

# Occlusal Cant-A Narrative Review

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**Abstract:-** Occlusal cant, indeed, plays a significant role in smile aesthetics. It refers to the asymmetry or tilt of the occlusal plane, which can affect the balance and harmony of the smile. The dynamic display zone, which includes lateral, vertical, and anteroposterior characteristics, as well as the cant of the occlusal plane, are important factors to take into account when creating a smile or designing mechanotherapy (treatment utilizing mechanical devices). Ensuring an aesthetic plane of occlusion involves aligning the teeth and jaws in a way that enhances the overall appearance of the smile. This may involve orthodontic treatment, dental restorations, or other interventions aimed at achieving symmetry and balance in the occlusal plane. By addressing occlusal cant as part of smile design and mechanotherapy, orthodontists can help patients achieve optimal smile aesthetics and function. This review article describes diagnosis, etiology, methods of detecting occlusal cant and treatment alternatives.

**Keywords:-** Occlusal Cant, Occlusal Cant Index (OCI), Yin Yang Arch Wire

## I. INTRODUCTION

The opinions on aesthetics vary, the beauty of a smile has long been cherished as a symbol of attractiveness. In orthodontic practice, analyzing smiles is crucial, with smile design becoming an integral part of treatment planning<sup>1</sup>. Various studies propose different criteria for assessing facial features to ensure precise evaluation<sup>2</sup>. Though aesthetic standards are subjective, there are principles that can be developed to enhance dental and facial aesthetics<sup>3</sup>.

The canting of the occlusal plane is one of the most important dentofacial characteristics. When one half of the mouth is at a higher level than the other, it relates to the vertical arrangement of the teeth. This can be explained as the occlusal plane rotating in the transverse plane, either upward or downward, on one side relative to the other. The aesthetic perception of a smile varies based on individual characteristics, race, and ethnicity. Research suggests that craniofacial asymmetry is present to some degree in all individuals undergoing treatment<sup>4</sup>.

The appearance of a smile is influenced by occlusal plane canting, which can have skeletal or dental origins and may present with or without facial asymmetry. Most healthy individuals exhibit occlusal canting within the range of 0°–3°. Clinically, canting exceeding 4° is widely recognized by

professionals and laypeople, especially in patients with class-3 malocclusions<sup>5,6</sup>.

In orthognathic procedures, it's imperative to level the occlusal plane. Failure to do so may result in uneven canting during the procedure, negatively affecting masticatory function. Timely recording of occlusal canting is crucial, as its development during treatment often indicates improper biomechanics, despite soft tissue compensation commonly observed in patients<sup>7</sup>.

Asymmetric cases pose significant challenges for orthodontists due to the intricate mechanics and uncertain treatment stability. Occlusal plane canting adds complexity to treatment<sup>8,9</sup>. This manuscript aims to discuss the resources available for accurate diagnosis and optimal treatment planning for cases involving occlusal plane canting, considering its aesthetic relevance and frequency in orthodontic patients.

## II. OCCLUSAL PLANE (OP) AND NATURAL HEAD POSITION (NHP)

The occlusal plane (OP) holds significant importance in smile analysis, and occlusal canting, a malocclusion characteristic, is a concern for aesthetics that requires careful evaluation during orthodontic assessment<sup>10</sup>.

An imaginary surface that is physiologically related to the skull is known as the occlusal plane (OP). In theory, it contacts the incisal edges of incisors and the occluding surfaces of posterior teeth; it is not technically flat, but rather represents the average curvature of this surface. As a result, the OP is created by creating a line that passes across the buccal and lingual cusp points as well as the incisal margins of all mandibular teeth. This line then crosses the arch to include the buccal and lingual cusp tips on the other side.<sup>11,12</sup>

The natural head position (NHP) is the most consistent relaxed head position in an upright posture, where the eyes gaze at a distant point at eye level, indicating a horizontal visual axis<sup>13</sup>. Various clinical methods exist to determine NHP, with a common approach being to instruct the patient to focus on a distant point at eye level or to observe their own eyes in a mirror<sup>14</sup>.

