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Fundamentals of Occlusion: Overview

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Abstract: ***It is true when they say occlusion is the key of dentistry. It is important to understand occlusion and the anatomy of the stomatognathic system to provide a successfulprosthesis that cause no harm and function in harmony.***

Keywords: principles of occlusion, dental occlusion

1. Introduction

The term 'occlusion' represents a broader concept than the arrangements of teeth. Occlusion is the dynamicbiological relationships of components of the masticatory system that control tooth contacts during function and dysfunction. It is essentially the integrated action of thejaw muscles, temporomandibular joints and teeth. The essential characteristics of the system morphologically and physiologically are genetically determined (jaw muscle characteristics, jaw shape and size, tooth eruption sequence), and functional relationships mature during growth and development. However, once established,continual modification of the jaw muscle system occurs with function and parafunction.[1]

Temporomandibular Joint

To understand how the mandible moves, it is important to know the anatomy of the TMJ. Basically, the TMJ consists of the glenoid fossa, the condyle and the articular disc, which is located between the condyle and the fossa, and divides the joint into lower and upper compartments. The upper compartment is located between the inferior surface of the glenoid fossa and the superior surface of the articular disc. In this compartment only translational movements' occur.7 The lower compartment exists between the superior surface of the condyle and the inferior surface of the articular disc. In this compartment only rotational movements occur. A synovial membrane lines the joint capsule and produces the synovial fluid that fills these two compartments. The articular disc is composed of avascular fibrous connective tissue. It has three well-defined regions: the anterior; intermediate; and, posterior bands. The disc has a very low coefficient of friction and is stabilized between the condyle and the articular eminence by its thick rim, which has specialviscoelastic properties.[9] An important masticatory muscle is the lateralpterygoid muscle, which has two heads: the superior, and, inferior. The superior head is attached to the articular disc and the inferior head is attached to theneck of the condyle. Nonetheless, it has been reported that the superior head of the lateral pterygoid muscle is attached to the anterior medial portion of the capsule, with varying degrees of attachment to the lateral aspect of thecapsule.10 Parts of the superior head of the lateral pterygoid muscle were also reported to attach to the mandibular condyle. However, no direct insertion ofthe superior head of the lateral pterygoid muscle into the disc was found. The posterior band of the disc is attached to two layers: a superior (elastic);and, an inferior (inelastic) layer. The two layers are collectively known as abilaminar (retrodiscal) zone. The superior layer, being elastic, allows the discto maintain its relationship with the condyle during translational mandibular movements. The inferior layer is inelastic; therefore, it maintains a normal relationship between the disc and the condyle. In the bilaminar zone blood and nerve supply are present. The joint is also composed of ligaments such as the stylomandibular and temporomandibular ligament. The joint is also surrounded by a capsule. The various structures of the TMJ are displayed in.[6]

Mandibular Movement

The mandible can perform two types of movements: translational and rotational. In general, translational movements occur when all parts of a body move in the same direction at the same speed. In the TMJ, the condyle and disc move together along the articular eminence as in the mandibular protrusive movements. Rotational movement occurs when the condyle rotates around an imaginary axis. Rotational mandibular movements are described around three imaginary axes: Horizontal, vertical; and, sagittal. The rotation occurs around an imaginary axis known as the **Terminal Hinge Axis**, which passes through the two condyles. In centricrelation (CR), the mandible can only execute hinge opening and closing. These rotational movements occur in the sagittal plane and in the range of 20-25mmwhen measured between the upper and lower incisors (horizontal axis).The vertical axis passes through the working condyle during lateral excursion ofthe mandible. The sagittal axis is an anteroposterior axis, which passes throughthe working condyle during the lateral excursion of the mandible. In this casethe non-working condyle is seen rotating downwards and medially.

Border Movement

Posselt (1952) described the full range of jaw movement in three planes by tracing the path of the lower incisor teeth as the jaw is guided through the border paths. The border path is the maximum range of jaw movement which is determined by the jaw muscles, ligaments, movement limitations of the temporomandibular joints, and the teeth.

- The top of the border path is defined by the position and cuspal inclines of the teeth
- The retruded path is defined by the anatomy of the temporomandibular joints

Anterior Determinants:

The physical features of tooth guidance vary with tooth arrangement and inter arch relationships. Anterior guidance is provided by the vertical (overbite) and horizontal oranteroposterior (overjet) relationships of anterior teeth.

