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Effect of occlusal vertical dimension on lip position and lower facial height: An in-vivo study

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Abstract

Introduction: The restorative needs for the prosthodontic patient frequently require an increase in occlusal vertical dimension. It is often difficult to assess whether occlusal vertical dimension has truly been lost. Therefore, it may be prudent to focus on whether alteration in occlusal vertical dimension is restoratively acceptable.

Aim: The study was carried out to evaluate the effect of increase in occlusal vertical dimension on lip position and lower facial height.

Methodology: Thirty patients were recruited for this study which include 15 males and 15 females, according to the inclusion and exclusion criteria. Data obtained was compiled on a MS Office Excel Sheet (v 2010) and was subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM). Inter group comparison has been done using Greenhouse-Geisser test followed by Pairwise comparison using Bonferroni corrected paired t tests.

Results: according to the study, it was seen that with increasing mm there was an increase in Upper Lip to Lower Lip, except at 4mm. With increasing mm, there was an increase in Lower Lip To upper Incisal edge and Upper lip to upper incisal edge. For Intercommissure Width, with increasing mm, there was an increase at 0 and 2mm followed by a decrease from 4mm to 8mm.

Conclusion: The study concluded that there was a statistically significant difference between 0 mm vs 8 mm from Upper lip-Lower lip and from Lower lip-upper incisal edge. Significant significant difference ($p<0.05$) was also seen for 0 mm vs 8 mm and 2 mm vs 8 mm from Intercommissure Width.

Keywords: Lip Position, Lower Facial Height, Occlusal Vertical Dimension

Introduction

The Glossary of Prosthodontic Term Ninth edition defines the vertical dimension as the distance between two selected anatomic points[1]. The vertical dimension when the mandibular teeth are occluding with the maxillary teeth is defined as the occlusal vertical dimension. The restorative needs for the prosthodontic patient frequently require an increase in occlusal vertical dimension. This could be due to loss of tooth structure and concomitant loss of occlusal vertical dimension, supraeruption of opposing teeth into edentulous spaces, or for aesthetic reasons[2]. It is often difficult to assess whether occlusal vertical dimension has truly been lost[3]. Therefore, it may be prudent to focus on whether alteration in occlusal vertical dimension is restoratively acceptable [4].

Another consideration for the alteration in occlusal vertical dimension is changes in soft tissue profile. In addition to the correct proportions of the teeth, the relationship of the teeth to the lips and gingiva is also an important factor for an aesthetic smile. During a normal smile, the upper lip should rest at the level of the mid-facial gingival margins of the maxillary anterior teeth[5]. Furthermore, the maxillary anterior teeth should follow the upper lip line[6]. The incisal edges of the maxillary anterior teeth should follow the curvature of the lower lip[7]. As the vertical dimension of occlusion increases, the distance between the maxilla and the mandible is increased. Therefore, it is likely that the position of the upper and lower lips at smile will also change. The movement of the corners of the mouth is dictated by the modiolus, where eight muscles meet. In particular, the zygomaticus major and the triangularis muscles, which insert into the zygomatic arch and the mandible respectively. Thus, by changing the occlusal vertical dimension, it is possible that the distance between the corners of the mouth will be altered.

Several authors have commented on the dynamic nature of the dentoalveolar complex and masticatory system[7]. The loss of occlusal vertical dimension is possible consequence of tooth wear, the original occlusal vertical dimension can be preserved by a dentoalveolar compensatory mechanism involving the extrusion of worn teeth[8,9]. Increasing the occlusal vertical dimension from the clinical perspective has been reported to facilitate the treatment of the patients presenting with generalized and complex dental abnormalities such as generalized tooth wear and significant occlusal irregularities[10,11]. However, there is still considerable debate in the literature about treatment modalities used to increase occlusal vertical dimension. Some authors have assumed that the occlusal vertical dimension is constant throughout an individual's life and any alteration of the occlusal vertical dimension will subsequently interfere with the physiology of masticatory system and patient's ability to adapt[12,13]. The reported consequent of increasing occlusal vertical dimension are hyperactivity of the masticatory muscles, elevation in occlusal forces, bruxism and temporomandibular disorder (TMDs). On the contrary, other authors have reported that such symptoms are transitory.

Although evidence regarding the implications of increasing occlusal vertical dimension is still lacking, the rehabilitative procedures involving an increase in occlusal vertical dimension are approached with caution.

Treatment planning for optimal aesthetics has been one of the main focus of the Prosthodontics community. Numerous publications have discussed concepts of treatment planning to optimize occlusion, function, and aesthetics[6,7,8]. However, there remains a lack of scientific data, especially in the aesthetic implications of changing the occlusal vertical dimension. The purpose of this study

was to analyse the effect of occlusal vertical dimension on dimensional measurements of smile.

Aim and Objective

Aim: The study was carried out to evaluate the effect of increase in occlusal vertical dimension on lip position and lower facial height.

