FUNDAMENTALS OF OCCLUSION IN PROSTHETIC DENTISTRY: A REVIEW ARTICLE

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Abstract: Occlusion is often considered the foundation of dentistry, as it plays a crucial role in achieving optimal treatment outcomes. A comprehensive understanding of occlusion and the anatomy of the stomatognathic system is essential for designing prostheses that function harmoniously, promote oral health, and prevent potential complications.
Keywords: Occlusion, Principles of occlusion, Masticatory function, Occlusal harmony, Functional occlusion, Temporomandibular joint (TMJ), Biomechanics, Stability.

INTRODUCTION:

Occlusion is a broad concept that extends beyond the alignment of teeth. It refers to the dynamic biological interactions within the masticatory system that regulate tooth contacts during both function and dysfunction. This system involves the coordinated action of the jaw muscles, temporomandibular joints (TMJs), and teeth. While key morphological and physiological characteristics—such as jaw muscle properties, jaw shape and size, and tooth eruption sequence—are genetically determined, functional relationships develop and mature over time. However, once established, the jaw muscle system continues to adapt based on function and parafunction.

A primary goal of restorative dentistry is to maintain or restore optimal dental occlusion. Treatment should aim to facilitate smooth, unhindered mandibular movements, avoiding occlusal interferences and excessive forces on the teeth, periodontal structures, or TMJs. For successful outcomes, all components of the masticatory system must function harmoniously and adapt to changes in occlusal morphology. Therefore, a thorough understanding of dental occlusion and masticatory system dynamics is essential for dentists.

Occlusion:

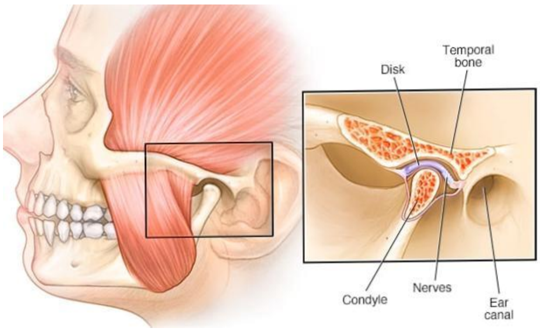
Occlusion refers to the static relationship between the incising or masticating surfaces of the maxillary and mandibular teeth. It is considered a stationary position since the mandible remains still. In contrast, the dynamic interaction between the mandible and maxilla is known as articulation, which describes the contact between the masticatory or incising surfaces of the teeth during functional movements of the mandible.

Temporomandibular joint:

The temporomandibular joint (TMJ) consists of the glenoid fossa, condyle, and articular disc, which divides the joint into upper and lower compartments. The upper compartment, between the glenoid fossa and the articular disc, allows translational movements, while the lower compartment, between the condyle and the disc, enables rotational movements. A synovial membrane lines the joint capsule and produces synovial fluid to lubricate both compartments.

The articular disc, made of avascular fibrous connective tissue, has three regions: anterior, intermediate, and posterior bands. It has a low friction surface and is stabilized between the condyle and articular eminence by its thick rim with viscoelastic properties.

The lateral pterygoid muscle, essential for mastication, has two heads: the superior head attaches to the articular disc and joint capsule, while the inferior head connects to the condyle's neck. Some studies suggest variations in the attachment of the superior head to the joint capsule and condyle.

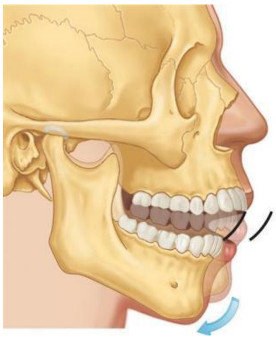


Mandibular movements:

The mandible is capable of two types of movements: translational and rotational. Translational movements occur when all parts of a body move in the same direction and at the same speed. In the TMJ, this happens when the condyle and disc move together along the articular eminence, such as during mandibular protrusion.

