Original Research Paper

Volume-9 | Issue-7 | July - 2019 | PRINT ISSN No. 2249 - 555X

Orthodontology

POSTURE SCREEN APP AN INNOVATIVE TOOL IN COMPARATIVE EVALUATION OF TYPES OF OCCLUSION AND THEIR RELATIONSHIP TO BODY POSTURE- A CROSS SECTIONAL STUDY

Ghena. A	Department(s) and institution(s) Ras Al Khaimah College of Dental Sciences, RAK, UAE
Aya. S*	Department(s) and institution(s) Ras Al Khaimah College of Dental Sciences, RAK, UAE *Corresponding Author
Lovely. M	Department(s) and institution(s) Ras Al Khaimah College of Dental Sciences, RAK, UAE

ABSTRACT

Aims: The purpose of this study is to assess the relationship between molar relationship and body posture. To put to use the "posture screen app" as a quicker tool for body postural assessment.

Methods and Material: 25 students with class I/II/III malocclusion were included in the study. Data collection tool was used to access the history and clinical intra- and extra-oral examination. Profile images were uploaded in "posture screen app mobile" to evaluate the body posture and classify them.

Results: Poor body posture was found to be associated with class III molar relationship (p-value: 0.0392), while class II molar relationship was found not to be significantly correlated with poor body posture. Among other occlusal factors, decreased over-jet was significantly associated with poor side posture (p-value: 0.0030).

Conclusions: Class III malocclusion has been found to have significant association with poor body posture and among the occlusal traits, decreased over-jet was found to affect the body posture negatively.

KEYWORDS : malocclusion, body posture, habits, over-jet

INTRODUCTION:

Occlusion is defined as a static, morphological tooth contact relationship. It may be defined also as the contact relationship of the teeth in function or para-function [1]. The mandible is attached to the hyoid bone where multiple hyoid muscles are attached. Those muscles may play a role in neck mechanics [2][3][4][5].

The relationship between malocclusion and body posture have been discussed over years, and it became the center of attention for many researchers, though no conclusive proof of such a relation was established.

Many researchers have reported positive relationship between malocclusion and body posture from their studies. [6] [7]. Maximum mouth opening was found to be significantly reduced in patients affected by intervertebral disk herniation [8]. Sidlauskiene et.al [9] assessed 94 patients, 7-14 year-old, using cephalometric radiographs and study models to examine the occlusion, followed by frontal, lateral, and back pictures to examine the body posture. This study concluded the existence of a correlation between the sagittal position of the mandible and kyphotic posture. Several studies revealed that a significant correlation between malocclusion and cervical lordosis does exist. (Evaluation of cervical posture of children in skeletal class I, II, and III) Ohnmeib et.al [10] highlighted the usefulness of collaboration between orthodontists and orthopedists in improving spinal posture. This conclusion was based on the observation of cervical changes during treatment of skeletal class II malocclusion. However, changes of body posture had been observed by Smiliene et.al [11] after treatment of skeletal class II malocclusion using twin blocks, but these changes were concluded to be due to physiologic growth rather than a response to occlusal improvement.

A more forwarded head posture was observed in patients with skeletal class III malocclusion compared to patients with class I and II malocclusion. In addition, those patients were found to incline their head more ventrally, compared to class I patients. This study was carried out by Hedayati et.al [12] in which 102 lateral cephalometric radiographs for patients 15-18 year-old were used and assessed. In a study published in 2014, Gogola has suggested that children with faulty postures have more intense malocclusion compared to those with correct posture. [13]

It was also believed that doing orthodontic treatment for the sole reason of treatment or prevention of postural imbalances is not effective. [14][15] L.Perillo also supported this opinion, and according to a study done by him in 2011, he concluded that there is no significant correlation between different malocclusal traits like overbite, over-jet, posterior cross-bite, scissor-bite, mandibular crowding, molar classification with body posture in children and young adults. [16]

Habits like bruxism were found not to be significantly associated with changes in the cranio-cervical posture for children, and that was concluded following a 1-month treatment of bruxism using bite-plate appliance. However, there was a change observed during the treatment. [17]

Body posture can be assessed using different methods including radiographs [12, 18, 19] and rasterstereography [14]. In this project we used a newly introduced application "posture screen app-mobile" which is easy to use by non-orthopedists, and it depends mainly on photographs in assessment of body posture, without the need for further radiographic exposure.