Objective: The objective of the study was to discuss the clinical considerations related to increasing the occlusal vertical dimension, when restoring a patient's dentition using these four attributes:

1. Interlabial gap height- The vertical distance between the upper and lower lip intertsecting the midpoint of the incisal embrasures.
2. Intercommisural width- Distance between left and right commissures
3. Upper Incisal edge to Upper Lip - The vertical distance between the midpoint of the incisal embrasure and upper lip
4. Upper Incisal Edge to Lower Lip - The vertical distance between the midpoint of the incisal embrasure and lower lip.

Materials and Methods

Armamentarium

Materials and Equipments used in the study

1) Metal stock trays (Colour plate -1)

2) Irreversible hydrocolloid impression (Septodont) (Colour plate.-1)

3) Type III dental stone (Kalabhai kalstone) (Colour plate -1)

4) Silicon bite registration (Jetbite, Coltene) (Colour plate -1)

5) Semi Adjustable Articulator, HANAU wide vue (Colour plate -2)

6) Arbitary Hinge Facebow (Colour plate -2)

7) Nikon camera (DSLR 5200), Tripod (Colour plate -3)

8) Colour coded box (Colour plate -4)

9) Patient's smile with splint in place. (Colour plate -5)

10) Wall mounted cephalometric head holding device (Colour plate -6)

Method

Approval for this study was obtained from Vinoba Bhave University Hazaribag. Thirty patients were recruited for this study which include 15 males and 15 females, according to the inclusion and exclusion criteria listed below.

Inclusion criteria

1) 20-30 years of age.

2) Voluntary involvement in the study.

3) No missing anterior teeth.

4) At least 3 teeth in occlusion in both posterior segments.

Exclusion criteria :

1) History of surgery in the facial area

2) History of neurologic disorders

3) Centric occlusion-Centric relation discrepancy >1mm.

4) Inability or unwillingness to smile

5) Persisting ear infections

6) Allergy to silicone, nitrile, or alginate;

7) History of claustrophobia.

They were invited to participate in this study following a brief presentation on the study. All participants were free from neurological or surgical problems in the facial area. One examiner conducted all measurement and performed statistical analysis using one way repeated measures ANOVA.

The study was conducted in two sessions: In session 1, informed consent was obtained and a limited oral examination was conducted to determine whether the research participant fits the inclusion/exclusion criteria. The number of teeth in occlusion was checked, and CO-CR using chin point guidance. Irreversible hydrocolloid impressions were made using metal stock trays. The impressions were poured in Type III Dental stone

(kalabhai). Arbitrary hinge face bow transfers were obtained and casts were mounted using semi adjustable articulator (Hanau wide vue). Silicone bite registrations paste was used at maximum intercuspation, which facilitated accurate positioning of the maxillary and mandibular casts, but were not used for the actual articulation procedure.

The vertical distance lines was measured using a digital caliper. This position was used to open the articulator +2 mm, +4 mm, +6 mm, +8 mm to obtain the correct posterior openings. At these openings, silicone bite registration material was injected onto the occlusal surfaces from 1st premolar to 2nd molar. These bite registrations were used as bite splints to obtain the desired openings in occlusal vertical dimension. Bite splints for +0mm were not made.

The bite splints were trimmed in the following manner:

1) The top portion was trimmed so that the indentations of the maxillary cusp tips were approximately 1mm deep.

2) The buccal surface of the top portion was trimmed to the depth of the facial cusp tips. This enabled the visualization of complete seating of teeth into the indentations.

3) The bottom portion was trimmed to cover up to the CEJ of the mandibular teeth. This would provide some stability to the bite splints to the mandibular teeth.

Splints were stored in colour coded plastic boxes (fig4).

The following color codes were used for the various bite splints:

Blue- 0 mm

Red- 2 mm

Purple- 4 mm

Yellow- 6 mm

Green- 8 mm

Since no bite splints were made for the 0mm group, the "blue" plastic boxes were left empty. The sequence of insertion of the bite splints was determined using colour boxes.

During the 2nd session, 3 photographs each were taken using Nikon D5200 DSLR camera with the various bite splints in place. In order to obtain a standardized head position, a wall mounted cephalometric head holding device was used for head positioning.

Patient were made to stand in an upright position with head positioned in stable position using an earpiece on both sides and nasion plane indicator. Both the ears along with earpiece placed should be visible (Colour plate -7).

A digital single reflex camera (D5200, Nikon) with macro lens 105mm f/2.8VR, (Nikon) was used for photographic data acquisition. The camera was mounted on a tripod. The camera was connected to a laptop computer with camera control software (Camera Control Pro 2, Nikon). The camera control software permitted real-time visualization of the photographs taken.

For the second session, the experiment was conducted by two operators. One operator positioned bite splints and adjusted head positions, while the other operator took the photos (directly from the laptop computer) and checked for discrepancies in the photos. If an obvious discrepancy in a particular set of 3 photographs was seen, the 3 photographs were re-taken. Reasons for obvious discrepancies included laughter, drooling, head movement. Approximately 10 sets of photographs were re-taken.

