A Study For Clinical Assessment Of The Relationship Between Freeway Space and Various Occlusal Parameters

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Abstract: Aim: Purpose of this study was to clinically assess relationship between freeway space (FWS) and occlusal schemes, overjet, overbite and wear facets. Methodology: 60 subjects fulfilling the inclusion criteria within the age range of 20-40 years were included in the study. Vertical dimension at rest (VDR) and occlusion (VDO) were measured with digital vernier calliper. Lateral occlusal scheme was examined intraorally. Overjet-overbite were measured at mandibular right central incisor on dental casts. Data were analysed statistically using chi square test ($\chi 2$) and Pearson's correlation (r). Results: A significant association was observed between FWS and occlusal scheme. Group function occlusion was found in 18 out of 26 subjects with FWS<2mm, whereas canine guided occlusion was found in 20 out of 30 subjects with FWS of 2-4mm. A significant positive correlation was observed between FWS and anterior overjet. Presence of occlusal wear facets was found in 20 out of 26 subjects with FWS< 2mm whereas in subjects with FWS=2-4mm, 8 out of 30 subjects showed presence of occlusal wear facets. Conclusion: Group function occlusion scheme and an increase in occlusal wear facets were found more prevalent when FWS was less than 2mm. An increase in FWS resulted in an increase in overjet. [Mehta S Natl J Integr Res Med, 2019; 10(4):46-51]

Key Words: Vertical dimension at occlusion, freeway space, canine guided occlusion, group function occlusion, overjet, overbite

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Introduction: Occlusal attrition may be defined as the wearing away of one tooth surface by another tooth surface[1]. Minimal attrition of occlusal surfaces of the teeth over a period of time is a natural phenomenon. However, excessive occlusal attrition is considered a pathology and can result in pulpitis, occlusal disharmony, impaired function, and esthetic disfigurement. Such patients often require extensive restorative treatment. Owing to the multifactorial etiologies of attrition, abrasion and erosion; identification and treatment of this clinical scenario becomes imperative and crucial for maintenance of the entire stomatognathic system.

The different clinical situations can be classified in to three categories, as proposed by Turner and Missirlian[2].
Category 1 including patients having excessive wear with loss of occlusal vertical dimension,
Category 2 including patients having excessive wear without loss of occlusal vertical dimension but with available FWS
Category 3 including patients having excessive wear without loss of occlusal vertical dimension but with limited available FWS.

In treatments requiring the restoration of VDO, we need to know the amount of FWS available interocclusally. FWS is the distance between the occluding surfaces of the maxillary and mandibular teeth when the mandible is in physiologic rest position[3]. Most studies recommend a freeway space in range of 2–4 mm, measured from 1st premolar when mandible is in physiologic rest position[4].

There have been tremendous variety of methods reported in the literature so far, for recording VDO in edentulous and dentulous patients. This method include pre-extraction records, radiographic methods, phonetics method, physiologic swallowing method and relaxed posture of mandible with the head in upright position[5-11]. Encroachment of the FWS may result in undue stretching of masticatory muscles causing excessive muscle contractions which in turn might damage the teeth, periodontium, supporting tissues and temporomandibular joint[12].

Selection of an ideal occlusal scheme which has to be followed during full mouth rehabilitation is significant. Occlusal schemes according to the tooth contact condition in eccentric movements can be divided as mutually protected occlusal scheme or canine protected occlusal scheme, group function occlusal scheme and balanced occlusal scheme. Mutually protected or canine

protected occlusion and group function occlusion have been utilized to rehabilitate dentition with fixed prosthesis[13]. It has been reported that the prevalence of occlusion schemes can be influenced by following factors: (i) patient's age, (ii) magnitude of lateral excursion and (iii) the static occlusal relationship.

This study was undertaken with the aim to evaluate the relationship between FWS and occlusal schemes; along with measuring anterior overjet, overbite and occlusal wear facets which can aid in restoration of extremely wornout dentition.