Hence, this study was done to assess various occlusal traits in depth by extra oral and intra-oral clinical examination and to find a correlation between these occlusal variations and the malocclusion already existing in the patients.

The aim also included to evaluate the intensity of various occlusal traits on malocclusion, TMJ and in turn body posture The study also evaluated the comparison of the posture app tool along with manual assessments and found that the tool was user friendly providing near to accurate results as compared to other methods.

MATERIALS AND EQUIPMENT USED:

- Diagnostic set
- Gold-man Fox probe
- Fox plane
- Indelible pencil
- Tongue depressors
- Dental floss
- Mixture of Gypsum and water
- Ruler
- Examination gloves

METHODOLOGY:

25 students (10 males and 15 females) from Ras Al Khaimah College of Dental Sciences, aged 17-25 year-old who agreed to participate in this study were asked to sign a consent form, after providing full explanation about the aims, procedures of extra-oral, intra-oral and postural assessment.

The study protocol was reviewed and approved by Ras Al Khaimah Research Ethics Committee (RAK-REC) and Ras Al Khaimah Medical and Health Sciences (RAKMHSU) Committee. All the included participants had to meet the following inclusion criteria:

i. Students 17-25 year-old
ii. Presence of maxillary and mandibular 1st molars in at least one side
iii. Absence of history of spinal surgeries

Exclusion criteria:

i. Genetic postural defects
ii. Maxillofacial trauma
iii. Neuromuscular disorders
iv. Substance addiction
v. Handicapped people
vi. Spinal surgeries
vii. Absence of 1st molar in both sides

Data collection form:

Participants were asked about their medical and dental history (data collection form attached). Their dental occlusion was assessed clinically, and side posture was assessed using photographs.

Extra-oral Examination:

Jaw Deviation

The participants were asked to sit in a position of 90 degree in the dental chair, and open and close their mouth to detect any deviation in the mandible if present.

Occlusal cant

Occlusal cant was assessed with Fox plane and parallelism to interpupillary line and Ala Tragal line was observed. The parallelism of fox plane wings to Ala Tragal line was observed by drawing the Ala-Tragus line using dental floss soaked in a thick mixture of gypsum and water. Fox-plane was placed intraorally in alignment to maxillary arch. From the side, the distance between the Ala-Tragus line and fox-plane was measured. No occlusal cant was recorded if this distance was equal on both sides. Presence or absence of occlusal cant was confirmed by taking a frontal picture of the subjects with fox-plane in place. The pictures were uploaded in power-point (version 2010) and interpupillary line was drawn and compared with fox-plane. Parallelism of these two lines indicates the absence of occlusal cant

TMJ Examination

Routine examination of Temporo-mandibular joint (TMJ) and muscles of mastication was performed as per standard procedure.

Intra-oral Examination:

Molar Relation:

All participants guided to occlude in their maximal intercuspal position, and molar relation was assessed.

- In class I, The mesio-buccal cusp of the maxillary 1st molar should rest on the buccal groove of the mandibular 1st molar.
- If the lower 1st molar was distalized, this indicates class II malocclusion.
- While if the lower 1st molar was mesialized, this indicates class III malocclusion.

Over jet and Over Bite:

Over jet, which is the horizontal distance between maxillary and mandibular incisors, was measured using Goldman-Fox probe placed parallel to the incisal edge of the maxillary incisors.