Posterior Determinants:

The influence of the TMJ on mandibular movements can be expressed by the inclination of the articular eminence (condylar inclination), the morphology of the medial wall of

the glenoid fossa and the shape of the condyle. These three factors influence the mandibular movements, as they dictate the direction, duration and timing of mandibular movements.

2. Tooth Contacts and Jaw Positions

The need to describe jaw and tooth positions accurately for treatment planning, writing of clinical reports and forlaboratory prescriptions requires an understanding of the following customarily accepted descriptive terms:

1) **Intercuspal contact** (IC) is the contact between the cusps, fossa and marginal ridges of opposing teeth.
2) **Iniercuspal position** (ICP, IP) is the position of the jaw when the teeth are in intercuspal contact (IC). Light rcoccurs with light tooth contact; in this situation, the number and area of tooth contacts are less than with heavy tooth contact (clenching). rcp is the tooth contact position at the end of the closing phase and the beginning of the opening phase of mastication. Most natural occlusions indicate rcp contacts as a combination of flat and inclined surfaces or inclined planes with supporting cusp to opposing tooth fossa or marginal ridge. The greatest number of contacts occurs between molar teeth, and this decreases to 67% contacts on first bicuspids and 37% contacts on second bicuspids. Light to heavy biting approximately doubles the number of tooth contacts (Riise & Ericsson 1983).
3) **Maximum intercuspation** (Mf) occurs with clenching(heavy bite force), when the number and area of tooth contacts are greatest. The increase in number and areaof tooth contacts occurs as a result of tooth compression within the periodontal space, which for individual teeth may be of the order of 100 rm in healthy periodontal tissues. With periodontal disease and periodontal bone loss, this may be greater.The distinction between rcp and Ml might appear to be of academic rather than clinical interest; however, the recognition of an increase in the number of tooth contacts is relevant when finalising anatomical tooth form for restorations, to ensure that with clenching there storation is not too heavily loaded.
4) **Centric occlusion** (CO) and ICP may be considered the same for clinical purposes; however, the Glossary of Prosthodontic Terms (Preston et al 1999) defines CO asthe tooth contact position when the jaw is in centric relation. CO may or may not be the same tooth contact relationship as ICP. Tooth contacts (CO) when the jaw is in centric relation may be more retruded than at ICP. In an epidemiological study, Posselt (1952) determined that CO and ICP coincided in only approximately 10%of natural tooth jaw relationships. In clinical practice, complete denture treatment usually requires working casts to be articulated in centric relation. The artificial tooth arrangement and jaw contact position between the denture teeth is then CO by definition.
5) **Median occlusal position** (MOP) is a dynamic tooth contact position that may be determined by a 'snap'(rapid) jaw closure from a jaw open position(McNamara 1977). Tooth contacts at MOP have been proposed as being equivalent to functional toothcontacts. MOP tooth contacts can only be determined clinically and are useful to indicate functional tooth contacts in clinical occlusal analysis.
6) **Centric relation** (CR) is the jaw relationship (also termed maxillomandibular relationship) in which the condyles are located in an anterorsuperior position in contactwith the central bearing surface (the thin avascular part) of the interarticular disc, against the articulareminence (Preston et a11999) (Fig. 1.1). This position is independent of tooth contact. RP and CR are describing similar clinical anatomical relationships. It is the condylar position at RP or CRthat is used for clinical recording of the jaw relationship for transfer to an articulator.

