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OCCLUSAL CONTACTS IN VARIOUS MALOCCLUSIONS - A REVIEW

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ABSTRACT

Mastication is one of the essential functions of the stomatognathic system. Occlusal contact during masticatory function is needed for grinding food and it ensures the formation of bolus. Mastication of food is dependent on the total occlusal contacts, occlusal contact area and the number of teeth in occlusion. Occlusion is defined as a manner in which the maxillary and mandibular teeth coincide with each other in all mandibular positions and movements. It results from neuromuscular control of the components of masticatory systems which includes teeth, periodontal structures, maxilla and mandible, temporomandibular joints and their associated muscles and ligaments. It appears that the functional occlusal area is an essential determinant of masticatory performance when compared to the occlusal surface or the platform area. The functional occlusal area has been measured as the number of contacts or areas of contact. The essential occlusal contacts in patients with malocclusion will help to explain the masticatory mechanism. This review is prepared to report all the aspects of occlusal contacts, their role in mastication and also occlusal contacts in various malocclusions.

Keywords: Dentition, Malocclusion, Mastication, Molars, Occlusion, Occlusal contacts

INTRODUCTION

Mastication is one of the important functions of the stomatognathic system that is subject to change during orthodontic treatment. Characteristics of the oral system, like dentition, jaw muscle activity, bite force and salivary flow rate, influences the masticatory process. Dentition and bite force have been shown as the vital determinants of masticatory function **[1]**. Teeth are essential in the masticatory system since they form the occlusal platform where food particles are fragmented. This fragmentation depends on the total occlusal area and thus on the number of teeth. Numerous variations in masticatory function may be associated with various dental factors such as the number of teeth present, number of occluding tooth contacts, the number of occluding pairs of teeth, the occlusal surface and the occlusal contact area **[2]**. It appears that the functional occlusal area is an essential determinant of masticatory performance when compared to the occlusal surface or the platform area. The functional occlusal area has been measured as the number of contacts or areas of contact. The essential occlusal contacts in patients with malocclusion will help to explain the masticatory mechanism **[3]**. Because orthodontists strive to create a functional occlusion at the end of orthodontic therapy, it is essential to investigate the various aspects of occlusion that might be related to masticatory function. It has been shown that subjects with malocclusion do not perform well when compared to those with normal occlusion.

Our extensive research expertise ranged from epidemiological studies to randomised clinical trials that have been published in reputed journals **[4–13]**. This knowledge was instrumental for us to review about the occlusal contacts in various malocclusions.

CLASSIFICATION OF MALOCCLUSION

Angle's Classification of Malocclusion

Class I malocclusion

According to Angle the mesiobuccal cusp of the maxillary first permanent molar should occlude with the mesiobuccal groove of the mandibular first permanent molar. This is the most commonest type of malocclusion. The bite is usually normal, but the upper teeth tend to slightly overlap the lower teeth. In Class I malocclusion patients may exhibit the dental irregularities such as crowding, spacing, rotations, and missing tooth.

Class II malocclusion

This group is characterized by the Class II molar relation where the distobuccal cusp of

the maxillary first molar lies in the mesiobuccal groove of the lower first molar.

Class III malocclusion

This type of malocclusion exhibits a Class III molar relation with the mesiobuccal cusp of the maxillary first molar is present in the interdental space between the mandibular first and second molars.

OCCLUSAL CONTACTS:

The essential aspects of the occlusal contacts of the posterior teeth are: the mandibular position and its excursion at the time of their occurrence and their location, size, distribution.and possibly the number of teeth present. The variation in masticatory performance may be related to many different dental factors, such as the number of teeth present, number of occluding tooth contacts, the number of occluding pairs of teeth, the total occlusal surface and the occlusal contact area. If the occlusal forces produce unfavorable occlusal contacts and if the periodontal structures are susceptible, trauma from occlusion will occur **[14]**. This would result in alveolar bone loss and excessive mobility of the teeth. The occlusion is most favorable when the contacts are small and arranged symmetrically and when the forces are directed in a vertical direction, along the long axis of the tooth. Areas of occlusal contact that a supporting cusp makes with the opposing teeth in centric occlusion are centric stops **[15]**. Therefore centric stops can be defined as areas of tooth that make contact with the teeth in the opposing arch in intercuspal position (centric occlusion) and contribute to occlusal stability. Assessment of magnitude of occlusal contacts has been done by articulating papers, shim stocks, occlusal waxes or silicone impressions, but these methods have not proved efficacy in reproducing the occlusal contacts accurately. Evaluation of occlusal contacts using 3D digital models proved to be satisfactory **[16]**.

OCCLUSAL CONTACTS IN PHYSIOLOGIC OCCLUSION

Two main groups of occlusal contacts are described in physiologic occlusion; those that occur on inclined plane surfaces of the cusps and those that occur on the cuspal tips.