Overbite, which is the vertical overlap between the maxillary and mandibular incisors, was measured and that's by drawing a line on the mandibular incisors showing the area covered by maxillary incisors, and the distance from the mandibular incisal edge to the line drawn using red indelible pencil represents the overbite.

Dental midline deviation/Cross bite/Crowding:

Cross-bite was recorded if present. Dental midline deviation was checked clinically –if present- by measuring the distance between the maxillary and mandibular midlines. Then, participants were asked to open their mouth and number of teeth with surface loss (attrition, erosion, abrasion) and crowding were recorded if present.

Postural evaluation:

Participants were asked to stand barefoot in their natural relaxed position, and photographs showing the side posture were taken. The distance between the camera and the participants was standardized. Those pictures were uploaded in "posture screen app mobile" where the posture line that joins **external auditory meatus, acromioclavicular joint, hip, knee, and ankle** was drawn in red. Another line showing the ideal posture line was drawn as well in green (fig: 1). Pictures collected from "posture screen app mobile" that show both actual and ideal posture lines were compared according to "Jordanian Physiotherapy Society" to be classified as excellent, good, poor, and very poor posture.

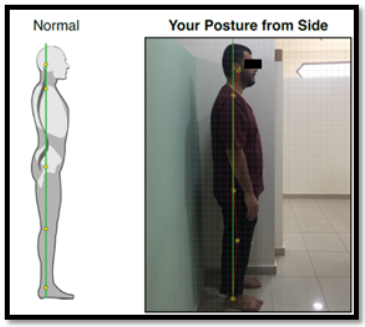

Figure 1: Postural evaluation using posture screen app mobile

RESULTS:

Comparison between types of molar relationship (I, II, III) and side posture (table 1, fig:2)

Out of 25 participants, 13 presented with good side posture, 7 of them were found to have class I molar relationship. Only 2 participants were presented with excellent posture, both of them were having class I molar relationship.

The rest presented with poor posture, more than half of them were found to have class III molar relationship.

In this study, poor side posture was found to be more associated with class III molar relationship compared to class I molar relationship (p-value = 0.0392)

Status of posture	Class I	%	Class II	%	Class III	%	Total	%
Excellent	2	18.18	0	0.00	0	0.00	2	8.00
Good	7	63.64	4	66.67	2	25.00	13	52.00
Poor	2	18.18	2	33.33	6	75.00	10	40.00
Total	11	100.00	6	100.00	8	100.00	25	100.00
Between Class I, Class II and Class III , p=0.0655								
Class I vs. Class II, p = 0.4782								
Class I vs. Class III, p = 0.0392*								
Class II vs. Class III, p = 0.3112								

*p<0.05

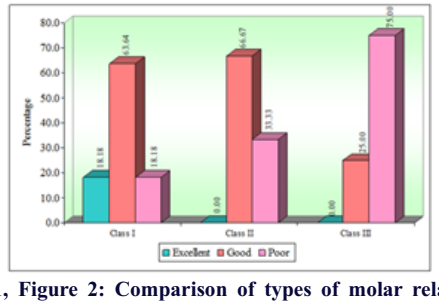

Table 1, Figure 2: Comparison of types of molar relationship (I,II,III) with status of side posture

Comparison of status of side posture with occlusal traits (table 2, fig:3)

Mean of over-jet scores were calculated, and it was within the normal limits in participants presented with both excellent and good side posture, while it was dramatically decreased in participants presented with poor side posture (mean ≈ -0.65 mm), and it was statistically significant (p-value = 0.0030).

Although crowding was found to be minimal in participants presented with excellent side posture, it was found to be not statistically

significant (p=0.4450).

Midline deviation, which was found to be within the accepted range (≤2 mm) in all postural categories, mean value of overbite, and attrition were found not to be statistically significant as well. (p-values: 0.7020, 0.4450, 0.1060 respectively).