Methodology: Sixty dentulous subjects were selected for the study after obtaining informed consent and ethical clearance from the Ethical Review board of the Institute. The subjects within the age range of 20-40 years who fulfilled the inclusion criteria were examined for the study. Inclusion criteria of the study comprised of: presence of fully erupted permanent teeth up to second molars, absence of partial group function on lateral excursive movements, absence of spacing or crowding in anterior teeth, absence of fixed prosthesis, absence of restoration of incisal edge or proximal surfaces of the tooth, absence of interferences on non-working side during lateral excursive movements. The exclusion criteria comprised of: history of any congenital conditions or trauma affecting facial form and appearance, history of orthodontic treatment, orthognathic surgery, and temporomandibular joint pain.

Identification of Occlusal Schemes: Canine protected occlusion is a form of mutually protected occlusion in which the vertical and horizontal overlap of the canine disclude the posterior teeth in the excursive movements of the mandible[14].

Group function occlusion can be defined as multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working-side whereby simultaneous contact of several teeth acts as a group to distribute occlusal forces[14]. The multiple contacts include contact between maxillary first premolar, second premolar, first molar and second molar with the respective opposing mandibular tooth. The lateral occlusal schemes of subjects were calculated by two clinical methods, one by visual examination and other by engagement of articulating paper. Articulating paper of 40 microns thickness (Baush Arti-Check Articulating papers, Germany) was used for marking the occlusal contacts between teeth [Figure 1]. Lateral occlusal schemes were checked on both right and left working sides.

Figure 1: Verification of lateral occlusal scheme with articulating paper

Calculation of FWS: The subjects were seated on a dental chair in an upright position. Two soft tissue landmarks, one at base of the nose and other at prominence of the chin, were marked at the midline of the face using sticker and indelible pencil. The dimensions of VDO and VDR were recorded by a single investigator using a digital vernier calliper (Aerospace Digital Vernier Caliper) having an accuracy of 0.01mm [Figure 2]. Subjects were asked to pronounce words ending with "em" and then VDR was recorded by the operator. Similarly VDO was recorded with all the posterior teeth in maximum intercuspation. FWS was calculated by subtracting the values of VDO from VDR.

Figure 2: Position of the subject in an upright position (left). Marking of two reference points and measurement of vertical dimension using digital vernier calliper(right)

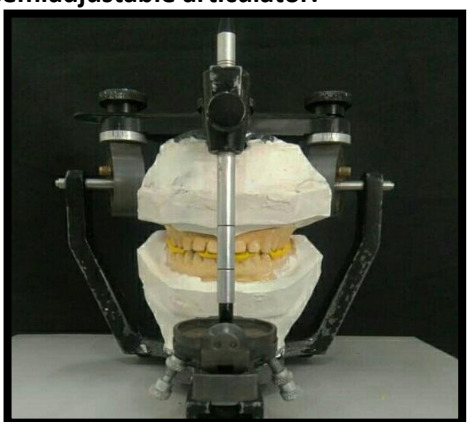
Measurement of Overjet and Overbite: Maxillary and mandibular diagnostic impressions were made with irreversible hydrocolloid impression

material (Marieflex, Septodont healthcare India Pvt Ltd) and casts were fabricated using Type III dental stone (Kaldent, Kalabhai Pvt Ltd, India). A facebow transfer was done to mount the maxillary cast on the Hanau Wide-Vue semiadjustable articulator [Figure 3]. Interocclusal bite was recorded at maximum intercuspation using polyvinylsiloxane bite registration material (Jet Bite, Coltene, Switzerland) [Figure 4]. The mandibular cast was mounted on the articulator using the bite registration record [Figure 5]. Overjet and overbite were measured on the cast at the region of mandibular right central incisor with the help of UNC-15 periodontal probe [Figure 6].

Figure 3: Facebow transfer to mount the maxillary cast on the articulator

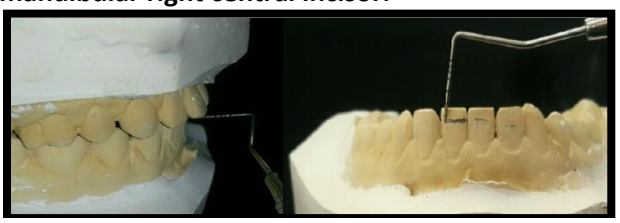
Figure 4: Interocclusal bite registration at maximum intercuspation.

Figure 5: Mounting of the casts on Hanau Wide-Vue semiadjustable articulator.



