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Review Article

Controversies in Orthodontic Diagnosis

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Abstract

Many writers' differing points of view have sparked a chain reaction of disputes that have given rise to a number of debates in the area of orthodontics. A situation of protracted public disagreement or discussion, generally involving a difference of opinion, is called controversy. Originating from the Latin word "controversia" the word was created by combining the terms "controversus" which means "turned in an opposite direction," and "versus," which means "to turn against." The word "controversy" has a distinct connotation in orthodontics. Therefore, it's critical to distinguish clearly between orthodontic and controversy-related issues. A trend is emerging towards evidence-based rather than opinion based decisions. This article's goal was to provide the most recent orthodontics issues and give evidence-based research in order to get to a mutually agreeable conclusion.

KEYWORDS: controversy, malocclusion, centric relation, articulator, cephalometric

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INTRODUCTION

Strong leaders' opinions have long been appreciated to the extent that professional organizations have coalesced around them since it has historically been their area of expertise. According to Angle, Begg, and Tweed, "disagreements are the rule rather than the exception" in some societies (1). Interestingly, there have been differing views on what constitutes excellent orthodontics from the beginning of our profession. Because of this, even if their value systems lack a more objective foundation, adherents of diverse ideologies embrace it as a "act of faith" and, when defended, exhibit a quasi-religious fervor. Thus, it seems that many of our beliefs and, by extension, our choices, are largely predicated on dogmas. Recognizing the many aspects of the malocclusion is the focus of orthodontic diagnosis. The diagnostic procedure aims to create a comprehensive description of the patient's issues and compile a list of those issues. To get the issue list, it is necessary to gather pertinent data (2). We refer to this collection as a database. The sources of this information are the patient's history, interview information, clinical examination (extraoral, functional, and intraoral), and inspection of diagnostic records (such as models, radiographs, cephalograms, and photos). Orthodontic diagnosis needs to be grounded in clinical experience, common sense, and scientific understanding where necessary (3).

CONTROVERSIES IN THE CLASSIFICATION OF MALOCCLUSION

Simon, Lundstrom, Hellman, and, most recently, Horowitz and Hixon recognized the importance of distinguishing between dentoalveolar and skeletal differences and determining their relative contributions to malocclusion formation. These authors proposed that classification should include this type of diagnosis and logically lead to a treatment plan (1). In a 1912 report to the British Society for the Study of Orthodontics, Norman Bennett proposed classifying malocclusion based on deviations in the transverse, sagittal, and vertical dimensions. Through Simon's research and development of his gnathostatic system, he paved the way to later realize this recommendation, which was initially rejected. Simon evaluated the teeth in three dimensions relative to the rest of the face and cranium. Previously, Simon attempted a canine-centric classification. In ideal occlusion, the orbital plane (a line drawn from the orbitale perpendicular to the Frankfort horizontal) coincided with the distal third of the maxillary canine, according to his canine law. Modern orthodontists do not consider the law provided by Simon as valid, while the canine's convenient position provides it as a preferred tooth as a reference for classification (4).

In the 1960s, Ackerman and Proffit (Fig 1) formalized the system of informal additions to the Angle method by identifying five major malocclusion characteristics that should be considered and described systematically in classification. The strategy addressed the Angle scheme's major flaws. It involved evaluating crowding and asymmetry in the dental arches, including the degree of incisor protrusion and its link to crowding. The assessment covered space in the transverse, vertical, and anteroposterior planes and also considered the proportions of the skeletal jaws (5).

Classification Of Canine Relations

Maxillary canines are seen as the most stable teeth because their long roots provide strong anchorage in the alveoli. They function as the "keystone" of the dental arch, similar to the keystone in a stone arch, offering crucial support for both the incisors and the posterior teeth. Canines also play an important role in protecting lateral excursive movements. The main objection to a canine-derived classification is tooth structure. Occlusal wear frequently causes the cusp tip to transition from a point to a flat facet (5).

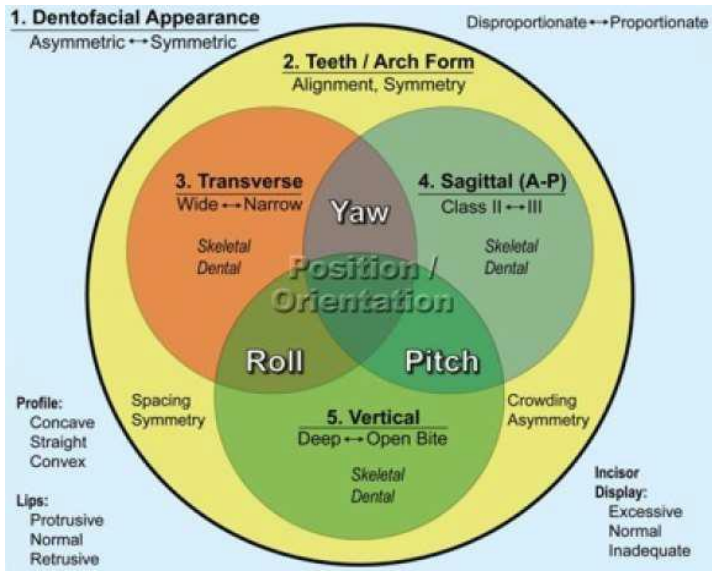

FIGURE 1: ACKERMAN AND PROFITT VENN DIAGRAM

Premolar Classification

Morton Katz proposed the premolar classification as a modification of Angle's classification. Premolars usually have sharply defined cusp tips.