The subjects' head tilt was subsequently adjusted to this vertical level. The head tilt adjustment was conducted for each set of pictures (5 times for each subject). The nasion relator was used. Subjects were asked to close gently on the back teeth, say, "M, M, M", relax, and smile. A photograph was then taken at the posed smile. The subjects were again asked to say, "M, M, M", relax, and smile, and another photograph was taken. This procedure

was repeated for the third photograph. The three photographs were verified for obvious discrepancies, file names were renamed, and the bite splint was replaced. The sequence of the placement of bite splints was randomized, and the individual groups were referred to as the colour codes (blue, red, yellow, etc.), instead of the vertical openings. This was done to blind the subjects as to which vertical opening was used. At the 0mm OVD opening, the same instructions were given, but no bite splint was placed. The photographs were imported into Adobe Photoshop (Photoshop CS6, Adobe), and the following measurements are made:

1) Interlabial gap height: The vertical distance between the upper and lower lips, intersecting the midpoint of the incisal embrasure (A-B).

2) Intercommisural width: Distance between left and right commisures (D-E).

3) Incisal edge – Upper lip: The vertical distance between the midpoint of the incisal embrassure and upper lip (A-C).

4) Upper Incisal edge – Lower lip: The vertical distance between the midpoint of the incisal Embrasure and lower lip (B-C).

The measurements are made in pixels.

On the stone model, the width of upper incisal edge was measured using a digital caliper, and recorded in millimeters. This distance was measured three times to obtain an average incisal edge measurement. The average measurement of incisal edge in pixels (from 15 photographs) was divided with the average measurement of incisal edge in millimeters to obtain a conversion ratio for each individual subject. The conversion ratio was used to convert the measurements in pixels to millimeters.

Results

Statistical procedures

Data obtained was compiled on a MS Office Excel Sheet (v 2010) and was subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM).

Inter group comparison has been done using Greenhouse-Geisser test followed by Pairwise comparison using Bonferroni corrected paired t tests.

For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

Table 1: Comparison between various mm for all measurements

Measurement / OVD	mm					
		N	Mean	Std. Deviation	Std. Error	p (Greenhouse-Geisser)
Upper Lip To Lower Lip	0	30	8.25	1.848	.337	
	2	30	8.73	2.141	.391	
	4	30	8.62	2.188	.400	.048*
	6	30	8.97	2.086	.381	
	8	30	9.77	1.573	.287	
	Total	150	8.87	2.019	.165	

Lower Lip To upper Incisal edge	0	30	5.59	1.636	.299	
	2	30	5.95	1.530	.279	
	4	30	6.41	1.501	.274	.002*
	6	30	6.72	1.432	.262	
	8	30	7.05	1.371	.250	
	Total	150	6.35	1.567	.128	
Intercomssor Width	0	30	55.97	5.561	1.015	
	2	30	55.63	5.672	1.036	
	4	30	53.87	5.877	1.073	.015*
	6	30	52.90	6.266	1.144	
	8	30	51.13	7.040	1.285	
	Total	150	53.90	6.285	.513	
Upper lip to upper incisal edge	0	30	5.81	1.265	.231	
	2	30	5.92	1.234	.225	
	4	30	6.12	1.176	.215	.217#
	6	30	6.24	1.095	.200	
	8	30	6.46	1.057	.193	
	Total	150	6.43	1.261	.103	

= p> 0.05, non-significant

*= p<0.05, significant

=p<0.01, highly significant … **for all tables

There was a statistically significant difference between various mm for the variables like. Upper Lip to Lower Lip, Lower Lip To upper Incisal edge and Inter commissure Width (p<0.05). But there was a statistically non significant difference between various mm for Upper lip to upper incisal edge (p>0.05). It was seen that with increasing mm there was an increase in Upper Lip to Lower Lip, except at 4mm with increasing mm, there was an increase in Lower Lip To upper Incisal edge and Upper lip to upper Incisal edge. For Inter commissure Width, with increasing mm, there was an increase at 0 and 2mm followed by a decrease from 4mm to 8mm.

Table 2: Pairwise comparison using Bonferroni corrected paired t tests

Dependent Variable	(I) groups	(J) groups	Mean Difference (I-J)	Std. Error	Sig.
ULLL	0 mm	2	-.483	.511	.879
		4	-.373	.511	.949
		6	-.727	.511	.615
		8	-1.520*	.511	.028*
	2	4	.110	.511	1.000
		6	-.243	.511	.989
		8	-1.037	.511	.258
	4	6	-.353	.511	.958
		8	-1.147	.511	.170
	6	8	-.794	.511	.531
LLUI	0mm	2	-.357	.386	.888
		4	-.817	.386	.220
		6	-1.127*	.386	.033*
		8	-1.460*	.386	.002**
	2	4	-.460	.386	.757
		6	-.770	.386	.275
		8	-1.103*	.386	.039*
	4	6	-.310	.386	.930
		8	-.643	.386	.459
	6	8	-.333	.386	.910
IW	0 mm	2	.333	1.577	1.000
		4	2.100	1.577	.672
		6	3.067	1.577	.299
		8	4.833*	1.577	.022*
	2	4	1.767	1.577	.796
		6	2.733	1.577	.417
		8	4.500*	1.577	.039*

