Effects of Open Mouth Posture on Dentofacial Development of Growing Children

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Abstract:

Objective: In spite of the continuous interest of orthodontists in the effects of soft tissues on dental and skeletal structures, this influence is not well clear. The purpose of this investigation was to clarify the effect of open lip posture on selected dentoskeletal features of growing children.

Materials and Methods: In this cross sectional study, 193 pupils (99 girls, 94 boys) with age range of 9 to 13 years were participated. All patients were examined by a trained investigator and those having incompetent lip seal were selected and their dentoskeletal features were compared with a control group consisting of 36 subjects with normal occlusion. The data were analyzed by independent sample t-tests.

Results: Among the 193 students examined in this study, 19 cases (10%) were diagnosed as having lip incompetence. A more open lip posture was associated with an increase in overjet, lower incisor inclination and Palatal plane to Mandibular plane angle ($p<0.05$); while Interincisal angle was significantly decreased in this group compared to control subjects ($p<0.05$). The amount of overbite and upper incisor inclination were not statistically different between the two groups ($p>0.05$).

Conclusion: The data from this study suggest that lip incompetence may have a significant environmental effect on dentofacial structures. Since lip seal assessment can be achieved simply by practitioners, parents or teachers, it is suggested that adults observe and provoke children to maintain appropriate lip posture.

Keywords: lip posture, dentofacial development, overjet, overbite, cephalometry

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The experimental and clinical evidence suggests that in addition to hereditary effects, skeletal and dental development may be significantly influenced by the environmental factors.[1]

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The position and stability of dental system and the pattern of facial growth are affected by orofacial muscle function. The presence of open lip posture may influence the balance between tongue and lip pressure and consequently affect the position and inclination of the teeth.[2,3]

Some previous studies have dealt with the relationship between open lip posture and dentofacial morphology. It has been shown that the poor lip seal may influence not only tooth position but also mandibular position and growth direction and it also associates with poor esthetics.[4,5] Mew stated that poor lip seal affects the growth pattern to the vertical direction.[6] In the study of Trotman et al.[7], the three parameters of lip posture, sagittal airway size, and tonsil

size were associated with coherent but different skeletal morphology. The relationship between open lip posture and maxillary arch width was evaluated by Gross et al.[8] In a 4 year period, children with the higher levels of open mouth posture manifested significantly slower growth of the maxillary arch width relative to closed mouth posture children. The authors concluded that open mouth posture with or without airway patency may be a potentially undesirable factor in dentofacial development.[8]

It has been stated that most subjects with open lip posture are oronasal breathers[9], but open mouth posture may be habitual rather than an obligatory action. A lack of lip seal is not a reliable indicator of mouth breathing.[10,11] However, the lack of lip seal has been emphasized by several authors as a factor that changes muscle function and consequently results in craniofacial alterations.[12-14]

In spite of the continuous interest of orthodontists in the effects of soft tissues on dental and skeletal structures, this influence is not well clear. According to our data, there are a few reports on the effects of lip posture on dentofacial complex of growing children and this influence has not been evaluated in Iranian population. The purpose of this investigation was to clarify the effect of open lip posture on selected dentoskeletal features of Iranian children.

Materials and Methods:

In this cross sectional study, 193 pupils (99 girls, 94 boys) who were referred to Department of Orthodontics of Mashhad Dental School were participated. Subjects' ages ranged from 9 to 13 years with a mean age of 11 years 4 months. Inclusion criteria consisted patients with Angle class I occlusion and without any signs or symptoms of respiratory dysfunction based on parents' reports. Individuals who their upper and lower incisors had not erupted completely and/or those having craniofacial deformities as well as subjects who were undergoing orthodontic treatment were excluded from the study, since these conditions may influence the outcomes. Informed consent was obtained from all subjects after a brief explanation of the study.

All patients were examined by a trained investigator and those having incompetent lip seal were selected and their dentoskeletal features were compared with a control group consisting of 36 subjects with Angle class I occlusion, normal overjet and overbite and normal sagittal and vertical skeletal relationships. The control subjects were matched with the test group for age and sex. None of them had any soft tissue abnormality or respiratory problems.

Data on lip posture were obtained at the time of clinical examination. The amount of space between the upper and lower lip at rest was observed by the examiner while the subjects were counting from 1 to 6, according to the method of Mew.[5] The subjects were divided into a good lip seal group (Lip competence or closed mouth posture group: less than 4 mm apart) and a poor lip seal group (Lip incompetence or open mouth posture group: over than 4 mm apart).