Status of posture	Over jet (mm)		Overbite (mm)		Midline Deviation (mm)		Crowding		Attrition	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Excellent	1.50	0.71	3.00	0.00	1.50	0.71	0.50	0.71	4.50	0.71
Good	2.42	1.66	2.50	1.87	1.23	1.36	2.46	1.76	2.38	1.89
Poor	-0.65	3.21	0.50	2.58	1.75	1.86	2.20	2.15	1.50	1.84
Total	1.12	2.74	1.74	2.31	1.46	1.52	2.20	1.89	2.20	1.94
H-value	11.8370		7.0470		0.7070		1.6180		4.482	
P-value	0.0030*		0.0290		0.7020		0.4450		0.1060	

*p<0.05

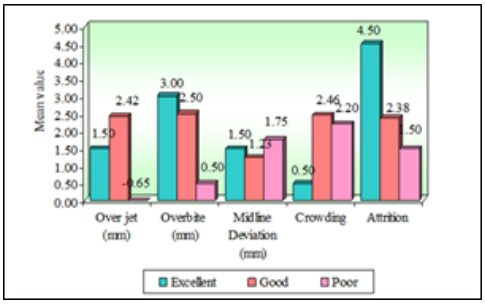

Table 2, Figure 3: Comparison of status of posture with status of over-jet (mm), overbite (mm), midline deviation (mm), crowding, and attrition

Comparison of status of posture with jaw deviation when opening/closing and occlusal cant: (table 3, fig:4)

Among all the examined participants, 16 did not experience jaw deviation when they were asked to open and close their mouth. 9 of them presented with good side posture

Five out of nine participants who experienced jaw deviation when opening/closing were found to have poor side posture. However, this was not statistically significant (p-value: 0.3447). There was no statistically significant difference in side posture in groups with and without occlusal cant as well. (p=0.65447)

Status of posture	Excellent	%	Good	%	Poor	%	Total	%
Jaw deviation when opening/closing								
Absent	2	12.50	9	56.25	5	31.25	16	64.00
Present - to the left	0	0.00	3	100.00	0	0.00	3	12.00
Present - to the right	0	0.00	1	16.67	5	83.33	6	24.00
Chi-square=2.1302 p=0.3447								
Occlusal Cant								
No cant	1	14.29	4	57.14	2	28.57	7	28.00
Occlusal cant	1	5.56	9	50.00	8	44.44	18	72.00
Chi-square=0.8472 p=0.6547								

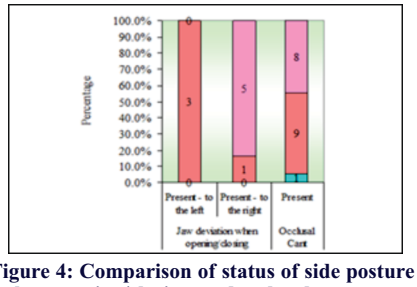

Table 3, Figure 4: Comparison of status of side posture with jaw deviation when opening/closing, and occlusal cant

Comparison of status of side posture with history of habits (table 4):

14 out of 25 participants were presented with history of habits like thumb sucking, lip biting, and bruxism. 6 of them were found to have poor side posture, while 7 with good side posture. Among those who did not present with history of habits, 6 presented with good posture. According to these findings, history of habits was found not to be statistically correlated with side postural changes (p-value: 0.9424)

Status of posture	Excellent	%	Good	%	Poor	%	Total	%
Absent	1	9.09	6	54.55	4	36.36	11	44.00
Present	1	7.14	7	50.00	6	42.86	14	56.00
Chi-square =0.1192 p=0.9424								

Table 4: Comparison of status of posture with history of habits

DISCUSSION:

Body postural changes can be related to various influences, including malocclusion. Understanding this relationship can enlighten the role of dentists in early prevention or treatment of postural changes by early treatment of the related factors.