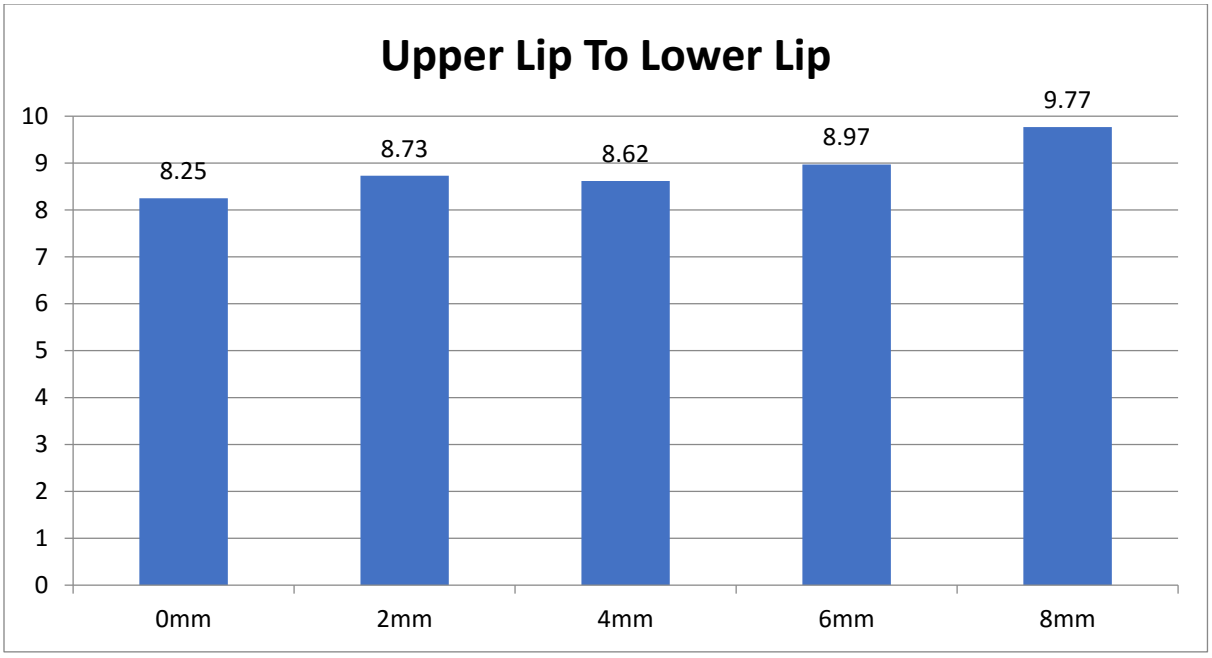
	4	6	.967	1.577	.973
		8	2.733	1.577	.417
	6	8	1.767	1.577	.796
ULUI	0 mm	2	-0.11	.302	.968
		4	-0.31	.302	.255
		6	-0.43	.302	.051
		8	-0.65	.302	0.325
	2	4	-0.2	.302	.633
		6	-0.32	.302	.221
		8	-0.54	.302	0.125
	4	6	-0.12	.302	.952
		8	-0.34	.302	.055
	6	8	-0.22	.302	.245

On pairwise comparison between various mm for each variable differences were seen for the following pairs

For UL-LL

Statistically significant difference ($p<0.05$) seen for 0 mm vs 8 mm

Statistically Non significant difference ($p>0.05$) seen for all the others



Upper Lip to Lower Lip

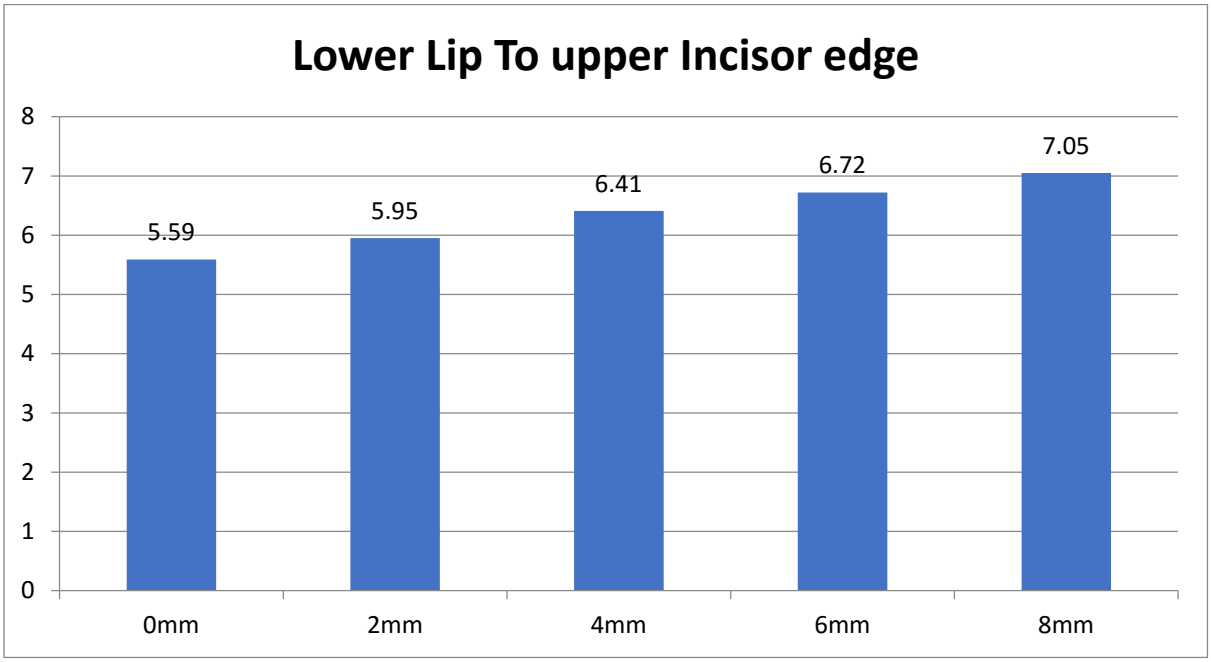
0mm	8.25
2mm	8.73
4mm	8.62
6mm	8.97
8mm	9.77