Du et al. (1998) conducted a study in which four orthodontic faculty members from a single dental school classified 25 dental casts using the British Incisor Classification, Angle, and Katz classification systems (11). The most unusual dental casts were chosen from a group of 350 pretreatment graduate orthodontic patients. The results indicated that Katz's categorization was more reliable than Angle's and the British's. Angle's categorization was the least reliable of the three methods (6).

CONTROVERSIES IN DIAGNOSTIC VALUE OF MODELS IN ORTHODONTICS

Models are the only three-dimensional records that can depict dentition in a functional occlusion. Orthodontic study models are precise plaster replicas of teeth and surrounding soft tissues. These are essential diagnostic tools that allow you to study tooth arrangement and occlusion from all angles (7). Plaster models are being replaced by digital models, which have proven to be highly effective. Han and colleagues initially presented records using plaster models and then advanced to facial photographs, panoramic radiographs, lateral cephalograms, and tracings. They showed that, in most cases (55%), models alone provided enough information for treatment planning. In the current study, all records were shown initially except for the models, and adding the plaster models did not alter any of the 80 treatment plans. Only 5% of cases had changes in their diagnostic value (8). Chad Callahan et al. conducted a study on the diagnostic value of plaster models in orthodontics. Twenty orthodontic patients (11 Class I, 7 Class II, and two Class III) were chosen. The study's results showed that 95% of the diagnostic values remained consistent. However, only 5 out of 20 diagnostic values were statistically significant: molar and canine relationships, overjet, overbite, and the depth of the curve of Spee (9). Rheude et al. investigated the efficacy of digital study models in orthodontic diagnosis and treatment planning. They conducted a comparison of digital and plaster models. They discovered variation in 14 of the 20 diagnostic criteria and concluded that it was clinically insignificant (8).

Abizadeh et al compared occlusal relationship and arch dimension measurements from digital study models to those from plaster models. And concluded that the repeatability of digital models when compared to plaster models is adequate for clinical applications, despite some systematic differences discovered in this study. As a result, digital study models can be considered as an adjunct to clinical occlusion assessment, but they may not yet replace current methods for scientific purposes. Plaster study models have been replaced by precise, user-friendly, and efficient digital models, according to current thinking. Digital models may be viewed as valuable additions to the orthodontic profession, with the potential to advance the field. Digital models, for example, provide incoming practitioners with electronic access to all information and eliminate the possibility of misplaced or broken models when a practice is sold. Digital models allow for precise measurements, and the method allows for the visualisation of intended treatment outcomes (10).

CONTROVERSIES IN CEPHALOMETRICS

Cephalometric analysis has played an important role in orthodontic diagnosis and treatment planning since its introduction. Despite numerous efforts by various studies to standardize values for different races, minimize distortion and magnification, and create universally accepted analyses, there are still many limitations in diagnosing orthodontic treatment (11).

REFERENCE PLANE S-N PLANE

The sella and nasion are both located within the skull and are not visible during clinical examination, making them unsuitable for direct clinical communication.(12) Unlike the Frankfort horizontal plane, which includes the porion and orbitale and follows the soft tissue of the orbit and ear post—both of which are clinically visible—this plane cannot be used in the same way. While the nasion holds anatomical significance for the face, the sella does not. The sella, which houses the brain's hypophysis and pituitary gland, is unrelated to the face, particularly the jawbones. The sella-nasion plane is not the foundational structure of the anterior cranial base and fossa, which serve as the superstructure for the nasal capsule and face, and has minimal relevance to the mandible and its shape (13).

REFERENCE PLANE- THE FRANKFORT HORIZONTAL LINE

The main barrier to using the Frankfort horizontal line is the difficulty in locating anatomical porion on the lateral cephalogram. Since the 'anatomic porion' is not easily visible, many researchers have opted to use the 'machine porion' instead (Broadbent, 1931; Tweed, 1946; Downs, 1948). This reference point is a radiographic marker located on the ear rod, which is placed into the external auditory meatus as part of a cephalometric head positioning device. However, when defining the Frankfort Horizontal (FH), using Porion determined by cephalometric instruments could introduce a clinically significant source of error (Krogman and Sassouni, 1957; Ricketts, 1961, 1981; Ricketts et al., 1974). Due to the variability in ear rod positioning and the size of the external auditory meatus, the machine Porion may be quite distant from the actual Porion (Ricketts, 1981). It can be contended that the radiographic marker on the ear rod (Po-m) is an inadequate replacement for the true Porion (Po-a) and should not be used when constructing the Frankfort Horizontal (FH) (14).