Identification of occlusal wear facets: Occlusal wear facets can be defined as loss of substance on the tooth surfaces as a result of attrition or abrasion[14]. The occlusal surfaces of all the posterior teeth were clinically examined for occlusal wear facets. The wear facets were also verified on the casts. This procedure was performed by a single operator.

Figure 6: Measurement of the overjet (left) and overbite (right) on the cast at the region of mandibular right central incisor.



The data collected were tabulated in a spreadsheet (Excel 2010; Microsoft Corp) and Chi square statistical analysis was conducted using SPSS software (IBM SPSS ver. 23). Pearson's correlation analysis was also performed for correlation of FWS with overjet and overbite.

Result: The results of this study are shown in tables and charts. Data obtained from the study was analysed using Chi square test and Pearson's Correlation.

A statistically significant association ($p<0.05$) was found with varying FWS and lateral occlusal scheme in the subjects. It was found that prevalence of group function occlusion was more in subjects with FWS less than 2mm whereas, canine guided occlusion was more prevalent in subjects with adequate FWS of 2-4mm. Equal prevalence of both the lateral occlusal schemes was found in subjects having FWS more than 4mm (Table 1).

Table-1: Frequency of Canine guided and Group function occlusion in individuals with varying freeway space.

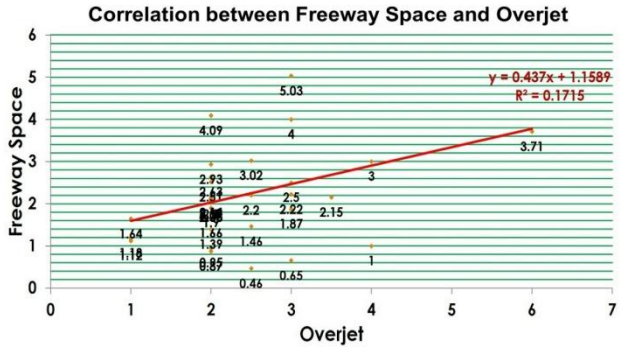
Free-way space (mm)	N	Canine guided Occlusion	Group function Occlusion
<2mm	26	8	18
2-4mm	30	20	10
>4mm	4	2	2
Total	60	30	30

χ 2value= 6.065 and p = 0.048 (Significant association found)

The correlation of FWS with the anterior overjet and overbite was performed using Chi square test

and Pearson's correlation analysis. A positive Pearson's correlation value(r=+0.414, p<0.05) was obtained for anterior overjet (Chart 1). It was observed that an increase in FWS resulted in increase in anterior overjet. On the contrary, no significant correlation (r=+0.006, p=0.96) between FWS and overbite was observed (Chart 2).

Chart 1: Chart representing highly significant positive correlation between Freeway Space and Overjet.



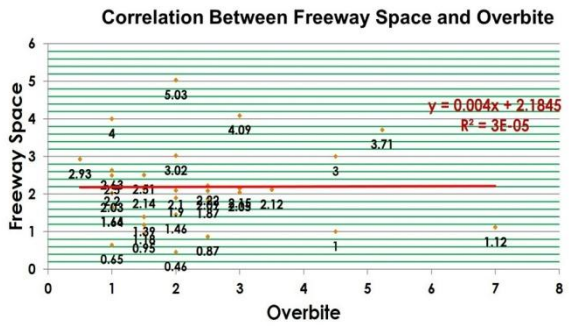
Similarly a statistically significant association was found between FWS and presence of occlusal wear facets using chi square test (p<0.05). The prevalence of occlusal wear facets was found more in subjects with FWS less than 2 mm while, minimal or absence of occlusal wear facets was associated with subjects having FWS of 2-4mm (Table 2).

Table–2: Frequency of individuals with Wear Facets on occlusal morphology in individuals with varying Freeway Space.

Free way space mm)	N	Wear facets present	Wear facets absent
<2mm	26	20	6
2-4mm	30	8	22
>4mm	4	2	2
Total	60	30	30

χ 2value=12.38 and p = 0.002 (Significant association)

Chart 2: Chart representing no significant correlation between Freeway Space and Overbite.