Measurements

The usual orthodontic documentation, including dental casts and cephalometric rediographs were obtained for test and control subjects. Overjet and overbite were measured to the nearest 0.1 mm directly from the dental casts using a caliper. The casts were trimmed using a wax recording of subject's bite at the time of clinical examination. Overjet was measured in millimeters as the difference between the incisal edge of the most proclined upper anterior tooth and the corresponding point on the labial surface of the mandibular incisor. To measure overbite, the incisal edges of upper anterior teeth were marked on the labial surface of lower anterior teeth and the distance between the incisal edge of lower incisor to the mark gave overbite in millimeter.

The radiographs were obtained in NHP position at the Radiology Center of Mashhad Dental School. The subjects were asked to keep their teeth in centric occlusion and with the lips relaxed. Patients were instructed to hold their breath and not to swallow while the radiographs were taken. The cephalograms were traced by one investigator and the accuracy of landmark identification was confirmed by another investigator. To minimize the error caused by

head positioning, the midline of double contour bilateral structures was drawn. Four angular variables were measured to the nearest 0.5° on these tracings. The reference points and plans used in the cephalometric analysis are shown in Figure 1.

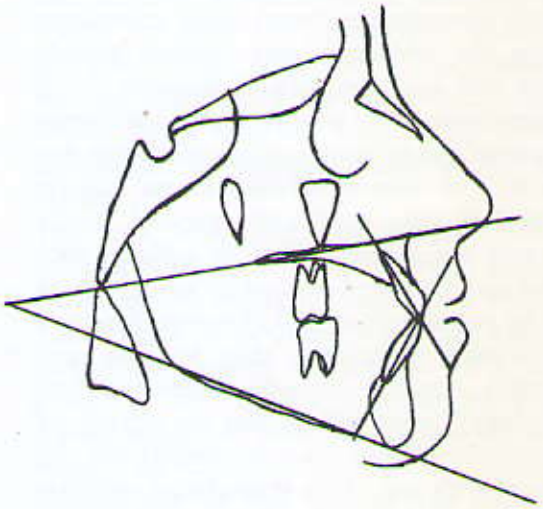

Fig 1: Cephalometric reference points and plans used in the present study.

variability. The reliability of the measurements (intraexaminer errrors) was examined by re-measuring dental casts and cephalograms of 10 randomly selected subjects by the same examiner within 1 week interval.

Statistical analysis: The overjet, overbite and cephalometric variables of control subjects were compared with the corresponding values of subjects with lip incompetence, using Independent sample t-tests. The level of significance was set at $\alpha<0.05$.

Results:

Among 193 students who agreed to be examined in this study, 19 cases (10%) were diagnosed as having lip incompetence. The error of measurements was calculated as below 0.2 mm and 0.5 degrees for linear and angular measurements, respectively.

Descriptive statistics of the variables analyzed in the test and control groups and a statistical evaluation of intergroup differences are given in Table 1. A more open lip posture was associated with an increase in overjet, lower incisor inclination (L1 to MP) and palatal to mandibular plane angle ($p<0.05$); while interincisal angle was significantly decreased in this group compared to control subjects ($p<0.05$). However, the amount of overbite and maxillary incisor inclination relative to palatal plane were not statistically different between the two groups ($p>0.05$).

Measure	Open mouth posture group (n=19)		Closed mouth posture group (n=36)		Significance
	mean	SD	mean	SD	
Overjet	3.6	2.19	1.66	0.85	S
Overbite	2.2	1.95	1.55	1.02	NS
U1 to Pal-P	109.5	4.58	109	4.98	NS
L1 to Man-P	94.5	5.44	91.5	4.54	S
U1 to L1	121.5	6.78	131	5.14	S
Pal-P to Man-P	34	4.85	28.5	3.56	S
S = significant					
NS = not significant					

Table 1. Morphological features of patients with incompetent lips compared to control subjects.

In this study, Some dentoskeletal features of children with open lip posture were evaluated. The results showed that there were significant differences in dentofacial morphology of good lip seal and poor lip seal groups, implying the influence of open lip posture on growth and development of growing children.

In the present study, the distance between upper and lower lips was measured between phonation. Thuer[15] measured the distance between upper and lower lips on lateral cephalograms. Gross et al.[16] performed direct observation of open mouth posture by psychology students and mentioned that there is little error in such observations of lip posture.

