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Facial Height and Its Effect by Tooth Wear, Age and Sex Assessed By Soft Tissue Analysis

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ABSTRACT

Introduction

Tooth wear is one of the major and widely accepted problem nowadays. It is the loss of dental hard tissues by these processes: attrition, abrasion and erosion. It can occur due to various factors such as abnormal tooth contact, abrasive dental hygiene habits and erosive dietary factors.

Methods

Full face photographs of each subject was taken from the frontal view with a natural head position guided to true horizontal in 66 sample. All photographs were evaluated for consistency in head position and picture quality. Total facial height was subdivided into two components: upper facial height and lower facial height. Measurements of UFH and LFH and their ratio were recorded. Also tooth wear was assessed on a tooth-by-tooth basis rated according to the 5-point ordinal scale (0-4). All the data was statistically analyzed by SPSS.

Results

Statistically significant difference was found between Lower Facial Height and age group (p-value 0.02) whereas there was no statistically significant difference between UFH and RUL with age group. UFH and LFH was found to be slightly higher in females than males, however, on application of independent t-test it was found that there were no statistically significant differences between gender and facial height (p-value > 0.05). Weak negative correlation was found between facial height, age and tooth wear (r=-0.24, p-value 0.052 and r-value =-0.28, p-value 0.023).

Conclusions

Facial height decreases with increase in age. Upper facial height is slightly greater than lower facial height with tooth wear.

Keywords: LFH; RUL; tooth wear; UFH; VDO.

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INTRODUCTION

Tooth wear is one of the progressive irreversible, multifactorial and destructive loss of dental hard tissues which is widely accepted now a days.It is one of the outcomes of aging.[1] It can occur because of mechanical, chemical or either mechanical and chemical process despite of absence of caries or trauma.[2,3] It is one of the common problems in individuals which remains untreated but gets noticeable when it leads to sensitivity or dental caries. The tooth wear can occur through three major processes attrition, abrasion and erosion. Attrition which is the loss of tooth tissue due to tooth in contact with opposing tooth, no foreign substance intervening and it's usually due to mechanical process such as bruxism.[4] Abrasion is the pathological loss of tooth substance caused by abnormal and repetitive mechanical wears other than tooth contact.[5] Erosion is the progressive loss of hard dental tissue by a chemical process not involving bacterial action.[6] Tooth wear is increasing with aging and is related to facial height which is the focus of the study. Facial height is divided into upper and lower components above and below the maxillary basal bone when teeth are in occlusion.[7] Upper facial height (UFH) is determined by genetics, whereas lower facial height (LFH) is expected to be affected by tooth wear, being the part of the face containing the dentoalveolar structures.[8] Literature do not have enough information to evaluate the effects of tooth wear, age and sex for facial height measurements as it is measured extra orally by soft tissue. So, this study aims to evaluate the effects of tooth wear, age and sex on measurement of facial height based on soft tissue analysis.

METHODS

A quantitative cross-sectional study was conducted in patients. Students, staffs and visitors over a period of 14 months (April 2022 to May 2023) in Department of Prosthodontics and Maxillofacial Prosthetics, College of Medical Sciences, Bharatpur. Ethical clearance was obtained from the institutional Review Committee of College of Medical Sciences – Institutional Review Committee (Ref. No. COMSTH-IRC/2022-014).All participants were informed prior to participation and informed consent was signed. A total of 65 participants were selected for the study by convenience sampling. Sample size (n) was calculated using formula, $n = z^2pq/e^2$, z =1.98, p = 20.4%[9], q =1-p, e = margin of error (10%). The sample size was calculated to be 63.65 i.e. 65 after rounding off. The inclusion criteria of this study are patients with complete maxillary and mandibular dentition in Class I relationship (excluding third molars), no gross facial asymmetries, no history of any congenital conditions or trauma affecting facial form and appearance and no signs or symptoms of temporomandibular disorders, according to the diagnostic criteria for TMD (DC/TMD)and exclusion criteria are patients with beard subjects due to difficulties in detecting the anatomic points of reference, patients with missing teeth. This study consisted of 33 men and 33 women of age between 19 to 66 years as the rate of tooth wear and its consequences are different with age.[10–13] Full face photographs of each subject were taken. For measurement of facial height three points were marked directly on each subject face using a fine tip dry erase marker at the glabella(the smooth part of the forehead above and between the eyebrow), nasospinale (the point at which the medium sagittal plane intersects the line joining the lowest points on the nasal margins) and soft tissue menton (lowest border of the mandible). A digital camera was mounted on a tripod with standardised, focus and at a standardised distance of 1.5m from the subject. The lighting condition remained constant for all photographs. According to the Bidra et al.[14] The subjects were