Discussion: The FWS or interocclusal clearance can be described as the space between the maxillary and mandibular occlusal surfaces when the mandible is in the rest position. It is found within a range of 2-4 mm [4]. Physiologic rest position of the mandible may be defined as the postural jaw relation when the patient is resting comfortably in an upright position and the condyles are in a neutral, unstrained position in the glenoid fossae[14]. It has been postulated that at physiologic rest position, a great reduction in activity of masticatory muscles is observed[15]. Electromyography (EMG) is an investigation which has been utilized for observing the muscle activity of the masticatory system. It has been reported that the physiologic rest position of mandible corresponds with the minimum baseline EMG levels[16]. Literature has suggested an increase in EMG activity in the muscles of mastication during eccentric and concentric grinding and edge-to-edge clenching for group function occlusion due to multiple tooth contacts[17,18,19]. These contacts on lateral excursion may cause less loading of the condyle on the working side of the occlusion[20]. On the contrary, canine guided occlusion has caused less muscle contractions leading to decrease in the EMG levels[17,21,22].

There have been studies in literature reporting a steeper lateral movement path and a narrower envelop of mandibular movement for canine guided occlusion when compared to group function occlusion[23,24,25] .

Hence, it can be inferred from the above studies that canine guided occlusion is more comfortable for the patient as it maintains the musculature in good health. The evaluation of the results of the present study and its correlation with Turner and Missirlian classification is shown in Table 3.

Kovac et al[26] reported that subjects with canine guided occlusion had significantly bigger overjet of anterior teeth and no significant statistical difference between the groups was found by comparing the results of the overbite of frontal teeth with regard to lateral occlusal schemes. The results of the present study are similar to the above study. An increase in FWS, which was associated with canine guided occlusion, showed an increase in anterior overjet whereas no significant association in relation with varying FWS and overbite.

Beyron[27] stated that abrasion of multiple teeth is an inevitable adjustment during stress distribution in group function occlusion. The present study concluded that in subjects with less FWS, in whom group function occlusion was more prevalent, more number of occlusal wear facets were noted. Hence, the result obtained was in favour of the phenomenon previously stated by Beyron.

Table 3- Correlation of Turner and Missirlian classification and results of the study.

Turner and Missirlian Category	FWS	Occlusal Scheme Prevelant	Derived Conclusion
1	>4mm	Group function occlusion Canine guided occlusion	As VDO is reduced and interocclusal clearance is more, rehabilitation can be done with group function occlusion or canine guided occlusion(as per requirement)
2	2-4mm	Canine guided occlusion	As VDO is maintained and interocclusal clearance is adequate, rehabilitation can be done with either of the lateral occlusal scheme, preferably canine guided occlusion.
3	<2mm	Group function occlusion	As VDO is maintained and available interocclusal clearance is less, rehabilitation should be done with canine guided occlusal scheme

Conclusion: Within the limitations of the present study, it can be concluded that: Analysis of freeway space should be carefully performed before commencing the full mouth rehabilitation. A decrease in free way space has significant association with bigger anterior overjet and presence of occlusal wear facets. Group function occlusal scheme is more prevalent in subjects with less than optimal freeway space. However, while rehabilitating these subjects, canine guided occlusal scheme should be advocated for the health of the orthognathic system.

Scope for further studies: Larger number of subjects may help in evaluating the prevalence of lateral occlusal schemes in Indian population.Identification of tooth contacts during lateral excursive movements performed using advance technology like Tekscan may help in accurate collection of the data.

References:

1. Smith BG. Dental erosion, attrition and abrasion. The Practitioner. 1975 Mar;214(1281):347.
2. Turner KA, Missirlian DM. Restoration of the extremely worn dentition. Journal of Prosthetic Dentistry. 1984 Oct 1;52(4):467-474.
3. Miralles R, Dodds C, Palazzi C, Jaramillo C, Quezada V, Ormeño G, Villegas R. Vertical dimension. Part 1: comparison of clinical freeway space. CRANIO®. 2001 Oct 1;19(4):230-236.
4. Fenn HRB, Liddlelow KP, Gimson AP: Clinical Dental Prosthetics , 2nd edn, p. 193. Staples Press Ltd, London,1961.
5. Boucher C, Hickey J, Zarb H: Prosthodontic treatment in edentulous patients. 7th ed. St. Louis: The C.V. Mosby Co., 1975.
6. Fayz F, Eslami A. Determination of occlusal vertical dimension: a literature review. The Journal of prosthetic dentistry. 1988 Mar 1;59(3):321-323.
7. Pound E: Let /S/ be your guide. J Prosthet Dent 1977; 38:482-489.
8. Silverman MM. The speaking method in measuring vertical dimension. Journal of Prosthetic Dentistry. 1953 Mar 1;3(2):193-199.
9. Ellinger CW. Radiographic study of oral structures and their relation to anterior tooth position. Journal of Prosthetic Dentistry. 1968 Jan 1;19(1):36-45.
10. Rivera-Morales WC, Mohl ND. Variability of closest speaking space compared with interocclusal distance in dentulous subjects. Journal of Prosthetic Dentistry. 1991 Feb 1;65(2):228-232.
11. Johnson A, Wildgoose DG, Wood DJ. The determination of freeway space using two different methods. Journal of oral rehabilitation. 2002 Oct;29(10):1010-1013.
12. POTGIETER P, Monteith BD, Kemp PL. The determination of free-way space in