### ➤ Symmetry and Asymmetry Perception

Research indicates that while symmetric faces are generally considered attractive, they are not necessarily more attractive than faces with less symmetry<sup>15</sup>. However, the preference for symmetry alone does not fully account for the

attractiveness of average faces<sup>16</sup>. While individuals typically favour symmetric faces, there isn't always a correlation between a person's preference for symmetry and their ability to detect it. The desire for detection of symmetry is influenced by many perceptual systems.<sup>17</sup> According to Honn and Goz, menstrual cycles and surroundings have a major impact on women's choices for beautiful male faces, indicating that standards of beauty can change over time.<sup>18</sup>

➤ *Occlusal Cant*<sup>19</sup>

Occlusal plane canting in the vertical plane is a factor influencing smile aesthetics and arises from either facial asymmetry or vertical position discrepancies in the right

and/or left quadrants of the dental arches, independent of facial asymmetry.

➤ *Etiologic Factors*

Determining asymmetries and classifying cases is complex due to the multifaceted nature of asymmetry. The etiology of asymmetry can be categorized into

- Hereditary Factors
- Environmental Factors.

Table 1: Etiologies of Occlusal Cant

Hereditary factors	Environmental factors
Cleft lip and palate, Hemifacial microsomia, juvenile idiopathic arthritis, Treacher Collins syndrome, Albright syndrome, Apert syndrome, Crouzon syndrome, craniosynostosis	Facial trauma and Fractures (prenatal and postnatal) jaw cysts facial tumors as well as their surgical treatment teratogens hormonal disorders (such as gigantism or acromegaly) Romberg syndrome posture temporomandibular joint (TMJ) ankylosis muscular disorders abnormal mouth breathing habits such as finger or lip sucking long term bottle or pacifier use pencil biting and nail biting tooth extraction and carries incorrect use of force during orthodontic treatment or when using midline elastics.

**III. DIAGNOSIS**<sup>20</sup>

In instances of a tilted occlusal plane, it's crucial to determine which side requires intrusion or extrusion to achieve plane leveling. Typically, the upper arch is utilized as the reference point for diagnosis by revealing the crowns and gingiva, and it's imperative for the orthodontist to be well-versed in all aesthetic principles to analyze the smile correctly.

➤ *Photographs of Smile*

Photographs serve as the traditional method for assessing smile aesthetics, crucial for diagnosing occlusal plane asymmetries. Initially, a spontaneous smile photograph is taken to capture the maximum elevation of the upper lip. Additionally, smile photographs during occlusion are routinely included in orthodontic documentation to detect any deviations in the upper arch.

➤ *Software*

With the assistance of computers and software like PowerPoint or Keynote, smile analysis can now be facilitated using reference lines. One such line is the bipupilar line, which can be transferred from its original position to various points such as the commissures region, gingival contour, tip of a canine cusp, or incisal edge of an incisor, depending on the specific need. This method is suitable for evaluating either the anterior or posterior region of the upper arch. Additional lines can be drawn to trace the contours of the upper arch,

lower arch, lower lip, or labial architecture for symmetry comparison. It's important to note that some patients with occlusal plane canting may also exhibit asymmetry in labial architecture when smiling. However, this asymmetry should not be considered in the diagnosis and treatment planning, making the bipupilar line a more reliable reference in such cases.

➤ *Devices*

Various tools can aid in analyzing and evaluating asymmetries in the posterior region. A wooden tongue depressor or a metal ruler, when placed in the posterior region with the patient in occlusion, enables more precise analysis of asymmetries in this area.

➤ *Radiographies or Tomographies*

Additional resources include PA tele radiography and facial tomography, which are particularly valuable when dealing with severe skeletal asymmetries. These imaging techniques are essential, especially when the treatment plan involves orthognathic surgery as the primary step to correct the tilted occlusal plane.

➤ *Midline*

Diagnosing the position of the upper and lower midlines in cases of occlusal plane asymmetries requires different considerations compared to symmetric cases. Typically, there is improper axial inclination of the anterior teeth associated with the tilt of the occlusal plane. Consequently, in such

cases, the practitioner should measure the dental midline in the papillary region of either the upper or lower arch.