The study group consists of 25 participants after exclusion of those without 1st molars on at least one side, those with genetic postural defects, maxillofacial traumas, neuromuscular disorders, substance addiction, handicapped people, and those who underwent spinal surgeries. The reason for excluding these categories was to try to eliminate other factors that can affect the posture negatively.

In this study, we detected the presence of an association between class III molar relationship and poor side posture compared to class I molar relationship, while there was no significant association between class II molar relationship and poor side posture compared to class I molar relationship. This is in agreement with the findings of other studies. For example, **Hedayati et.al** reported mild straighter inclination of cervical vertebrae in class III individuals, while in class I and class II molar relation, this was not statistically significant. It was also reported that a more forwarded head posture was observed in individuals with skeletal class III compared to skeletal class I and class II, and that class III patients tended to incline their head more ventrally [12]

Smailiene et.al reported similar findings, in which 23 children were assessed orthopedically to detect their back shape and cephalometric radiographs before and 10-14 months after treatment of class II malocclusion using twin block appliances. Postural changes were detected but they were more likely due to physiological growth rather than being a reflection of improvement in occlusion, which supports our findings as well [11].

However, some articles reported contradictory results. For example, **Ohnmeiß et.al** studied the effect of skeletal class II treatment using functional orthodontic appliances on the position of the cervical spine posture and stated that during skeletal class II treatment, the position of upper cervical spine changes [10]. Lopatiene et.al, Nik et.al, and Šidlauskienė et.al. reported similar results [20,19,9].

The present study aimed at evaluating occlusal factors in depth to analyze if any of the varying occlusal co-factors might be related to postural changes, The occlusal factors evaluated were ; over-jet, overbite, midline deviation, crowding, and tooth surface loss. Among these factors, only decreased over-jet was found to be significantly correlating with poor side posture. However, a study conducted by **Perillo et.al** in which 1189 participants were divided into control and study groups concluded that little relevance was found between potential body postural effects and malocclusion, and that dental treatment should not be for the sake of prevention or treatment of postural imbalance [16]. An overview was also carried out in Italy 2010, concluded that performing occlusal and/or orthodontic treatment, especially if expensive and irreversible, for the sole reason of treatment of postural imbalances or alteration of spinal curvature is not advisable [15]. Similar conclusion was also reported by **perinetti et.al** as well [21].

In our study, history of habits was found not to be significantly associated with postural changes. Moreover, a study conducted by **Bortoletto et.al** found similar results. This study consists of treatment of bruxism by bite plates in children 6-10 years for one month. Cranio-cervical posture was checked with the aid of photographs before, during, and 1-month following treatment. Bruxism treatment was found not have significant improvement in cranio-cervical posture, which supports our findings [17].

Jaw deviation on opening/closing and the presence of occlusal cant were also evaluated to complete all factors that can be an initiating factor to occlusal problems. These two measures were found to be non-significant when associated with postural changes. However, on PubMed search no reference articles could be obtained with evaluation of all occlusal cofactors which could be an underlying cause for malocclusion and in turn to TMJ and postural changes.

Advantages of the study:

- Using "posture screen app" made general postural analysis by non-specialists possible.
- This application provide us an easier way for checking body posture even at home
- After malocclusion treatment, participants can keep track of their postural changes using this app instead of multiple review visits with specialist.

CONCLUSION:

On literature review many articles that studied the relationship between malocclusion and body posture, were found with no conclusive effects as to if malocclusion could cause postural body changes. After review of literature it was observed that, in-depth occlusal analysis and underlying causes of malocclusion were not evaluated by any authors. Hence in our study multifactorial analysis on factors causing occlusal discrepancy was evaluated and for better accuracy on body postural changes the "posture screen app "was used. Our study, found a positive relationship between body postural changes with class III molar relationship. Among the multifactorial occlusal analysis of various occlusal traits, decreased over-jet was found to be associated with postural changes, while habits were found to be negative to postural changes.

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