For LL-UI

Statistically highly significant difference ($p<0.01$) seen for 0mm Vs 8mm

Statistically significant difference ($p<0.05$) seen for O mm vs 6 mm and 2mm vs 8 mm

Statistically Non significant difference ($p>0.05$) seen for all the others



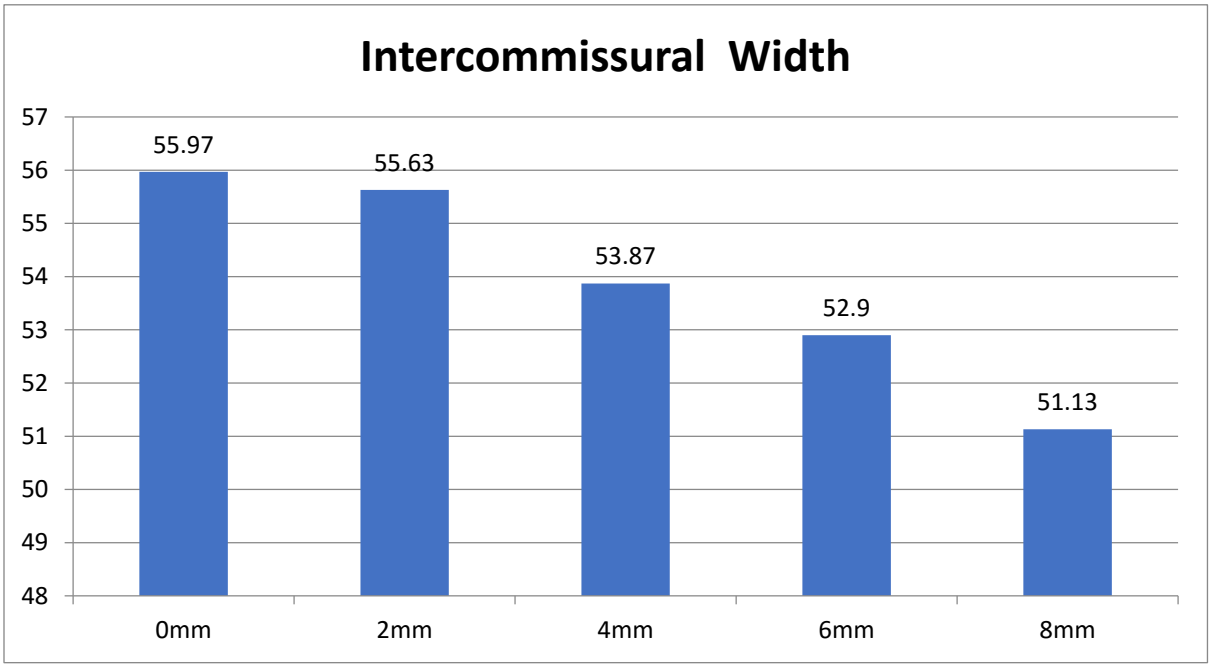
Lower Lip To upper Incisor edge

0mm	5.59
2mm	5.95
4mm	6.41
6mm	6.72
8mm	7.05

For IW

Statistically significant difference ($p<0.05$) seen for 0 mm vs 8 mm and 2mm vs 8 mm