#### ➤ Evaluation

The evaluation of occlusal cant is associated with patterns of dentoalveolar and/or skeletal development. It can be classified with or without face asymmetry resulting from unilateral extruded molars, asymmetric mandibular growth, or asymmetric dentoalveolar development. Clinical examination, frontal photos, cephalometry, and three-dimensional imaging techniques are used to assess patients with occlusal cant.

A tongue blade is placed over both first molars during a clinical examination in order to determine whether or not occlusal cant is present. The number of individuals with temporomandibular joint (TMJ) issues who visit orthodontic clinics has increased recently. Occlusal discrepancies had less of an association with facial asymmetry in patients with unilateral TMJ problems. On the other hand, mandibular hypoplasia on the afflicted side causes an increase in occlusal plane canting in these patients. As a result, in these situations, a thorough clinical examination and radiographic assessment of the TMJ are essential.

In order to assess and measure occlusal cant objectively, posterior-anterior (PA) radiography is required. Simple visual comparison of asymmetry is possible with PA radiographs. The parallelism and asymmetry of face points and planes in relation to preset planes are shown by the Grummons frontal analysis and Sassouni analysis, two frequently used studies for asymmetry. The measurement of the deviation is the horizontal distance on PA radiographs between the menton and the midsagittal plane, and the measurement of the angle of occlusal cant indicates the angle of the occlusal plane with respect to the actual horizontal plane. Furthermore, when asymmetry is present, basilar/submentoververtex (SMV) radiographs are helpful because they enable evaluation of asymmetry within each component portion of the craniofacial complex as well as the relative relationships between these components. Orthopantomograms can also provide details concerning mandibular asymmetry, such as condylar height symmetry determined by combining condylar and ramus heights.

For diagnosis and treatment planning, three-dimensional computed tomography (CT) is helpful, particularly in situations of facial asymmetry that are difficult to diagnose with traditional techniques.

#### ➤ CANT Identification Device in Orthodontics<sup>21</sup>

The Cant Identifying Device (CID) consists of a fox guide plane and a spirit level bubble leveller, which is mounted on top of the CID. It gives a more definitive insight of the cant both in the anteroposterior as well as the transverse dimensions.

#### ➤ The Advantages of this Device are:

- Clinician can easily visualize the cant of occlusal plane from the frontal and lateral views
- Easily available
- Less bulky
- Comfortable to the patient
- Economical
- Easily recordable using the frontal and Profile Photographs

The main disadvantage with this device is that the amount of occlusal cant cannot be quantified to any measurement or the degree of canting of occlusal plane cannot be measured.



Fig 1: Cant Identification Device in Orthodontics

#### ➤ Occlusal Cant Index<sup>22</sup>

The OCI was created for diagnostic, communication, and research applications and has demonstrated robust content validity. It categorizes occlusal cant into four grades based on its detection among both orthodontists and laypersons.

- Grade 0 where 0 represents the absence of an OC, and the OP is parallel to the true horizontal plane;
- Grade I refers to a mild OC of 1°;
- Grade II involves an OC range from 2° to 3°;
- Grade III consists of severe OC cases of 4° and above

Table 2: Occlusal Cant Index

Grades	Degree	Side	Descriptions
Grade 0	0°		No OC is present (the OP is parallel to the true horizontal plane)
Grade I	1°	Right	The OP is tilted down on the right side by 1°
	1°	Left	The OP is tilted down on the left side by 1°
Grade II	2–3°	Right	The OP is tilted down on the right side by 2–3°
	2–3°	Left	The OP is tilted down on the left side by 2–3°
Grade III	≥4°	Right	The OP is tilted down on the right side by ≥4°
	≥4°	Left	The OP is tilted down on the left side by ≥4°

#### IV. TREATMENT PLAN

Based on the diagnosis, the treatment plan for occlusal plane canting may follow different patterns, which are discussed below.