Rotational movement occurs when the condyle rotates around an imaginary axis. These rotational movements are described around three axes: horizontal, vertical, and sagittal. The rotation happens around the Terminal Hinge Axis, an imaginary axis that passes through both condyles. In centric relation (CR), the mandible can only perform hinge opening and closing movements. These movements occur in the sagittal plane, within a range of 20-25mm, measured between the upper and lower incisors (horizontal axis).

The vertical axis passes through the working condyle during lateral excursion of the mandible, while the sagittal axis runs from front to back, passing through the working condyle during lateral movements. In this case, the non-working condyle rotates downward



and medially.

DISCUSSION

Concepts of complete denture occlusion

Static concept - The static relations in occlusion include centric occlusion, protrusive occlusion, right and left lateral occlusion. All of these relations must be balanced with the simultaneous contacts of all the teeth on both sides of the arch at their very first contact. The cuspal inclines should be developed so that the teeth can glide from a more centric occlusion to eccentric positions without interference and without the introduction of rotating or tipping forces.

Dynamic concept - The dynamic concept of occlusion is primarily concerned with opening and closing movements involved in mastication. Jaw movements and tooth contacts are made, as the teeth of one jaw glide over the teeth of the opposing jaw. Movements of the mandible which occur when the teeth are not in contact are termed as free movements.

Occlusal rehabilitation in complete denture falls into four occlusal concepts:-

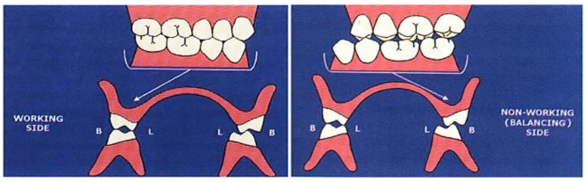
- Unbalanced articulation
- Balanced articulation
- Linear or monoplane articulation
- Lingualized articulation

Working and Non-working side

During mandibular lateral excursions, the side the mandible moves toward is called the working side, and the side it moves away from is the non-working side. The condyle on the working side is known as the working or rotating condyle, while the condyle on the non-working side is the non-working or orbiting condyle. The working condyle rotates around the vertical axis during lateral excursion, and it can also move laterally, backward, upward, and downward.

Meanwhile, the non-working condyle undergoes a translatory movement, shifting medially as it leaves centric relation (CR). This movement, known as the immediate side shift, refers to the lateral translation of the mandible towards the working side before the rotational movement of the working condyle occurs. The amount of immediate side shift can vary among patients and even from one side of the mandible to the other in the same patient.

There is also a progressive side shift, which represents a translatory portion of mandibular movement in a specific plane. It occurs in direct proportion to the forward movement of the non-working condyle. Both the immediate and progressive side shifts are important, as they affect the occlusal morphology of the teeth and influence overall mandibular movements.

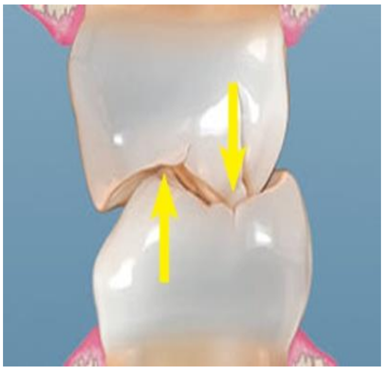


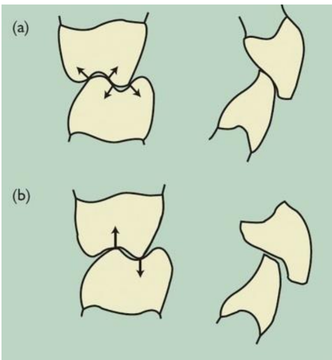
Supporting and non-supporting cusps

Cusps of posterior teeth are classified as supporting or non-supporting. The supporting cusps include the mandibular buccal and maxillary palatal cusps when the posterior teeth are in normal occlusion (i.e., no cross-bite or reverse horizontal overlap). The non-supporting cusps are the mandibular lingual and maxillary buccal cusps. Supporting cusps are typically rounded and blunt, while non-supporting cusps are pointed and well-defined.