Statistically Non significant difference (p>0.05) seen for all the others

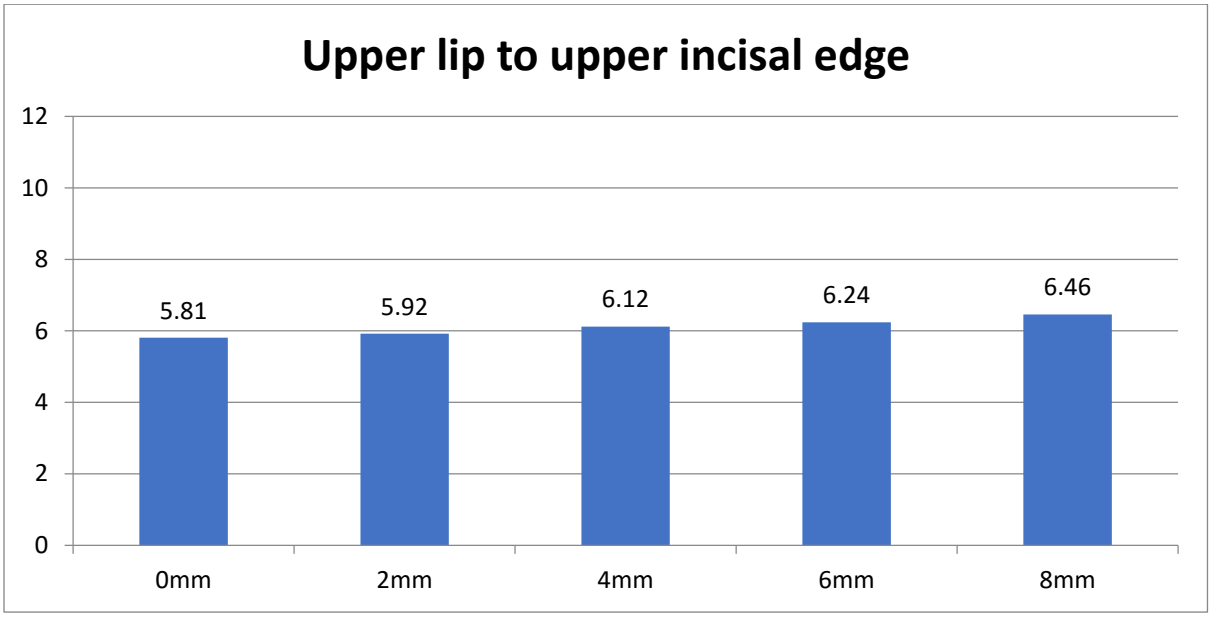


Intercommissural Width

0mm	55.97
2mm	55.63
4mm	53.87
6mm	52.92
8mm	51.13

For UL-UI

Statistically Non significant difference (p>0.05) seen for all



Upper lip to Upper incisal edge

0mm	5.81
2mm	5.92
4mm	6.12
6mm	6.24
8mm	6.46

Statistical analysis had been performed using greenhouse-geisser test for inter group comparison followed by pair wise comparison using boneferroni corrected pair t test.

On pairwise comparison between various reading for each variable, statistical differences were seen for the following pairs:

1) For upper lip to lower lip

Statistically significant difference ($p<0.05$) seen for 0 mm vs 8 mm.

Statistically non significant difference ($p>0.05$) seen for all the others.

2) For lower lip to upper incisal edge

Statistically highly significant difference ($p<0.01$) seen for 0 mm vs 8 mm.

Statistically significant difference ($p<0.05$) seen for 0 mm vs 6 mm and 2 mm vs 8 mm.

Statistically non significant difference ($p>0.05$) seen for all the others.

3) For intercommissure width

Statistically significant difference ($p<0.05$) seen for 0 mm vs 8 mm and 2 mm vs 8 mm.

Statistically non significant difference ($p>0.05$) seen for all the others

4) For upper lip to upper incisal edge

Statistically non significant difference ($p>0.05$) seen for all.

Discussion

The vertical dimension of occlusion and its significance are of great importance in oral treatment. It has become one of the most desirable factor for the patient to have an attractive facial appearance. In recent years, desire for an attractive facial appearance is not limited only to young

adults, however, it has become common among elderly as well, So, it's our prime concern to maintain the correct occlusal vertical dimension for pleasing appearance and aesthetic need. The occlusal vertical dimension for dentate individuals are mainly determined by the remaining dentition, hence, loss of occlusal vertical dimension can significantly affect patient's function, comfort and aesthetics. The reported consequences of increasing the occlusal vertical dimension are hyperactivity of the masticatory muscles, elevation in occlusal forces, bruxism and temporomandibular disorders.

An important considerations for the alteration in occlusal vertical dimension is changes in the soft tissue profile. In addition to correct proportions of the teeth, the relationship of the teeth to the lips and gingival is also an important factors for the aesthetic smile. With an alteration in occlusal vertical dimension, the distance between the maxilla and mandible gets altered and hence, it is more likely that the position of the lips at smile also changes. During a normal smile, the upper lip should rest at the level of mid facial gingival margin of maxillary anterior teeth, while the maxillary anterior teeth should follow the curvature of lower lip. There have been studies mentioned in literature to optimize occlusion, function and aesthetics with an alteration in occlusion vertical dimension. The purpose of this study was to analyse the effect of occlusal vertical dimension on lip positions and lower facial height, using different attributes, so, that any changes in aesthetics and appearance due to an alteration in occlusal vertical dimension can be easily determined.

Fischer et al.[12] discussed about the dentogenic concept of denture aesthetics. Several authors have commented on the dynamic nature of the dento alveolar complex and masticatory system, so, the loss of occlusal vertical dimension is possible consequences of tooth wear, the original occlusal vertical dimension can be preserve by a dento-alveolar compensatory mechanism, Likewise a study by **Murphy et al**.[5] discussed about the compensatory mechanism in facial height, due to two opposing dynamical forces.

