Simplifying Laboratory Communication: The Dental Midline Position, Incisal Cant and Incisal Horizontal Plane

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INTRODUCTION
The primary objective of aesthetic dental treatment is to generate a natural, healthy appearance for an otherwise damaged dentition. The word “aesthetic” implies beauty, naturalness and a youthful appearance relative to one’s age and aesthetic dentistry has been called the “art of the imperceptible” by McLaren and Rifkin. A pleasing dental appearance is the subjective appreciation of the shade, shape and arrangement of the teeth and their relationship to the gingiva, lips and facial features. Symmetry - the property of being symmetrical, with a correspondence in size, shape, and relative position of parts on opposite sides of a dividing line or median plane or about a centre or axis plays a large part in the perception of dental aesthetics (Figure 1). In a study by Dunn, when evaluating photographs of male and female smiles, 24 out of the 25 demographic groups picked the same attractive female smile which was characterized by natural teeth having a light shade, a high lip line, a large display of teeth and radiating symmetry. Multiple studies show that society places a great amount of importance on appearance, with attractive people having more success, higher paying prestigious jobs, better success in obtaining dates, more favourable jury verdicts and more positive responses, even from infants. The ability of the dentist to communicate the location and orientation of the patient’s facial landmarks to the dental technician will dictate the success of the esthetic outcome. This article will look at the aesthetic parameters of dental midline position, incisal cant and incisal horizontal plane, and provide a simple methodology to relate these parameters to the dental technician when multiple anterior restorations are prepared. Of course, details of the smile arc, the curve formed by the incisal edges of the maxillary anterior teeth in relationship to the lower lip, need to be communicated to the laboratory technician. The maxillary incisal curve and the lower lip curve should be roughly parallel to one another and perpendicular to the vertical midline drawn between the maxillary central incisors (Figure 2). For complicated cases, it is critical to give an accurate relationship of the casts in a sagittal or lateral axis, when designing the curvature and angle of the smile line (bicuspids to molars) as the potential for misalignment of the cast increases with the number of restorations involved.
THE DENTAL MIDLINE

The median plane is a line passing longitudinally through the middle of the body from front to back, dividing it into the right and left halves.12 The facial midline is a critical reference position for determining multiple design criteria13 with the maxillary midline position relative to the facial midline stressed in orthodontic treatment planning14 as it is an important functional component of occlusion.15 In a totally symmetric face the dental midline and the facial midline should coincide but this is often not the case (Figure 3). A study by Miller showed that the midline is situated in the exact middle of the mouth in approximately 70% of people and that the maxillary and mandibular midlines fail to coincide in almost three fourths of the population16 (Figure 4 and 5). However in a study looking at dental students, Soares found that the coincidence of facial midline with the arch midline occurred in only one half of the students.17 Among orthodontic patients the most common asymmetry trait is mandibular midline deviation from the facial midline.18 Thus the mandibular midline cannot be used as a reference point by the dental technician in deciding where to put the maxillary midline (Figure 6).

However, there is conflicting data as to how important the maxillary and or mandibular midline position is to patients and their perception of esthetics and the ability of dental professionals and lay persons to perceive dental midline shifts. It seems that midline abnormalities are the least noticed.2 Johnston, when evaluating the dental attractiveness of facial photographs with orthodontists and lay people, found that, as the size of the dental to facial midline discrepancy increases, the attractiveness ratings were scored lower. There was a 56% probability for a layperson to record a less favourable attractiveness when there was a 2 mm. discrepancy between the dental and facial midline while a discrepancy of 2 mm. or more was noticed by 83% of orthodontists19. In a study by Chan quantifying a layperson’s ideal and maximum deviation of the midline, he found that the smile became unattractive when the maxillary midline deviated 2.9 mm, or once the maxillary-mandibular midlines deviated 2.1mm.20 Cardash in his study of midlines, states that nearly half of the observers were unable to detect midline deviations of <2mm. however some detected midline deviations of <1mm.21 Kockich claims that general dentists and lay people are unable to detect even a 4mm midline deviation.22 Irrespective of these studies, many authors state that when restoring multiple anterior teeth the ideal choice is to always maximize the esthetic result by placing the maxillary dental midline in harmony with the facial midline.1,23,24

MIDLINE CANT OR OBLIQUE MIDLINE

In the ideal face, the midline of the teeth should be centered in the face and be completely vertical.23 Even when the midlines of one or both arches are not centered, it is more important to ensure that the anterior teeth are vertically oriented in the face and perpendicular to the incisal plane.25 Attractiveness scores and acceptability ratings decline consistently as axial midline angulation increases26 (Figure 7). Studies have shown that midline deviations of up to 3 or 4 mm. are not noticed by lay people if the long axes of the teeth are parallel with the long axis of the face.22,27 Spear states that perhaps the most important relationship to evaluate is the mediolateral inclination of the maxillary incisors.28 If the incisors are inclined by 2mm. right or left, lay people regard this as unesthetic.26 Thus this type of midline deviation (the oblique midline) is noticeable and should be corrected with interproximal preparation.28