##### A. Unilateral Intrusion of the Upper Arch

In cases where the diagnosis indicates satisfactory teeth and gingival display on one side of the upper arch and excessive gingival display on the other side, the excessive side should undergo intrusion, followed by the extrusion of the corresponding teeth in the lower arch. Following the intrusion in the upper arch, the arch needs to be stabilized, while the lower arch is extruded using intermaxillary vertical elastics. These elastics can be attached directly to the upper arch or occasionally connected to a skeletal anchorage device.

##### B. Intrusion of the Lower Arch

In situations where one side of the upper arch displays 100% of the crown without any gingival exposure, while the other side shows less than 100% crown exposure, it is advisable to avoid intrusion on the upper arch. This is because intrusion could significantly reduce exposure on the already well-exposed side, negatively impacting smile aesthetics. Instead, correction of the occlusal plane should commence with intrusion on the lower arch, specifically targeting the side with reduced crown exposure in the upper arch. Following intrusion on the lower arch, stabilization is achieved, and the patient is instructed to use vertical elastics on this side to induce extrusion of the upper arch.

##### C. Combination of intrusion on both arches

In situations where one side of the upper arch lacks gingival display and shows less than 100% crown exposure, while the other side exhibits complete crown exposure and excess gingiva, a combination of intrusion on the excess side and extrusion on the incompletely exposed side is recommended. However, prior to this, intrusion on the lower arch on the same side is necessary. Therefore, correcting canting in such cases should commence with intrusion on both arches. If the extent of intrusion is equal on both the upper and lower arches, extrusion on the opposite arch is unnecessary as the intrusion itself corrects the canting.

However, if the extent of intrusion varies between the sides, vertical elastics may occasionally be needed on one side to achieve proper intercuspation. This approach is particularly suitable for hyperdivergent patients, as it predominantly utilizes intrusive forces with minimal or no extrusive mechanics.

##### D. Archwire for Non-Invasive Improvement of Occlusal Cant-The Yin-Yang Archwire<sup>23</sup>

###### ➤ Configuration of Archwire

This archwire is prefabricated using titanium-molybdenum alloy (TMA) to ensure a good range of springback. It features a continuous design with a wavy configuration resembling the yin and yang symbol when viewed from the front, or a combination of the curve of Spee and reverse curve of Spee when viewed from the side. The Yin-Yang archwire is available in two wire size series: 0.017 × 0.025 and 0.018 × 0.025. The 0.017 × 0.025 size is suitable for 18-slot size brackets, while the 0.018 × 0.025 size is designed for 22-slot size brackets. It is installed from molar to molar in each tooth bracket, similar to a conventional plain archwire. The archwire comes in two configurations: 60° and 100° up-and-down configurations. The 100° configuration is used for initially correcting a cant, while the 60° configuration is employed to maintain the correction.

###### ➤ Mechanics of Archwire

The Yin-Yang archwire operates on the principle of reciprocal extrusion and intrusion between the right and left sides. Its wavy down wire configuration facilitates tooth extrusion, while the wavy up wire configuration facilitates tooth intrusion. The magnitude of extrusion and intrusion is equal and reciprocal, with extrusion providing anchorage for intrusion, and intrusion providing anchorage for extrusion. To achieve complete reciprocal mechanics between extrusion and intrusion in the posterior region, the use of a Transpalatal arch (TPA) or lingual holding arch (LHA) in conjunction with a Yin-Yang archwire is necessary for correcting both posterior and anterior occlusal cant. However, for correcting anterior occlusal cant alone, the use of TPA and LHA may not be necessary.



### ➤ Selection of Archwire

The Yin-Yang archwire offers two orientations for correcting occlusal cant. To determine the appropriate orientation, align the archwire so that both ends are at the same level and then assess the up-and-down orientation at the anterior. For a right-sided occlusal cant, use a Yin-Yang archwire with a right side down and left side up orientation at the anterior. Conversely, for a left-sided occlusal cant, utilize a Yin-Yang archwire with a left side down and right side up orientation at the anterior.