There have been few researchers in the past who have discussed the methods of diagnosis and treatment of loss of occlusal vertical dimension. Hu used crown length for calibration. **Hulsey**[13] discussed about the esthetic evaluation of lip-teeth relationships present in the smile. **Berry et al**.[3] discussed the possible mechanisms of the compensation for attrition. **Cohen** did a cephalometric study of the vertical growth of the lips. **Marin** [14,15] described a method of gradual re-establishment of occlusal vertical dimension using a diagnostic acrylic splints on artificial teeth in old complete dentures. **Sandesh** [16] did a study to develop a device capable of measuring the biting forces generated during maximum biting to measure the biting force generated during a change in vertical dimension. **Toth** [17] did a study to measure the 3-dimensional parameters of the posed smile and to see whether there are any correlations with vertical cephalometric skeletal measurements. **Kenneth** discussed restoration of the extremely worn dentition and careful evaluation of the etiology, history, and factors relative to occlusal vertical dimension are essential to appropriate treatment planning.

Photographic technique was selected in this study as the resolution of the image obtained from the digital single reflex camera was 4928×3264 pixels which provides a more detailed image than can be captured using modern 1080p video camera which capture video at 1920×1080 pixels. Although no statistically significant difference in smile capturing was found between video and photographic technique as found by **McNamara et al.** [18] Photographic technique also gives advantage of ease of

measurement. Hence in the present study, photographic technique was used.

Thirty patients were selected as per the inclusion and exclusion criteria which included 15 males and 15 females. The study was conducted in two sessions. In session 1, we obtained an informed consent and conducted a limited oral examination. An alginate impression was made using metal stock trays and poured in type III dental stone. Arbitrary hinge face bow transfer was obtained and cast was mounted using semi-adjustable articulator. Following this, maximum intercuspation position were obtained using silicon bite registration paste which facilitated accurate positioning of maxillary and mandibular cast, however, these positioning were not used for actual articulating procedure. The articulator was opened by +2mm, +4mm, +6mm, +8mm (bite splints at +0mm were not made) to obtain the correct posterior opening. Silicon bite registration material was injected on the occlusal surfaces of mandibular teeth from 1st premolar to 2nd molar. These bite registration material was used as bite splint. These bite splints were trimmed as per the criteria mentioned above and were stored in colour coded plastic boxes.

In session 2, photographs were taken using DSLR camera. Three photographs each were made with the various bite splint in place. These photographs were imported to adobe photoshop software and values were obtained in pixels. A conversion table used to convert pixel to millimeter.

Although there are many studies on smile and esthetics in literature, most of them used static pictures or direct measurements. Researchers have studied age-related changes in lip length, maxillary incisor exposure, and intercommissure distance. There were further studies to examine a comprehensive list of smile parameters with respect to age. With age, the lips undergo several predictable changes that effect the dental display. For example atrophy of muscles result in decreased lip volume, loss of lip architecture, and lip lengthening. **Gross et al** [19] was one of the first researcher to investigate both the relationship between occlusal vertical dimension and lower facial height and the subjective perceptions of models with incremental increase in lower facial height, who found a ±4mm change in lower facial height with ±8mm change in occlusal vertical dimension. **Kamashita et al** and **Ushijima et al** [20] found similar results with variable amounts of lip support and varying occlusal vertical dimension. **Tjan et al** [21] defined the average smile as one that reveals 75% to 100% of the maxillary anterior teeth and interproximal gingiva. One clinical report claimed that increasing the occlusal vertical dimension decreases excessive gingival display in the smile. **Hulsey** [13] found subjects who had upper lip at the height of the gingival margin of the upper central incisor, were found to be the most aesthetically pleasing. **Ackerman** described the “display zone” as the area framed by upper and lower lip. The author described teeth and the gingival scaffold as components of the smile which lie within this display zone. The display zone area was quantified in the present study by outlining the incremental area between the upper and lower lip at smile. A mean display zone area of 509 ± 190 mm was found for the 0mm occlusal vertical dimension groups, the high standard deviation indicates a considerable amount of variability in display zone area among different subject. A statistically significant increase was found with increase in occlusal vertical dimension although no significance was found between the +4 mm occlusal vertical dimension and the +6 mm occlusal vertical dimension groups. However, in the present study, statistically non significant difference was found with respect to the upper lip to upper incisal edge at smile with increasing occlusal vertical dimension. The width of the smile affects the width of the buccal corridors, which is a

contributing factor to the aesthetic of a smile. However, this investigation find a significant change in inter commissural width, upper lip to lower lip distance, and lower lip to upper incisal edge distance with increasing occlusal vertical dimension.

The present study has several limitations. Firstly, the bulkiness of the silicone occlusal registrations may have negatively influenced the smile. Secondly, the age range of 20-30 years may not represent the typical prosthodontics patient. None of the participants exhibited any loss of occlusal vertical dimension. Change in angulation may have caused a small discrepancy in the measured vertical distance. Further studies on this same topic with large sample size, with more varied subject and models, are required to provide a clear understanding of the long term clinical implications for the effect of occlusal vertical dimension on lip positions and lower facial height.

Limitation to the study

Study made methodological improvements over facial aesthetics and made the topic more relevant to the specialties of prosthodontics. However, Some limitations remained, which were as follows

1) This study required measuring points placed on movable tissues for increased occlusal vertical dimension, with mandibular splints placed on posterior teeth.