THE INCISAL HORIZONTAL PLANE

The interpupillary line is a reference plane that is used to determine the incisal horizontal plane, the gingival plane and the occlusal plane.1 An incisal plane cant of
An incisal occlusal cant is a form of asymmetry that is apparent when a person smiles but is not perceived on intraoral images or study casts. An incisal occlusal cant is consistently rated as non aesthetic. A midline cant is consistently rated as non aesthetic. Canine positions are generally asymmetric and are in different vertical positions as well as being angled differently. Kockich found that an occlusal plane cant is a very displeasing smile characteristic to health professionals and laypeople. An incisal occlusal cant is a form of asymmetry that is apparent when a person smiles but is not perceived on intraoral images or study casts. Even when using a facebow transfer, the condylar determinants do not take into account the aesthetic orientation requirements, since the anterior and posterior occlusal determinants are evaluated and transferred to the articulator from a functional standpoint with the assumption that the aesthetic orientation of the anterior teeth is correct. In addition, when referencing to remaining unprepared teeth, their positions may not accurately represent the incisal horizontal plane of the incisors. Canine positions are generally asymmetric and are in different vertical positions as well as being angled differently. Thus mounting casts referenced to the vertical position of the canines will result in the restorations having an incorrect incisal plane.

**LABORATORY COMMUNICATION**

If the clinician is to transfer these important parameters of the maxillary dental midline, the lack of midline cant, and the incisal horizontal plane to the dental technician, which should all be referenced to the facial midline and interpupillary line, how is this reliably accomplished? In the past, classic stick bites, Q-tips, pencils, plastic stir sticks, and symmetry bites have been used to capture these dimensional relationships. The limitations of these systems are many. All have limitations due to the short working time of many bite registration materials, so that the clinician is forced to work quickly to centre and place these before the material sets. If the stick bite, or symmetry bite is slightly off, the whole process needs to be repeated. With fixed symmetry bites, the vertical and horizontal are fixed at 90 degrees to each other, assuming that the horizontal incisal plane matches exactly to the interpupillary line and no correction is indicated nor anticipated. A stick bite to the horizontal assumes that the patient can keep their head perfectly still with their head perfectly upright.

A simple solution to the transfer of the required data to the dental technician is the OneBite facial plane relator (Clinical Research Dental). There are a number of distinct advantages to the OneBite over other available systems. The bite fork portion is separate from the adjustable horizontal and vertical components,
so that if the bite fork is placed slightly off centre when placed into the bite material, the ability to move the components laterally eliminates the need for repeating the procedure. Figures 11-13 show the placement of the bite registration material Quick Bite (Clinical Research Dental) onto the anterior teeth, onto the bite fork and the intra-oral placement of the bite fork. After the vertical and horizontal components were placed firmly into the bite fork slot, it can be seen in photograph 14 that the bite fork was placed slightly off laterally to the patient’s left side. The bite fork placement does not have to be redone, as Figure 15 shows that the horizontal adjustment is easy to accomplish, by loosening the screw, sliding the component laterally until centered to the patient facial midline, and then securely tightening the locking screw. Another benefit of the OneBite is that the vertical and horizontal component can be left in a locked 90 degree relationship to each other if the patient demonstrates symmetry of the midline, horizontal, and the interpupillary line, or the components can be unlocked by rotating the horizontal bar so that the locking pins are facing the clinician, if there is a discrepancy with the interpupillary line. Figure #16 shows that the patient’s right side horizontal portion of the OneBite is slightly lower than the interpupillary line. This can easily be adjusted by unlocking the components, rotating the horizontal bar until it is in harmony with the interpupillary line, securely tightening the locking screw and then fixing the components together by injecting temporary C&B material into the lateral slot and screw. For illustrative purposes the rotation has been exaggerated in Figure 17 to show the wide range of adjustments that are easily managed by the OneBite. The components are
then taken apart by placing lateral force on the locking screw which facilitates transport to the laboratory. Another advantage of the OneBite is that in the laboratory, the vertical component can be reduced in length at the plastic cross supports to fit easily onto a semi-adjustable articulator.

CONCLUSION
The rationale for the need of accurate communication by the dental clinician to the laboratory technician of the dental midline, incisal midline cant and incisal horizontal plane have been discussed. A simple technique that facilitates this communication has been presented that should minimize the need for expensive remakes for esthetically driven restorations.

DISCLOSURE
Dr. Len Boksman is Director of Clinical Affairs for Clinical Research Dental in London, Ontario, Canada.

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REFERENCES

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