seated in front of a black background and full face photographs of each subject were taken from the frontal view with a natural head position guided to true horizontal. Photographs were taken with mandible closed in maximum intercuspation position. To standardize the photograph one standard sized coin was attached in the background of photograph. Using Adobe Photoshop software, the measurement of face was done and recorded. Total facial height (glabella to nasospinale – UFH), lower facial height (nasospinale to menton – LFH) and ratio of UFH and LFH were calculated.After photograph tooth were assessed on a tooth to tooth basis Lobbezo and Naeije [15] and was rated according to 5 point ordinal scale(0-4) grade 0 = no wear, grade 1 = visible wear within the enamel only, grade 2 = visible wear with dentin exposure and mild to moderate loss of clinical crown height (≤1/3),grade 3= significant loss of crown height >1/3 but <2/3, and grade 4 = loss of crown height (≥2/3) Incisor, Canine, Premolars and Molars are included in the analysis. All the score of the individual teeth were summed and an average score was calculated for each subject as previously described.[16] Participants were divided into 3 groups according to the wear index, namely mild-A (i.e. grade 0-1) moderate-B (grade 2) severe wear-C (grade 3-4).

RESULTS

The total of 66 participants were divided into three groups based on their tooth wear. Group A i.e. mild tooth wear consisted of 28 participants, Group B i.e. moderate tooth wear consisted of 17 participants whereas Group C i.e. severe tooth wear consisted of 21 participants. Independent t-test was applied to find out the association between facial height and the different tooth wear groups. There were no statistically significant differences between the facial height and wear group (p-value > 0.05) (Table 1).

Table 1. Average upper and lower facial heights and their ratio in three age groups (n=66).

Facial height	Age group	Average height (mm)	SD (mm)	p value
UFH	19-40	52.82	9.25	0.3
	41-65	48.96	10	
	>66	50.5		
LFH	1	43.98	4.04	0.02*
	2	38.9	6.81	
	3	38.9		
RUL	1	1.21	0.18	0.51
	2	1.26	0.14	
	3	1.29		

**Statistically significant, p value <0.05, Independent t-test applied*

The study participants were categorized into three different age groups. There were 41 participants in Group A consisting of individuals 19 to 40 years of age. There were 23 participants in Group B consisting of individuals 41 to 65 years of age whereas there was 1 participant in Group C consisting of individuals 66 years and older. Independent t-test was applied to find out the association between facial height and age group. Statistically significant difference was found between Lower Facial Height and age group (p-value 0.02) whereas there was no

statistically significant difference between UFH and RUL with age group (Table 2).

Pearson's correlation was used to find out the correlation between facial height with age and tooth wear. Weak negative correlation was found between facial height and age (r value -0,28, p value 0.021 and r value -0.38, p value 0.001). Similarly, weak negative correlation was found between facial height and tooth wear (r value -0.24, p-value 0.052 and r value -0.28, p-value 0.023) (Table 4).

Table 2. Difference in facial height measurements between males and females (n=66).

Variables	Male	Female	p-value
Facial height	Mean ± SD (mm)	Mean ± SD (mm)	
UFH	51.51±10.47	51.9±9.32	0.85
LFH	42.3±8.45	42.83±0.9	0.79
RUL	1.22±0.17	1.22±0.17	0.9

Mean UFH was found to be 51.90 in females while it was found to be 51.51 in males. Similarly, mean LFH was found to be 42.83 in females and 42.30 in males. Mean RUL was found to be 1.22 in both males and females. Mean UFH and LFH was found to be slightly higher in females than males, however, on application of independent t-test it was found that there was no statistically significant difference between gender and facial height (p value > 0.05) (Table 3).

ANOVA test was applied to test association between the different wear groups and LFH,

Table 3. Facial height correlation with age and tooth wear (n=66).

Facial height	Age		Tooth wear	
	r	p-value	r	p-value
UFH	-0.28	0.021*	-0.24	0.052*
LFH	-0.38	0.001*	-0.28	0.023*
RUL	0.1	0.41	0.03	0.811

Table 4. Facial Height in different wear group (n=66).