2) Because of splint, patients had tendency to tense their facial muscle.

3) Because of splints, patients could not smile normally and since splints were fabricated to the second molar, there were excessive occlusal prematurities which needed adjustments.

4) Because a patient's smile could not be the same with every splints, there could be possibility of error in the measurements made from the photograph. Although, all subjects were provided detailed instructions, there could still be variations in the result.

Conclusion

Study was investigated in two sessions. The changes related to Occlusal Vertical Dimension (OVD) on lip position and lower facial height. Objectively and subjectively on model with incremental increases in occlusal vertical dimension up to 8mm.

Result from Greenhouse-Geisser test followed by pairwise comparison using Boferroni corrected paired t test concluded that there was a statistically significant difference between various readings are as follows:

a) From Upper lip-Lower lip

Statistically significant difference ($p<0.05$) 0 mm vs 8 mm.

Statistically non significant difference ($p>0.05$) seen for all the others.

b) From Lower lip-upper incisal edge

Statistically highly significant difference ($p<0.01$) seen for 0 mm vs 8 mm.

Statistically significant difference ($p<0.05$) seen for 0 mm vs 6 mm and 2 mm vs 8 mm.

Statistically non significant difference ($p> 0.05$) seen for all the others.

c) From Intercommissure Width

Significant significant difference ($p<0.05$) seen for 0 mm vs 8 mm and 2 mm vs 8 mm.

Statistically non significant difference ($p>0.05$) seen for all the others.

d) From Upper lip to Upper incisal edge

Statistically non significant difference ($p>0.05$) seen for all.

References

1. The Glossay of Prosthodontic Term Jprosthet Dent 2005;94:10-92.

2. Turner KA, Missirlian DM .Restoration of the extremely worn dentition. J Prosthet Dent 1984;52:467-474.
3. Berry DC,pool DF .Attrition: possible mechanism of compensation.J Oral Rehabil 1976;3:201-206.
4. Richards LC Dent attrition an craniofacial morphology in two Australian Aboriginal population J Dent Res 1985;64:1311-1315.
5. Murphy T Compensatry mechanism in facial hight adjustment to functional tooth attrition. Aust Dent J 1959;5:312-323.
6. Dawson PE Evaluation,diagnosis and treatment of occlusal problems pp280-285. St Louis, MO:CVMosby,1989.
7. LindauerSJ,Gay,T,Rendell J . Effect of jaw opening on masticatory muscle EMG- force characteristics.J Dent Res 1993;72:51-55.
8. Hammond RG ,bederOE.Increase vertical dimention and speech articulation errors.JEsthet Dent 1984:52:401-406.
9. Crothers A ,Sandham A, Vertical height differences in subjects with sever dental wear .Eur J Ortho 1993;15:519-525.
10. Johansson A Johansson AK , Omar R, Carlsson GF. Rehabilitation of the worm dentition .J Oral Rehabil 2008;35;548-566.
11. Johansson A, Omar R. Identification and management of tooth wear. Int J Prosthodont1994;7:506-516.
12. John J Frush, Roland D Fischer,Thedeynesthetic interpretation of dentogenic concept. J.Prosth.dent 1958;8;558-581.
13. Charles M. Hulsey, An esthetic evaluation of lip-teeth relationships present in the smile. Amer. J. Orthodont.1970;57;133-144.
14. Danny Omar Mendoza Marin et al. Reestablishment of Occlusal Vertical Dimension in Complete Denture Wearing in Two Stages. Case Reports in Dentistry 2015;1-5.
15. Danny Omar Mendoza Marin, Andressa Rosa PerinLeite, NorbertoMartins de Oliveira Junior, Marco Antonio Compagnoni, Ana Carolina Pero, JoãoNeudenirArioliFilho. Reestablishment of Occlusal Vertical Dimension in Complete Denture Wearing in Two Stages.Case reports in dentistry.2015;1-4
16. Sandesh S Gosavietal.The Study of the Effect of Altering the Vertical Dimension of Occlusion on the Magnitude of Biting Force. Journal of International Oral Health 2015; 7(11):110-114,
17. Toth EK, Oliver DR, Hudson JM, Kim KB. Relationships between soft tissues in a posed smile and vertical cephalometric skeletal measurements. Am J OrthodDentofacialOrthop. 2016;150(2):378-85.
18. Schabel BJ, Baccetti T, Franchi L, McNamara Jr JA. Clinical photography vs digital video clips for the assessment of smile esthetics. The Angle orthodontist. 2010 Jul;80(4):678-84.
19. Martin D. Gross et al, The Effect of Increasing Occlusal Vertical Dimension on Face Height. Int J Prosthodont 2002;15:353–357
20. Masao Ushijima DDSa, Yuji Kamashita, Yasuhiro Nishi, Eiichi Nagaoka, Changes in lip forms on three-dimensional images with alteration of lip support and/or occlusal vertical dimension in complete denture wearers. Journal of Prosthodontic Research 57 (2013) 113–121.
21. Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. J Prosthet Dent. 1984;51(1):24-8.