Although the inclination of upper incisors was not significantly different between the groups of this study, the lower incisors were significantly more proclined in subjects with open lip posture. This finding is similar to the results of Drevensek et al.[4] who reported that the mean value of lower incisors inclination was significantly higher in lip incompetent individuals. In contrast, a previous study showed extruded and retroclined mandibular incisors relative to mandibular plane in subjects with open mouth posture.[7] The decrease in interincisal angle of lip incompetent sample found in this study can be attributed to increased inclination of lower incisors in these individuals compared to closed lip seal group.

In this study, the amount of overjet was significantly larger in subjects with poor lip seal, but the amount of overbite did not show a statistical difference between the two groups. Yata et al.[17] reported that in their subjects with malocclusions, there were significant differences in overjet and overbite between the groups with good lip seal and poor lip seal. Our cases with open lip posture showed higher palate-mandibular angle compared to controls. This may be the result of mandibular backward rotation. Tortman et al demonstrated that a more open lip posture was associated with a downward and backward rotation of the face, an elongated total anterior face height and a more obtuse gonial angle.[7] Similar findings have been reported by other investigators.[3,4,6] In contrast, some investigators found no significant difference in facial types of subjects with good lip seal and poor lip seal [17,18], probably because of racial trends to more horizontal growth of the face in the sample they evaluated.

The difference between morphological features of open mouth posture and closed mouth posture groups of this study can be attributed to the difference in perioral muscle force. The open lip posture has been emphasized by several authors as a factor that changes lip musculature[12-14]. Previous investigators found some correlation between the orbicularis oris superior muscle function and some craniofacial variables.[19,20] It has been shown that a poor lip seal can influence the position and inclination of anterior teeth due to the lack of balance between tongue and lip pressure.3 In some studies, the perioral muscle force was significantly lower in subjects with poor lip seal compared to good lip seal group, as tested by button pulling.[17,18] However, Ingervall and Jonson[21] were not able to find any correlation between muscle force and bite morphology. Lowe[22] found that the activity of the orbicularis oris muscle could not be correlated with any of the craniofacial variables investigated in his study. A previous study[23] showed that the upper lip pressure on the teeth is a result rather than a determinant of incisor position, indicating adaptation of lip pressure to facial morphology. Another reason for morphological difference between the groups of this study may be related to the tongue posture. It is a prevalent finding in subjects with open mouth posture to place their tongue in a low forward position[8]. In the study of Ueda et al.[18], there were many cases with tongue thrusts in the poor lip seal group. The low posture of the tongue may impede incisor eruption, facilitate posterior eruption and consequently cause mandibular backward rotation, and also may cause maxillary arch deficiency.[8,16]

It has been shown that although lip incompetence is a fairly common behavior, as children get older they show lower rates of this response.[8] Gross et al stated that the gradual decrease in frequency of open mouth posture continues through [9] years of age8. Ueda et al observed that there was no case of poor lip seal in the normal occlusion adult group, but about one third of patients in malocclusion adult group were recognized with poor lip seal.[18] They concluded that when people mature, a suitable

lip seal develops from unconscious reasons and sometimes social pressure, but adults in the poor lip seal group can not keep the lips closed because of their malocclusion, even if they are aware of this problem.

Open mouth posture may be the result of several factors. Enlarged tonsils and adenoids[24] and allergies[25] or some developmental factors have been reported to cause mouth breathing which results in open lip posture. In addition, a previous nasal obstruction may initiate a habitual pattern of open lip posture. Another probability is that the subject may never be encouraged to engage in appropriate mouth posture[8].

The data from this study suggest that lip incompetence may have a significant environmental effect on dentofacial structures. Therefore, it is important to achieve a good lip posture in growing children as early age as possible. The lip seal exercise for perioral configuration has been emphasized by several authors during the growth period.[17,26] Frankel[26] claimed that lip seal training was effective in activating and improving the muscle tone and correcting mandibular position. Using a standard procedure, lip seal assessment can be achieved simply and inexpensively by practitioners, parents or teachers. With respect to the high incidence of open mouth posture in orthodontic patients[27], and considering the relationship between this posture and dentofacial morphology, it is suggested that parents and practitioners train and provoke children to maintain appropriate lip posture.

Conclusion:

The findings showed that lip incompetence may have a significant environmental effect on dentofacial structures. Since lip seal assessment can be achieved simply and inexpensively by practitioners, parents or teachers, it is suggested that adults observe and provoke children to maintain appropriate lip posture.

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