolar bone. Here again it would be impossible to locate this junction except in the midline, because there is no actual demarcation over the central incisor teeth discernible in a lateral roentgenogram. Howes[9] used a point opposite the root apex, but this really could not delineate between basal and alveolar bone.

In spite of attempts to locate point A away from the midline, the fact remains that true A point must be located on the lateral cephalogram in the midline and at the deepest point of the curvature.

Utilization of Point A

According to definition, point A represents the inferior limit of basal bone in the maxilla. Since orthodontic treatment is considered to have no effect on basal bone, this point should not be subject to change as the result of treatment. Therefore, the change in position of point A with the accompanying reduction of the SNA angle must be due to growth at nasion or the usage of a point that is not valid. The desirability of obtaining a therapeutic change in A point probably is a major reason for its shifting orientation and location.

It is desirable, however, to obtain a landmark denoting the approximate limit of bone anterior to the root of the maxillary central incisor tooth. This point would be useful in the various cephalometric analyses since it would essentially follow the movement of the central incisor teeth and thus denote change during treatment. The authors have developed such a landmark, naming it the Tufts A Point (TA Point). The formulation of TA point was based on several factors:

1) The research described in this paper indicated that, in the majority of dried skulls and children examined, the thickness of bone labial to the maxillary central incisor tooth was approximately one millimeter.
2) Howes[9] also stated that he rarely found more than 1.5 millimeters of bone labial to the maxillary central incisor teeth.
3) In a discussion concerning the various A points, Graber[10] suggested that it might be worthwhile to take into consideration both a midline A point and another one over the central incisor teeth.

The formulation of TA began by locating A point by inspection. Then, in a plane from A parallel to the ANS-PNS plane, a point was marked one millimeter anterior to the root surface of the most anterior maxillary central incisor tooth (Fig. 3). Point A was used to orient the relative height of TA point. This was in harmony with Graber's suggestion of relating one to the other.

Superimposition

Since one of the main purposes of any cephalometric landmark is to demonstrate consistency or movement of position over a period of time, it was necessary to develop a method of superimposition that would not be invalidated by normal growth changes. The tip of the anterior nasal spine (ANS) was chosen in conjunction with a plane drawn from the posterior nasal spine to the anterior nasal spine. Although it has been argued that the tip of ANS frequently is obscured or indiscernible on many cephalometric films, it was not detrimental to this new procedure. Since the serial x-rays were taken with the same equipment and exposures, if a portion were "burned out" in the first film, it would repeatedly be burned out in all the films. Unless the exposure were changed, which is unlikely in a practitioner's office, the results should be constant. Consequently, the measurement S-ANS (Fig. 4) was taken from the most anterior point of the anterior nasal spine that was recognizable, and should be the same in subsequent films. Actual superimposition of the films themselves was not necessary, since the original TA point could be measured and transposed to the posttreatment film without tracing the original film.

Summary

The cephalometric landmark, point A, was investigated with regard to definition, location, and usefulness in cephalometric analyses.

Lateral cephalometric films of twenty-five dried skulls and fifteen children were studied, all having at least one maxillary central incisor in position. A thirty-gauge needle was used to outline the contour of bone covering the root of the maxillary central incisor, and on the dried skulls a fine strip of aluminum dry foil outlined the midline of the maxilla below ANS. The contour and thickness of bone over the incisor was noted, and the difference between the midline A point as defined by Downs[1] and the nearest point on the needle was measured.

From the contour and position of bone covering the root of the incisor, it was concluded that it would be impossible to locate (by inspection of a cephalometric film) any landmark on this bone. It was also shown that the midline A point and the bone over the incisor bore no relationship to each other. Therefore, only the A point as defined by Downs may actually be located by inspection on a lateral cephalometric film.

Since it is desirable to find a landmark in this area which would more readily demonstrate change due to therapy, a new landmark, designated as TA point, was formulated. The location of this point was based on the average thickness of bone over the maxillary central incisor root, the position of A and the utilization of the palatal plane for reference. Also, a method for superimposition of TA point was demonstrated on tracings using fifteen pre- and posttreatment records.

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