Variables	Wear group	Mean ± SD of height (mm)	p-value
UFH	Group A	53.88±10.8	0.23
	Group B	51.56±8.66	
	Group C	49.03±9.11	
LFH	Group A	44.62±9.52	0.08
	Group B	42.99±6.95	
	Group C	39.47±6.11	
RUL	Group A	1.22±0.18	0.8
	Group B	1.2±0.18	
	Group C	1.24±0.16	

ANOVA test was applied

UFH and RUL and there was no statistically significant difference between the three.

DISCUSSION

This study shows the effects of tooth wear, age, sex on facial height measurement based on soft tissue analysis. For maintaining standardisation and calibration the photographs were taken according to exact same protocol. The ratio of RUL was used to avoid any bias during facial height measurement.Weak negative correlation was found between UFH and LFH with age and tooth wear. This finding differs from study by Levartovsky et al.[9] where weak positive correlation was found between UFH and LFH measurements and tooth wear. However, no correlation was found between RUL ratio and tooth wear in study by Levatovsky et al similar to our study. These difference between studies may be due to increase in age, decrease in facial height due to decrease in occlusal height because of tooth wear and resorption of bone height.In this study the facial height is more in younger age group than older age group. Statistically significant difference was found between LFH and age group whereas no statistically significant difference was found between UFH and RUL with age group where as in the study conducted by Crothers and Sandham[17] no significant differences wasfound in total facial height (nasion-gnathion) between the wear groups. The UFH was larger and the LFH was smaller in the study cohort (bruxers) than in the control group(non- bruxers) as in our study. Their conclusion was the total loss of crown height was partly compensated by change in vertical dimension of upper face and by development of dentoalveolar structures which is contradictory to the study conducted by Levatosvsky.[9]

UFH and LFH of females are slightly more than females though the RUL seems same and no significant change which relates that facial height does not significantly change with gender. It can be due to wide ethnic variation in facial height and in small sample sizes which is opposite to the result obtained in study conducted by Levartovsky et al.[16]

Study conducted by S. Levartosky[16] showed that men have greater facial height than female. Several studies on tooth wear and its association with facial height were conducted anthropologically and archeologically on ancient population whose result were based on common theory stating adult dentofacial complex is not a static entity but it compensate for some of the dental effects of tooth wear.[18–20] Compensatory mechanism was demonstrated by study conducted by Murphy[7] that includes continuous tooth eruption and general alveolar bone growth associated with severe tooth wear in a sample of aboriginal skulls. According to Dawson's theory the repetitive contracted length of the elevator muscles, determines the VDO in mandible to maxilla relationship.[21] There is a process of continuous formation of layers of cementum to the root and the concurrent elongation of the alveolar process throughout life in severe tooth wear. According to the review of Newman the continuous formation of cementum is similar to that of Dawson's concept if the rate of attrition is greater than the rate of eruption and growth, there is a decrease in lower facial height. Theory of compensatory eruption of the teeth limited the reduction of LFH is explained by Sternberg et al.[22] It shows no effect of tooth wear on LFH.As in our study there were no statistically significant difference found between UFH,LFH and the wear group. It shows upper facial height greater than lower facial height. It can be because of dento-alveolar development contribution to maintenance of total facial height, compensating for loss of vertical height by severe tooth wear. It is similar to study by Crothers and Sandham. His conclusion was

that the total loss of crown height in the study group was partly compensated by change in the vertical dimension of the upper face and by the development of the anterior dento-alveolar structures, mainly in the lower arch.[17] Whereas, the study conducted by Levartovsky et al. on association between dental wear and reduced VD of the face showed no significant differences in UFH, LFH and the wear groups. The current study shows significant clinical relevance in cases that require full mouth rehabilitation due to severe tooth wear. For such patient, VDO increase is often needed. The amount of VDO loss should be restored by rehabilitation. The amount of VDO increases may be minimal and should be determined based only on patient functional and esthetical needs.

The limitation of this study is use of marked points on the subject's soft tissue, which can have some errors. By using cephalometric analysis, the study can be more accurate. So, further in -vivo study is required for better conclusion.

CONCLUSIONS

Facial height decreases with increase in age because of resorption of bone with increasing age. Upper facial height and lower facial height is slightly higher in females, with lower value in males, due to a morphological variation related to sexual dimorphism.Weak negative correlation exists between facial height and age as well as tooth wear. The RUL was not affected by age and tooth wear. This might support the compensatory mechanism theory. Upper facial height is slightly greater than lower facial height with tooth wear.

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