The debate over the best line for cephalometric orientation has been settled, and it can be summarized into the five areas of consideration listed below:

1. Clinical significance: The clinician's ability to visualize the Frankfort horizontal plane facilitates effective clinical communication, which is absent with the sella-nasion method. Additionally, it allows him to illustrate the alignment of the face, chin, and palate with the Frankfort horizontal plane, a feature that is also missing in the sella-nasion system.

2. Anatomical significance: The Frankfort horizontal plane has a direct relationship with the basic sense organs of sight and hearing, which correspond to the face. In contrast, Sella is concerned with the brain, not the face.

3. Measurement accuracy: Research evaluating plane selection accuracy found no significant differences when using a true porion instead of the ear rod, provided that experienced technicians performed the plane tracing.

4. Use in description: If the reference line is to be considered reliable for description, the correlation between maxilla and mandible measurements and the reference line must be minimal. In a study, SNA and SNB had a significantly higher correlation with FH than N-Po and N-A.

5. Application in growth forecasting: A study evaluated the effectiveness of these orientation lines for predicting growth. In every instance, the reference frame utilizing the Frankfort horizontal plane proved to be more effective than the sella-nasion frame (15).

To summarize, angle ANB is commonly used in cephalometric radiography to describe skeletal differences between the maxilla and mandible. Jacobson proposed the Wits appraisal as an alternative to angle ANB. The Wits appraisal avoids nasion and reduces the rotational effects of jaw growth, but it describes skeletal differences using the occlusal plane, a dental parameter. Tooth eruption and dental development can have a significant impact on the occlusal plane (16).

AGAINST ANB AND WITTS APPRAISAL

Ferrazzini demonstrated empirically (qualitatively) and geometrically (quantitatively) that the angle ANB was determined not only by the anteroposterior relationship of the jaws, but also by the inclination of the palatal plane, maxillary prognathism, and vertical facial dimension. He emphasized that "too much importance should not be given to the ANB angle, nor should it be considered an absolute measurement of the anteroposterior relationship of the jaws" (17). Roth et al. and Martina et al. recognized the ANB angle as an invalid measure of sagittal skeletal disharmony because it is affected by rotations and variations in sagittal and vertical jaw dimensions relative to the cranial base. Bishara et al investigated the changes in the ANB angle and Wit’s appraisal in men and women between the ages of 5 and adulthood, and whether the changes were significant. Their findings support the assertion that the ANB angle fails to accurately depict the relationship between the maxillary and mandibular apical bases because of the natural variability in the spatial positions of both the sella turcica and nasion (18). In 1969, Taylor observed that the ANB angle did not consistently reflect the true apical base relationship. Differences in horizontal measurements between points A and B could result in the same ANB value, as variations in the vertical distance from the nasion might offset other differences. Similarly, Beatty noted in 1975 that the ANB angle is not always a reliable method for assessing the actual extent of apical base divergence. He devised the AXD angle as an alternative to the ANB angle for measuring apical base discrepancy, in which point x is located by projecting point A onto a line perpendicular to the SN. Steiner describes point D as being located in the bony symphysis. We conclude that the Wits appraisal is a linear measurement rather than a comprehensive analysis. It serves as an additional diagnostic tool that can help in assessing the degree of anteroposterior skeletal dysplasia and evaluating the reliability of the ANB angle (19).

CONTROVERSIES IN TMJ DIAGNOSIS (20) (Table 1)

ALLEGATION	VERDICT
TMD is a single disorder with a single cause	TMD is a collection of disorders, in some of which the TMJ is not the focus
The diagnosis of MD is based on a detailed analysis of occlusion	The 'gold standard' is based on a thorough history, clinical examination, and when indicated TMJ imaging
Dental-based model for TMD management	Medical-based model and biopsychosocial approach to MD management
Orthodontic treatment causes TMD	Orthodontic treatment does not cause TMD
The anterior-superior-medial condyle position is the ideal	No one ideal condylar position exists and there exists a range of positions
Advocate canine protected occlusion (some tolerance for group function occlusion)	Accept all functional occlusion types, but no interferences (balancing and protrusive contacts tolerated, but not interferences)
Centric slides cause TMD	Large centric slides are most likely related to the result of disease rather than the cause
Favor the use of articulators in orthodontics	Use of articulators in orthodontics is not evidence based and is cost-ineffective
TMD treatments are typically based on treating the cause	TMD treatments are typically symptomatic and palliative
Believe anterior repositioning splints can recapture displaced disks	Displaced disks cannot be recaptured; retro-discal tissues adapt to become the 'new disk
Oral occlusal appliances work better than other TMD treatment therapies	Oral occlusal appliances are not more effective than other TMD treatment therapies