Contacts on steeply inclined planes may generate mechanical effects which are considered by some to be unfavourable for the permanent stability of the positions of the tooth pair involved, or of the mandible itself .The tipping of teeth in the frontal plane around a fulcrum in the root may disturb the normal mandible muscular function by means of effects mediated by the periodontal mechanoreceptors **[17]**.

Contacts between cusp tips and flat or nearly flat receiving areas such as fossae or occlusal embrasures on the central fossa line collectively are called 'cusp-fossa' contacts. Theoretically they appear less likely to generate mechanically unstabilizing, horizontal components of force, or to stimulate periodontal mechanoreceptors which, in turn, may inhibit normal mandibular muscle activity.

TYPES OF OCCLUSAL CONTACTS (Table 1)

Table 1 has been adopted from the article: Study of the number of occlusal contacts in maximum intercuspation before orthodontic treatment in subjects with Angle Class I and Class II Division 1 malocclusion **[18]**.

METHODS TO RECORD OCCLUSAL CONTACTS (Table 2)

Table 2 has been adopted from the article: Comparison of Occlusal Contact Changes During Retention Between Hawley-Type Retainers and Other Retention Appliances: A Systematic Review **[19]**.

Table 1: Types of Occlusal Contacts

TYPES OF OCCLUSAL CONTACTS	DEFINITION
Tripodism	**Centric retention cusp contacts the perimeter of the slopes of the opponent fossa in three points**
Bipodism	**Centric retention cusp contacts the perimeter of the slopes of the opponent fossa in two points**
Monopodism	**Centric retention cusp contacts the fossa in one individual point**
Cusp to marginal ridge	**Contact between the cusp tip and the opposite marginal ridge**
Cusp to two marginal ridges	**Two contacts between the cusp tip and two opposite marginal ridges**
Cusp to opposite inclined planes	**Individual contact on the cusp tip and the internal slope, external slope, mesial or distal slope of the opposite side**
Surface to surface	**Individual contact between two opposing slopes**
Edge to edge	**Individual contact between cusp tip and cusp tip on the opposite side**

Table 2: Methods to Record Occlusal Contacts

AUTHOR	STUDY DESIGN	INTEROCCLUSAL REGISTRATION	OUTCOME
Durbin and Sadowsky	**Prospective study**	**Polyether impression bite**	**No. of occlusal contacts**
Haydar *et al*	**Prospective study**	**Silicone based impression bite**	**No. of occlusal contacts**
Sauget *et al*	**Randomised controlled trial**	**Polysiloxane**	**No. of occlusal contacts**
Dincer *et al*	**Prospective study**	**Silicone putty**	**No. of occlusal contacts**
Basciftci *et al*	**Prospective study**	**Silicon based impression bite**	**No. of occlusal contacts**
Sari *et al*	**Prospective study**	**Silicone putty**	**No. of occlusal contacts**
Sultana *et al*	**Randomised controlled trial**	**Pressure sensitive sheet**	**Occlusal force, Occlusal contact area**
Varga *et al*	**Controlled clinical trial**	**Hawleys transparent strips**	**Bite force, No. of occlusal contacts**

Occlusal contact points can be determined clinically on patients with the aid of articulated dental casts. The patient will be in a vertical position, with the back and head on a reclined dental chair, approximately 45 degrees to the floor. The patient will be asked to open and close his mouth until MI is reached. After prophylaxis and drying of all teeth, the patient will be asked to open and close his mouth and occlusal contacts will be assessed using 12 μm articulating film (Accu film II, ParkellTM, Farmingdale, New York, USA). In this way, when in occlusion, the contacts will be marked. An **[20]** other method is polyvinyl siloxane-based occlusal registrations (Re´Cord®, Bosworth, Illinois, USA) is used to obtain posterior occlusal contacts bilaterally .The bite registration material will be applied to the occlusal surfaces of all lower canines, premolars, and molars both sides with a silicone gun and subject was asked to apply moderate bite pressure for 30 seconds **[20]**.

OCCLUSAL CONTACTS IN NORMAL OCCLUSION

Possible contacts in a normal occlusion was found to be 138, ranging from 90 to 103 for 28 teeth according to study by Ziebert **[21]**. The total average of occlusal contacts in normal occlusion was found to be 79 in maximum intercuspation according to Erhlich *et al* **[22]**. Riise *et al* **[23]** in his study using light occlusal pressure, registered a mean value of 11 contacts per subject. and cusp-fossa type of contacts on the buccal supporting cusp were majorly present in normal occlusion in the study conducted by Hellman *et al* **[24]** and Erhlich *et al* **[22]**. Athanasiou *et al* **[15]** established an average of 23.8 contacts per arch in subjects with normal occlusion using the technique of photo-occlusion. Thus, Ross *et al* **[25]** also recorded an average of 24 occlusal contacts for patients with normal occlusions. The areas of occlusal contact were greater for subjects with normal occlusion than those with malocclusion **[26]**.

