The Cephalometric prediction: Limitations and considrations

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Abstract

In recent years, more adults are seeking orthodontic treatment for esthetic reasons. This has resulted in more orthognathic surgery that is performed to correct skeletal discrepancies in severe malocclusion producing a better quality of life. For this reason orthodontists need a method of rapidly and accurately predicting the results of treatment plans. The aim of this article is a review about the different methods and approaches in presurgical prediction and some considerations about it. The presurgical prediction can be accomplished manually or by a computer. First time Schendel et al.[1] employed computer system for the analysis of pre- and postoperative soft tissue profiles. Since then, many clinicians use computers for diagnosis, treatment planning and growth prediction.[2,3]

Like all manual cephalometric tracings, computer digitization is prone to errors.[4]

Several programs have been presented for prediction such as Quick Ceph Image Pro[5],Dolphin Imaging (Canoga Park CA), Dentofacial Planner [6], Vistadent AT (GAC International) [7], TIOPS™ [8], COGSOFT [9], CASSOS10. The amount of differences by digital tracing was less than the reported errors obtained in manual cephalometric tracings.[4,11]

For any prediction method it is essential to evaluate the correlations between soft tissue and hard tissue changes in different directions.

In mandibular advancement most authors predict a 1:1 ratio for the soft tissue chin advancement with the movement of the hard tissue chin with strong correlations. [11-12] However; the results has been reported for the correlation between advancement of the lower lip, measured from the lower incisor tip to labrale inferius, and

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mandibular advancement are variable. The investigations have reported relationships ranging from a high coordination of 0.8:1 to a low of only 0.26:1.[11-14]

In maxillary advancement, the studies have reported variable results about soft tissue reaction of the upper lip and nose to the surgical process. Several authors [15-17] have reported that the nose tip, nasal base, upper lip, and the nasolabial angle response to surgical advancement of the maxilla. However all authors expressed that, the results are in fact variable. McCollum et al 18 showed that a strong correlation exists between the movement at the labrale superius and upper incisor tip. This correlation was reported as a ratio of 0.55:1. Subnasale responded at a ratio of 0.52:1 and anterior nasal tip responded at a ratio of 0.26:1 relative to upper incisor. In the vertical plane, Carlotti et al 19 found when the maxilla is advanced, in conjunction with a V–Y soft-tissue lip closure technique and an alar base cinch, the upper lip length increased by a mean of 1.8 mm. Maxillary impaction and mandibular auto rotation alter chin and lower lip position. Some authors expressed that the soft tissue of the chin closely follows the mandible in the horizontal dimension, with a1:1 ratio between soft-tissue and hard tissue pogonion.[11] In the vertical dimension, Radney20 found that only a moderate correlation exists between the soft-tissue and the hard-tissue chin, but Mansour et al 21 found that the soft-tissue menton changed more than hard-tissue menton. McCollum et al 22 reported a ratio of 0.9:1 for the response of the soft-tissue contours of the chin to hard tissue changes in the horizontal plane. In the vertical dimension, although the correlation between soft tissue and hard tissue gnathion is at a ratio of 0.9:1, but soft-tissue menton responded to hard-tissue menton at a ratio of 1:1. The lower lip in the horizontal dimension responded at a ratio of 1:1 with the lower incisor tip. Also in the vertical dimension, stomion inferius followed lower incisor tip at 1:1 ratio.

Some authors who have reported poorer correlations between lower lip and underlying hard tissue concluded that accurate prediction of the lower lip was difficult perhaps due to differences in muscle tone pre- and postsurgery.[20,21]

The prediction can be oriented by hard tissue changes and after this, soft tissue changes be predicted. This is a traditional approach. Obviously, the traditional hard tissue analyses are not diagnostical 22 because the soft-tissue profile of a patient is not necessarily a reflection of the relationships of the underlying hard tissues.23,24 For this reason, some authors considered variable cpoints to design alternative methods. Holdaway determined the most desirable position of the upper lip first then adjusting the upper incisor teeth. [25, 26] Many authors, such as Fish and Epker [27] or Wolford 28 have designed methods for a more accurate prediction. In general, planning has been based on first determining where to surgically position the jaws and teeth and then adapting the soft tissue with the new jaw positions.

Arnett and Bergman [29, 30] emphasized the importance of a comprehensive soft-tissue evaluation of the patient and stressed that the orthodontist should correctly place the lower incisor teeth before the surgery. This ideal position usually defined as having the long axis at right angles to the mandibular plane.

Following the studies of Burstone [31] and other investigators [32, 33] it became clear that the soft-tissue did not necessarily reflect the form of the underlying dental and skeletal structures. Worms et al [34] were the first to suggest that in the treatment planning of mandibular surgery the most desirable contour of the soft-tissue chin should be determined first and then the repositioning of the teeth and jaws accomplished.

This idea was comprehensively developed by McCollum [35-38] who advocated for the prediction of treatment outcome, the orthodontists should primarily determine the most favorable possible contours of the entire soft-tissue facial profile. The favorable contours is determined by several angular and linear measurement such as Total Facial Convexity, The Burstone “B” line 31, Vertical Proportions, Nasofacial Relationship, Nasal-Upper Lip Relationship. Interlabial Relationship, Lip Strain or Tension, Upper Incisor Exposure, Lower Lip to Chin Relationship and Chin Length. Then, based on data derived from studies on the reaction of soft tissues to surgical movements of the underlying jaws and teeth, the second step is to assess the amount and direction of movement of the teeth and jaws necessary to accomplish those specific soft-tissue goals.

In this method, the orthodontist can, plan, and conduct the presurgical orthodontic treatment (such as determination of the teeth to be extracted and type of anchorage) necessary to obtain the optimum presurgical tooth positions, allowing the surgeon to affect the precise amount of jaw movement.

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