Supporting cusps play a major role in maintaining vertical occlusal dimension and in mastication. Their tips are generally located near the center of the tooth, allowing occlusal forces to be directed along the long axis of the tooth, minimizing lateral stresses when the teeth are in Maximum Intercuspation Position (MIP). Non-supporting cusps help provide vertical and horizontal overlap between posterior teeth, reducing the risk of tissue impingement (such as tongue and cheek biting), and guide mandibular movement during mastication. They also help maintain the food bolus on the occlusal table.

Each cusp has an inner and outer aspect, both formed by incline planes. The inner aspect extends from the cusp tip to the central fossa, while the outer aspect extends from the cusp tip to the height of the contour on the labial and lingual surfaces of the posterior teeth.





The contact between upper and lower teeth

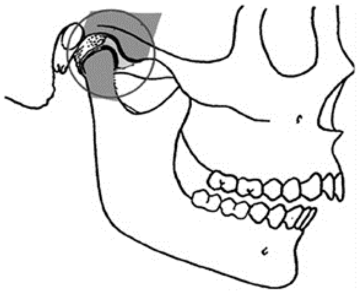
The area of occlusal contact between unworn opposing teeth is small. The level of friction is low as a consequence, and the space between the occlusal surfaces provides an escape way for the sheared bolus. This enables full use of the overlaps and efficient mastication. Increasing wear causes the contacting surfaces to become larger and flattened, and the space for the escape way to be reduced. The whole outer aspect of the supporting cusp may eventually occlude with the inner aspect of the non-supporting cusp. The occlusal contacts in the MIP and the position of the mandible in the MIP should be stable so that occlusal force does not cause adverse effects. However, the number of occlusal contacts per tooth is low. A lower number of occlusal contacts was found when light occlusal pressure was applied than when a heavier pressure was applied. This occlusal area of contact was found to increase with increasing of the occlusal pressure.

Centric Relation

Centric relation (CR) is the position of the condyles when they align with the thinnest avascular portion of their respective discs, with the condyle-disc assembly in the anterior-superior position against the articular eminences. This position is independent of tooth contact. CR is not a specific mandibular position but rather an axis around which the mandible can rotate, restricted to pure rotational movement about the Terminal Hinge Axis (THA). CR is clinically identifiable, recordable, and reproducible in patients without pain or dysfunction in the TMJ.

The condyle's position in CR is commonly used as a reference point when Maximum Intercuspation Position (MIP) is unsatisfactory or when occlusal rehabilitation is necessary, and it is also used in edentulous patients when planning for complete dentures.

To record CR clinically, several methods are employed, such as bimanual mandibular manipulation (with or without a jig), chin point guidance (with or without a jig), and Gothic arch tracing. The bimanual manipulation technique is generally considered more consistent than the others. CR and MIP are assessed during mandibular border movements in the



sagittal plane.

Determinants of Occlusion

Occlusion and mandibular movements are influenced by three key determinants: the temporomandibular joints (TMJ), referred to as the posterior determinant; the teeth, known as the anterior determinant; and the overall neuro-masticatory system (see Table 1). Clinicians cannot alter the posterior determinants (TMJs) since these are fixed, but they have the ability to modify the anterior determinant (teeth) for better or worse. The neuro-masticatory system must adapt to the restorative changes made during treatment.