Lateral jaw positions

1) **Mediotrusive** (or non-working or balancing) side refers to the side of the jaw which moves towards themidline (or medially) in lateral jaw movement. The term 'balancing' may also be understood in functional terms as the 'non-working' side, that is, the side opposite the chewing side. Non-working side is considered in the analysis of casts on an articulator, or the arrangement of the teeth for complete or partial dentures, in which nonworking tooth contacts may be a desirable arrangement in denture construction. The term is also used in clinical occlusal analysis to identify the arrangement of teeth and the presence of mediotrusive (or balancing or non-working) tooth contacts or interferences.
2) **Laterotrusive** (or working) side refers to the side of the jaw which moves laterally away from the midline in jaw movement. This may also be termed the 'working' or chewing side in function, that is, the side where chewing occurs.
3) **Bennett movement and Bennett angle** are terms originally described by Bennett (1906) as the first clinical study which identified lateral or side wards movement of the jaw and differentiated the bilateral features of condyle movement with remarkable clarity in one subject(Bennett himself).
4) **Bennett movement** describes a lateral component of movement of the condyle with laterotrusive jaw movement. Bennett described a lateral horizontal component of movement, which has also been described in relation to the setting of articulatorcondylar guidance as 'immediate side shift' (ISS).The latter is strictly an articulator term. There is some evidence from clinical recordings (Gibbs & Lundeen1982) that Bennett movement may occur in function,in some individuals, at the end of the closing path of a chewing movement.
5) **Bennett angle** is the angle formed by movement of the contralateral condyle with the sagittal plane during lateral jaw movement. The contralateral (or balancing) condyle moves downwards, forwards and medially, forming an angle (Bennett angle) with the sagittal plane when viewed anteriorly (from the front) or superiorly.

Occlusal Interferences

Interferences are undesirable occlusal contacts that may produce mandibular deviation during closure to maximum intercuspation or may hinder smooth passage to and from the intercuspal position. There are four types ofocclusal interferences.

1) Centric
2) Working
3) Nonworking
4) Protrusive

The **centric interference** is a premature contact that occurs when the mandible closes with the condyles in their optimum position in the glenoid fossae. It will cause deflection of the mandible in a posterior, anterior, and/or lateral direction.

A **working interference** may occur when there is contact between the maxillary and mandibular posterior teeth on the same side of the arches as the direction in which the mandible has moved. If that contact is heavy enough to disocclude anterior teeth, it is an interference.

A **nonworking interference** is an occlusal contact between maxillary and mandibular teeth on the side of the arches opposite the direction in which the mandible has moved in a lateral excursion. The nonworking interference is of a particularly destructive nature. The potential for damaging the masticatory apparatus has been attributed to changes in the mandibular leverage, the placement of forces outside the long axes of the teeth, and disruption of normal muscle function.

The **protrusive interference** is a premature contact occurring between the mesial aspects of mandibular posterior teeth and the distal aspects of maxillary posterior teeth. The proximity of the teeth to the muscles and the oblique vector of the forces make contacts between opposing posterior teeth during protrusion potentially destructive, as well as interfere with the patient's ability to incise properly.

Canine Guidance

The Glossary of Prosthodontic Terms5 defines canine guidance as a form of mutually protected occlusion in which the vertical and horizontal overlap of the canine teeth disengages the posterior teeth in the excursive movements of the mandible. Accordingly, when the mandible moves to one side, the overlap of canines results in separation (disclusion) of posterior teeth on the working side. The mandible is guided by the canines during its lateral excursions with posterior teeth disclusion. In lateral mandibular excursions, the vertical and horizontal overlap relationships of the canines should be enough to disclude all other teeth. Canine guidance is more commonly seen in young patients whose canines are not worn. It may also be created by adding restorative materials (such as composite) when a posterior fixed prosthesis or implant-retained fixed prosthesis is planned in order to protect it. Canine teeth are suitable to guide the mandible during its excursive movement for many reasons, as previously mentioned. Furthermore, canines have a favourable root anatomy and a lower crown–root ratio. They are also supported by sense and compact bone, which tolerate occlusal forces better than cancellous bone. In addition to this, they have a strategic position in the jaws.

Group Function

Group function is defined as multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side whereby simultaneous contact on several teeth acts as a group to distribute occlusal forces. When the mandible moves to one side, two or more pairs of opposing teeth guide the mandible. Ideally, contacts should be between canines, premolars and the mesiobuccal cusp of the first molar. The group function occlusion can be seen in patients whose canines were worn away or are missing, thus allowing the posterior teeth to come in contact during lateral movements of the mandible. It may also be found in Class III malocclusion when the anterior teeth are in an edge-to-edge position, or have a reverse horizontal overlap.

3. Conclusion

A thorough understanding of the basic anatomy and how the stomatognatic system functions is necessary to make the right decisions while treating patients, to provide a restoration that causes no harm and falls in a harmony.

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