CONTROVERSIES IN CENTRIC RELATION

CR is the position of the condyles independent of tooth contact, whereas CO is the interocclusal dental position of the maxillary teeth relative to the mandible teeth. Over the past 50 years, the definition of CR has evolved significantly, shifting from describing the condyle's position as posterior relative to the glenoid fossa, to posterior-superior, and eventually to an anterior and superior position (21). Prior to 1968, CR was thought to be the most posteriorly retruded condylar position. The most recent edition of the Glossary of Prosthodontic Terms (GPT) (Academy of Prosthodontics, 2005) defines CR as "a maxillomandibular relationship where the condyles engage with the thinnest avascular part of their respective disks, with the complex in an anterior-superior position against the slopes of the articular eminences." This version of the GPT also includes six historical definitions of CR. Roth advocated for a retruded, posterior-superior 'seated' CR position when the occlusion was in CO, meaning CR (CRO) equals CO, or CR coincides with MI or ICP (Roth, 1973, 1976). Roth later abandoned his belief in retruded CR in favor of the modern viewpoint of antero-superior CR (Cordray, 2006; Schmitt et al., 2003; Klar et al., 2003) (22).

CONTROVERSIES IN IMPORTANCE OF ARTICULATERS IN ORTHODONTICS

CR positions are not a single, universally optimal position for everyone. The range of acceptable CR positions across the population does not suggest that each individual functions within a broad range of CR positions. Instead, it implies that there is likely a unique condyle position—a "seated position" within a narrow range—that is optimal for each person (e.g., mid-CR or slightly anterior and superior) (21). It is worth noting that CR may change locations very slightly throughout the day for each individual due to a variety of factors such as masticatory and facial muscle fatigue, posture, tongue position, and minor changes in the size, shape, and position of the disc depending on the level and extent of loading. The utilization of articulators as an aid to diagnosis in orthodontics has been debated since Dr. Ronald Roth introduced the historic prosthodontics-

gnathology philosophy to the orthodontic field in the early 1970s. Roth proposed that by "mounting" dental casts of orthodontic patients on articulators, orthodontists could identify three-dimensional centric discrepancies (23). Posselt invented the "terminal hinge axis" more than 50 years ago. He proposed that during the first 20 mm of opening and closing, the mandible (condyles) rotate like a door hinge. Posselt's concept was fundamental to the development of articulators. However, Posselt's theory was developed at a time when CR was thought to be a retruded, posterior position of the condyles in the glenoid fossa, and it was measured using distal guided pressure on the chin. Lindauer et al. showed in 1995 that the condyles rotated and translated simultaneously during opening and closing. The concept of a "instantaneous center of rotation"—a simultaneous center of rotation and translation—that is specific to each patient and cannot be duplicated on an articulator was supported by their findings, which also showed that the terminal hinge axis is nonexistent (24).

MRI data are not available from orthodontic gnathologists to support their descriptions of condyle positions, despite the reliability of centric bite registrations. Several gnathologically centric bite registrations advocate that condyles are located in certain positions, but this is not the case in reality (25). The difference between gnathological and non-gnathological findings is typically 1 mm or less, with the majority of this difference occurring vertically. When the errors associated with the entire registration and mounting process are considered, the significance of these differences and the gnathologists' claims is reduced even further. In children, the TMJ condyle-glenoid fossa complex moves posteriorly and inferiorly as they grow. To sustain an optimal CR throughout treatment, gnathologists would then need to perform fresh mountings. Patients' chewing habits are not detectable by articulators or their bite registrations. We conclude that articulator mountings are not a cost-effective exercise and provide no additional biological information about the presence of disease in orthodontic patients. Curiously, occlusal forces generated during parafunction (bruxing and clenching) are the most destructive of all, and articulators have never been able to record or analyze these kinds of movements and forces. According to evidence-based opinion, the use of articulators in orthodontics is pointless and their efficacy is not well-supported (26).

CONCLUSION

Orthodontics, like any other medical discipline, is not free of debate. Debates about treatment regimens, diagnostic methodologies, and professional ethics will continue to surface. However, by acknowledging and addressing these debates through open dialogue, evidence-based research, and a commitment to patient-centered care, the orthodontic community can work toward a future in which differing perspectives stimulate growth, improve treatment outcomes, and, ultimately, benefit the patients we serve. To address these issues, traditional opinion-based orthodontics must be replaced by evidence-based procedures.

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There are no conflicts of interest

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