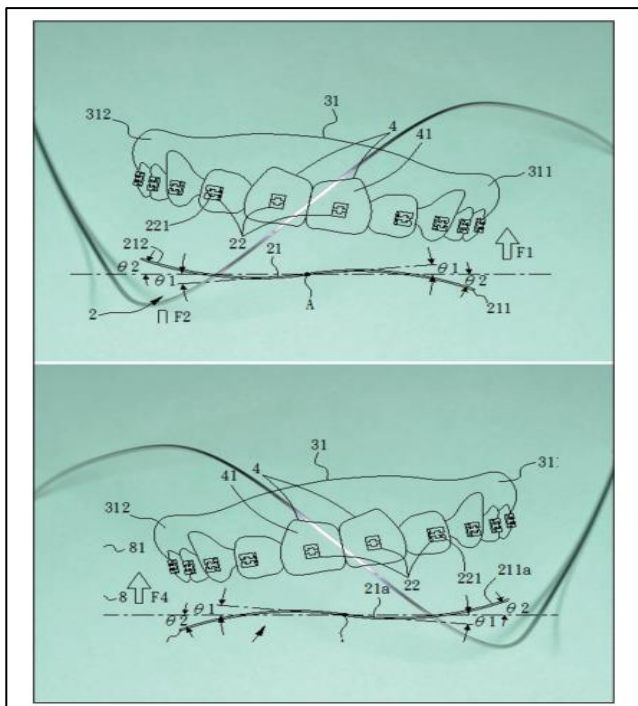


Fig 2: Yin-Yang Archwire

### ➤ Orthognathic Surgery

While there are drawbacks to conservative orthodontic treatments, such as the requirement for patient participation and the possibility of disappointing outcomes, surgical techniques are nevertheless useful and suitable for individuals who have facial asymmetry and/or occlusal cant (OC). The degree of the occlusal cant and jaw discrepancies in both sagittal and vertical dimensions, as well as the patient's awareness of the aesthetic problem, all influence the choice to proceed with surgical surgery for addressing facial asymmetry. Usually, the occlusal plane has to be leveled before surgery.

### ➤ Skeletal Anchorage

The treatment mechanism for occlusal cant involves both intruding the extruded molars and extruding the intruded molars. While molar intrusion is a more stable technique that lowers anterior vertical height, extruding molars can increase the mandible's posterior rotation propensity and raise anterior vertical height. Alternative devices such as occipital headgear, elastomeric chains, magnets, modified palatal appliances, detachable appliances with elastics, and removable appliances have been proposed for the treatment of intruding molars.

### ➤ Combination Treatment Using Orthodontic Camouflage and Orthognathic Surgery

In order to establish face symmetry, this treatment modality combines orthognathic surgery in the mandible with occlusal cant correction utilizing skeletal anchors (miniscrews or miniplates) in the maxillary region. When a patient presents with both facial asymmetry and occlusal cant, and the occlusal cant is caused by unilateral over-erupted posterior maxillary teeth, miniscrew therapy can successfully correct the cant, obviating the need for a Le Fort I osteotomy. Alternative surgical procedures for correcting facial asymmetry may involve sagittal split ramus osteotomy and genioplasty, as well as intraoral vertical ramus osteotomy, after occlusal cant treatment with miniscrews.

## V. CONCLUSION

Even in the absence of facial asymmetry, vertical position differences in the right and/or left quadrants of the dental arches can result in vertical occlusal plane canting, which is a key factor impacting smile aesthetics.

Occlusal canting is becoming more common, and more people are becoming aware of the problem.

In order to provide individuals with occlusal cant a satisfactory treatment outcome, it is imperative to investigate the underlying causes of their condition, take into account the classification of occlusal cant, and deliberate on the benefits of alternative treatment options.