OCCLUSAL CONTACTS IN DIFFERENT MALOCCLUSIONS

Occlusal contacts in Class I malocclusion:

Possible contacts in class I malocclusion were found to be 237 according to Kanno *et al* **[18]**. The total average of occlusal contacts in Class I malocclusion was found to be 43.38 and mean number of contacts per arch was found to be 21.69 contacts in the study by Kanno *et al* **[18]**. Gondim *et al* **[27]** in his study registered an average of 23.20 contacts per arch and Oliveira *et al* **[28]** with 20.5 contacts per arch in class I malocclusion. In Class I malocclusion higher frequency of occlusal contact types corresponded to the

surface to surface and a cuspid to marginal ridge in 21.52% and 20.68%, respectively and tripodism and edge to edge occlusal contacts registered the smallest percentage of total, with 2.53% and 1.27% respectively in study by Kanno *et al* **[18]**. In Class I malocclusion, the monopodism occlusal contact type was located on distobuccal cuspid and the central fossa of the first mandibular molar, and the central fossa and the palatal mesial cuspid of the first maxillary molar in the study by Kanno *et al* **[18]** ande Gondim *et al* **[27]**.

Occlusal contacts in Class II malocclusion:

Possible contacts in class II malocclusion was found to be 246 according to Kanno *et al* **[18]** .The total average of occlusal contacts in Class II malocclusion was found to be 44.38 and mean number of contacts per arch was found to be 22.19 contacts in the study by Kanno *et al* **[18]** similar to the findings of McNamara and Henry **[29]** with an average of 19.7, Riise and Ericsson **[23]** with an average of 18.15, and Taicher and Ehrlich **[22]** with an average of 39.5, Garrido *et al* **[30]** with an average of 19.43.This average was relatively higher in comparison to other studies: Aoki *et al* **[31]** with an average of 7.14, Korioth **[32]** with an average of 14.0, McDevitt and Warreth [26] with an average of 11.5, and Ferrario *et al* **[33]** with an average of 13.0. In Angle Class II Division 1, the most frequent contact types corresponded to the surface to surface (30.08%) and monopodism (18.70%). The lower frequency was shown by tripodism (3.66%) and edge to edge (0.41% in study by Kanno *et al* **[18]**. The type of occlusal contact surface to surface had the greater frequency in class II malocclusion in study by Kanno *et al* **[18]** and Ross *et al* **[25]**.

Occlusal contacts in Class III malocclusion:

Areas of occlusal contact were smaller for class III malocclusion when compared to normal occlusion and other malocclusions **[18]**.

RECENT ADVANCES IN MEASURING OCCLUSAL CONTACTS

Assessment of magnitude of occlusal contacts has been done by articulating papers, shim stocks, occlusal waxes or silicone impressions, but these methods have not proved efficacy in reproducing the occlusal contacts accurately **[34]**. Several Three Dimensional imaging systems of study models are available to produce 3D digital models of a patient's teeth. Evaluation of occlusal contacts using 3D digital models proved to be satisfactory **[35]**.

T- Scan (T-Scan III, Software version 8.0.1, Tekscan, Inc.,Boston, MA, USA) is a digital

occlusion analysis system that records and measures tooth contact, force and timing in real time using a thin, flexible, pressure sensitive bite transducer embedded in dental arch shaped recording sensor. The occlusal data obtained from T-Scan can be represented graphically as 2D or 3D images for analysis. It records the centre of force, first contact, maximum bite force and maximum intercuspation **[36]**.

CHALLENGES FACED DURING MEASUREMENT OF OCCLUSAL CONTACTS

Occlusal contacts are difficult to be compared and contrasted between published papers because of the lack of similarity in the methodology and definition of interocclusal contact areas. Dawson and Arcan's classification **[37]** of occlusal contacts is based on the degree of light penetration into the occlusal wafer. Another classification is dependent on the thickness or colour change of registration materials. So a standard method of measuring occlusal contacts would be useful in comparing the occlusal contacts in normal occlusion and malocclusion.

CONCLUSION

A thorough knowledge of various types and methods of measuring occlusal contacts is needed for clinical practice since the ultimate goal of orthodontists at the end of orthodontic therapy would be to obtain a functional occlusion. Areas of occlusal contact were greater for subjects with normal occlusion when compared with subjects with malocclusion.Class I malocclusion had larger occlusal contacts when compared to other malocclusions and the least was for Class III malocclusion. Recent technologies like T-Scan proves to be a reliable method in assessment of occlusal contacts.

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AUTHOR CONTRIBUTION

First author Vaishali.S contributed conception, manuscript preparation, formatting and drafting the article and Second author Ravindra Kumar Jain contributed to literature collection, revising it critically for important intellectual content, supervision and guidance.

CONFLICT OF INTEREST

None

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