edentulous patients: a cephalometric approach. Journal of oral rehabilitation. 1983 Jul;10(4):283-293.
13. Tiwari B, Ladha K, Lalit A, Naik BD. Occlusal concepts in full mouth rehabilitation: an overview. The Journal of Indian Prosthodontic Society. 2014 Dec 1;14(4):344-351.
14. Prosthodontics T. The glossary of prosthodontic terms. Journal of Prosthetic Dentistry. 1994.
15. Michelotti A, Farella M, Vollaro S, Martina R. Mandibular rest position and electrical activity of the masticatory muscles. The Journal of prosthetic dentistry. 1997 Jul 1;78(1):48-53.
16. Ormianer Z, Gross M. A 2-year follow-up of mandibular posture following an increase in occlusal vertical dimension beyond the clinical rest position with fixed restorations. Journal of oral rehabilitation. 1998 Nov;25(11):877-883.
17. Gutiérrez MF, Miralles R, Fuentes A, Cavada G, Valenzuela S, Santander H et al. The effect of tooth clenching and grinding on anterior temporalis electromyographic activity in healthy subjects. CRANIO®. 2010 Jan 1;28(1):43-49.
18. Valenzuela S, Baeza M, Miralles R, Cavada G, Zúñiga C, Santander H. Laterotrusive occlusal schemes and their effect on supra-and infrahyoid electromyographic activity. The Angle Orthodontist. 2006 Jul;76(4):585-590.
19. Valenzuela S, Portus C, Miralles R, Campillo MJ, Santander H, Fresno MJ et al . Bilateral supra-and infrahyoid EMG activity during eccentric jaw clenching and tooth grinding tasks in subjects with canine guidance or group function. Cranio: the journal of craniomandibular practice. 2012 Jul 1;30(3):209-218.
20. Sidana V, Pasricha N, Makkar M, Bhasin S. Group function occlusion. Indian Journal of Oral Sciences. 2012 Sep 1;3(3):124.
21. Okano N, Baba K, Akishige S, Ohyama T. The influence of altered occlusal guidance on condylar displacement. Journal of oral rehabilitation. 2002 Nov 1;29(11):1091-1098.
22. Okano N, Baba K, Ohyama T. The influence of altered occlusal guidance on condylar displacement during submaximal clenching. Journal of oral rehabilitation. 2005 Oct;32(10):714-719.
23. Belser UC, Hannam AG. The influence of altered working-side occlusal guidance on masticatory muscles and related jaw movement. Journal of Prosthetic Dentistry. 1985 Mar 1;53(3):406-413.
24. Jest T, Lindquist L, Hedegard B. Changes in chewing patterns of patients with complete dentures after placement of osseointegrated implants in the mandible. Journal of Prosthetic Dentistry. 1985 Apr 1;53(4):578-583.
25. Kovač Z, Uhac I, Kovačević D, Grzić R, Delić Z, Borčić J. Anterior tooth relationship in Cuspid Protected and Group Function Occlusion. Acta stomatologica Croatica. 2002 Sep 15;36(3):331.
26. Salsench J, Martínez-Gomis J, Torrent J, Bizar J, Samsó J, Peraire M. Relationship between duration of unilateral masticatory cycles and the type of lateral dental guidance: a preliminary study. International Journal of Prosthodontics. 2005 Jul 1;18 (4).
27. Beyron HL. Occlusal changes in adult dentition. J Am Dent Assoc. 1954;48:674‑686.

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