## REFERENCES

- [1]. Ackerman MB, Ackerman JL. Smile analysis and design in the digital era. *J Clin Orthod.* 2002; 36:221-36.
- [2]. Abu Alhajja ES, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. *Eur J Orthod.* 2011; 33:450-6.
- [3]. Schabel BJ, Franchi L, Baccetti T, McNamara JA Jr. Subjective vs objective evaluations of smile esthetics. *Am J Orthod Dentofacial Orthop.* 2009;135: S72-9.
- [4]. Erickson KL, Bell WH, Goldsmith DH: Analytical model surgery, in Bell WH (ed): *Modern Practice of Orthognathic and Reconstructive Surgery.* Philadelphia, PA, Saunders, 1992, p156.
- [5]. Şenışçık NE, Hasipek S. Occlusal cant: etiology, evaluation, and management. *Turk J Orthod.* 2015;27(4):174–180.
- [6]. Padwa BL, Kaiser MO, Kaban LB. Occlusal cant in the frontal plane as a reflection of facial asymmetry. *J Oral Maxillofac Surg.* 1997;55:811–816.
- [7]. Jayakrishnan Mithun K, Shetty KN, et al. Clinical innovation CANT identification device in orthodontics—enabling early detection of occlusal CANT. *Int J Innovative Sci Res Tech.* 2020;5(2):2456–2465.
- [8]. Burstone CJ. Diagnosis and treatment planning of patients with asymmetries. *Semin Orthod.* 1998;4(3):153-64.

- [9]. Jeon YJ, Kim YH, Son WS, Hans MG. Correction of a canted occlusal plane with miniscrews in a patient with facial asymmetry. *Am J Orthod Dentofacial Orthop.* 2006;130(2):244-52.
- [10]. Lamarque S. The importance of occlusal plane control during orthodontic mechanotherapy. *Am J Orthod Dentofacial Orthop.* 1995;107(5):548-58.
- [11]. Kasrovi PM, Meyer M, Nelson GD. Occlusion: an orthodontic perspective. *J Calif Dent Assoc.* 2000;28:780-790. Review.
- [12]. Davies SJ, Gray RM, Sandler PJ, O'Brien KD. Orthodontics and occlusion. *Br Dent J.* 2001;191:539-542, 545-549.
- [13]. Uşümez S, Orhan M. Inclınometer method for recording and transferring natural head position in cephalometrics. *Am J Orthod Dentofacial Orthop.* 2001;120:664-670.
- [14]. Liu XJ, Li QQ, Pang YJ, Tian KY, Xie Z, Li ZL. Modified method of recording and reproducing natural head position with a multicamera system and a laser level. *Am J Orthod Dentofacial Orthop.* 2015;147(6):781-787.
- [15]. Penton-Voak IS, Jones BC, Little AC, Baker S, Tiddeman B, et al. Symmetry, sexual dimorphism in facial proportions and male facial attractiveness. *Proc Biol Sci.* 2001;268:1617-1623.
- [16]. Jones BC, DeBruine LM, Little AC. The role of symmetry in attraction to average faces. *Percept Psychophys.* 2007;69:1273-1277.
- [17]. Little AC, Jones BC. Attraction independent of detection suggests special mechanisms for symmetry preferences in human face perception. *Proc Biol Sci.* 2006;273:3093-3099.
- [18]. Hönn M, Götz G. The ideal of facial beauty: a review [in German]. *J Orofac Orthop.* 2007;68:6-16.
- [19]. Occlusal Cant: Etiology, Evaluation, and Management Neslihan Ebru Sxenısxık1 and Selcan Hasipek
- [20]. Occlusal plane canting: a treatment alternative using skeletal anchorage Marcel Marchiori Farret1,2,3,4,
- [21]. Clinical Innovation CANT Identification Device in Orthodontics- Enabling Early Detection of Occlusal CANT Jayakrishnan1 , Mithun K2 , K Nillan Shetty3 , Rohan Rai4 , Anjali Jayaraj
- [22]. Development and validation of an occlusal cant index Hessah A. Alhuwaish and Khalid A.Almoammar
- [23]. An archwire for non-invasive improvement of occlusal cant and soft tissue chin deviation Eric Jein-Wein Liou1 , Kunal Mehta2,3,4, James Cheng-Yi Lin5,6