The posterior determinant - The TMJ significantly influences mandibular movement and, consequently, tooth shape. Three TMJ features are key: condylar inclination, glenoid fossa medial wall morphology, and condyle shape. These dictate mandibular movement (direction, range, timing), affecting cuspal angle steepness and ridge/groove direction. Condylar inclination (articular eminence angle) directly impacts condylar path and cuspal angles. Steeper inclination means steeper cusps. This angle varies considerably (17-77 degrees). These influences are categorized as vertical (affecting cusp steepness, like condylar inclination) and horizontal (affecting ridge/groove direction, like side shift). Greater condylar inclination leads to steeper cuspal angles and deeper fossae because the mandible moves downward at a steeper angle during protrusion.

Mandibular side shift (sideways movement) is also crucial. The non-working condyle moves downward, inward, and forward. The glenoid fossa medial wall and temporomandibular ligament influence this, determining if the shift is immediate or progressive. Immediate side shift (sudden shift) occurs with a loose ligament and space at the medial wall, requiring less steep cusps, shorter cusps, and shallower fossae. No immediate side shift (tight ligament, close medial wall) allows steeper cusps, greater height, and deeper fossae. Progressive side shift (gradual movement) also allows steeper cusps. Side shift direction and timing further refine cuspal angles. The working condyle's superior, inferior, posterior, and anterior movements, along with the non-working condyle's downward movement, all contribute to occlusal morphology. Steeper downward movement means steeper cuspal angles and deeper fossae.

The anterior determinants- The anterior determinant refers to the combined influence of both front and back teeth on jaw movement and tooth shape. While posterior teeth act as a vertical stop for the mandible, anterior teeth guide the mandible into maximum intercuspation (MIP) and during side-to-side and forward movements. In cases of anterior open bite, where the front teeth don't meet, this guidance is lost, and posterior teeth may take over this role. Key components of the anterior determinant include the incisal guidance (the vertical and horizontal overlap of the front teeth), the occlusal plane, the Curve of Spee, and the Curve of Wilson.

IMPORTANCE:

The idea of balanced occlusion for dentures, initially intended to improve retention during chewing, proved impractical as even a small food particle disrupts the balance. While denture teeth do make some contact during chewing (though only briefly throughout the day), balance is now considered important for other movements like swallowing, denture reseating, and bruxism. Without balance, dentures can shift, tip, or torque, causing inflammation and bone resorption. Even if these non-chewing contacts involve less force, many patients find comfort only with balanced occlusion. Equal contact of all posterior teeth in centric relation is crucial for mucosal health.

Chewing force with natural teeth varies widely (5-175 pounds) based on food choices, tooth support, crown integrity, and muscle development. Denture wearers, however, exert significantly less force. Studies show average chewing force for denture wearers in the molar/bicuspid area is around 22-24 pounds, dropping to nine pounds in the incisor area. Overall, denture wearers can only generate 10-15% of the chewing force of someone with healthy natural teeth, often barely enough for adequate chewing.

Therefore, using modified anatomic teeth and a semi-adjustable articulator (that accommodates facebow transfer and condylar guidance records to establish personalized incisal guidance) is recommended. Selective grinding based on bite records minimizes occlusal interferences and deflective forces. Patient education, motivation, and regular checkups are essential for long-term health of the supporting tissues.

Wearing the same dentures long-term leads to tooth wear and loss of occlusion, causing uneven force distribution and pathological changes in oral tissues. This results in discomfort, unstable occlusion, poor chewing, and aesthetic issues, potentially leading to denture intolerance. Regular yearly checkups are essential to maintain proper fit and stable occlusion. Patients should also be encouraged to practice good denture hygiene, such as removing them at night.

CONCLUSION:

Tooth loss impacts chewing, appearance, and a patient's mental well-being. While numerous occlusion theories exist, their practical application based on individual patient needs is often overlooked. Each case requires careful assessment of hard and soft tissues, bone resorption patterns, muscle control, and patient cooperation. A primary goal of restorative treatment is to create a dental occlusion that doesn't harm the stomatognathic system. Therefore, understanding basic occlusion and the masticatory system is essential for all dental professionals. Functional assessment and occlusal examination should be routine.

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