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Evaluation of Lip Profile in Adolescent Subjects with Skeletal Class I Occlusion and Class III Malocclusion.

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الخلاصة

الأهداف: لفحص الاختلاف في موقع الشفة من الأمام إلى الخلف باستعمال الأشعة الجانبية للرأس لعينة من المراهقين من الصنف الأول والثالث لإطباق الأسنان.
المواد وطرائق العمل: اشتملت الدراسة على 80 مراهق (40 ذكر و 40 أنثى) قسموا طبقا لنوع إطباق الأسنان إلى مجموعتين: المجموعة الأولى تضم أشخاص ذوي الإطباق الأول للأسنان (40 شخص) والمجموعة الثانية تضم أشخاص ذو الإطباق الثالث للأسنان (40 شخص). باستخدام الأشعة الجانبية للرأس، تم قيم موقع الشفة باستخدام (7) قياسات خطية ومقياسين زاويين .حللت البيانات باستخدام اختبار t لعينتين مستقلتين . النتائج: لوحظ اختلاف معنوي بين المجموعتين لأغلب المتغيرات. بالنسبة لمجموعة الإطباق الثالث لأسنان ،لوحظ أن الشفة العليا أكثر تراجعا بالنسبة للخطوط (S,B,C) وأكثر بروزاً للشفة السفلى بالنسبة للخطوط (H،B). فضلاً عن أن المجموعة ذاتها تملك اقل قيمة للزاوية (H) واكبر قيمة للزاوية (Z) عند مقارنتها بمجموعة الإطباق الأول للأسنان. أظهرت الدراسة أن خطي (H و B) لديهما القدرة الأكبر على التمييز بين مجموعتي الإطباق. لوحظ وجود اختلاف بين الذكور والإناث في كلتا المجموعتين. بالنسبة لمجموعة الإطباق الأول للأسنان، وقد أظهر الذكور بروزاً أكثر للشفاه بالنسبة للخط (S)، بينما مجموعة الإطباق الثالث للأسنان اظهر الذكور بروزا أكثر للشفة العليا بالنسبة للخطوط (S,B,C). وفي كلتا المجموعتين اظهر الذكور أعلى قيمة بالنسبة للزاوية (H) واقل قيمة للزاوية (Z) مقارنة بالإناث. الاستنتاجات: مجموعة الإطباق الثالث للأسنان تميل إلى امتلاكها مظهر جانبي للشفة الذي يختلف بشكل ملحوظ عن مجموعة الإطباق الأول للأسنان وذلك بامتلاكها بروز بالشفة السفلى وتراجع بالشفة العليا،اقل قيمة للزاوية (H) وزاوية (Z) المنفرجة وهذا ما يؤكد أهمية التقييم للأنسجة الرخوة كعامل مساعد في التشخيص وخطة العلاج لمثل هذا النوع من الإطباق.

ABSTRACT

Aims: To examine the difference of anteroposterior lip position using lateral cephalometric radiograph in a sample of Class I and Class III malocclusion adolescents. **Materials and Methods:** The study comprised 80 adolescent subjects (40 males and 40 females) who were divided according to the type of occlusion into two groups; dental and skeletal Class I group (40 subjects) and the dental and skeletal Class III group (40 subjects). On lateral cephalometric radiograph, lip position was assessed using 7 linear and 2 angular measurements. The data were analyzed using independent samples t–test. **Results:** Significant differences were noticed between the two groups for most of the variables. The combined sample showed more retrusive position of the upper lip in Class III group in relation to Steiner, Burtone and Canuts lines. While significantly more retrusive position of the lower lip in Class III group was noticed in relation to Burstone and Harmony lines. In addition, Class III sample showed a significantly smaller H angle and greater Z angle than Class I group. When these reference lines were compared for sensitivity, H line and B line were found to have the greatest power to differentiate between the 2 groups. Sexual dimorphism was noticed in both groups. In Class I group, males showed more protrusive lips in relation to Steiner line. While in the Class III lines group, males showed more protrusive upper lip in relation to Burton and Canuts lines and in both groups males showed significantly larger H angle and smaller Z angle than females. **Conclusions:** The skeletal Class III malocclusion tend to have lip profile that differs significantly from skeletal Class I occlusion and is characterized by retrusive upper lip, protrusive lower lip, smaller H angle and more obtuse Z angle. These findings emphasize the importance of integumental evaluation as an aid in orthodontic diagnosis and treatment planning of this type of malocclusion.

Key words: Lip profile, Class I occlusion, Class III malocclusion.

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INTRODUCTION

Improving dentofacial relations is one of the aims of orthodontic treatment.[1-3] The clinical ability to alter dentofacial form requires an understanding of facial esthetics, which is vital for any clinician involved in treatment that will alter patient's appearance.[4] Edward H Angle described class III malocclusion as one in which the lower first molar is positioned mesially relative to the upper first molar.[5] Class III malocclusion is the least prevalent type of the Angle's classification of malocclusion,[6] but it is one of the most sever dentofacial anomalies. Individuals with Class III malocclusion frequently show combination of skeletal and dentoalveolar components.[7] The main focus of concern for the Class III patient, presenting a concave facial profile, a retrusive nasomaxillary area and a protrusive lower face and lip may be the profile rather than the occlusion.[8]

For a long time, orthodontists have focused on the horizontal lip position as the most important feature in determining beauty. Several lines have been introduced to assess the anteroposterior position of the upper and lower lips and the esthetic quality of the profile.[9-14] There have been many attempts to qualify the degree of soft tissue protrusion or retrusion in the ideal face. Cephalometric radiographs can be used to measure various soft tissue profiles in an attempt to describe this feature, and also as an aid to treatment planning.[15]

Hence, as one of the most important components of orthodontic diagnosis and treatment planning is the evaluation of the patient's soft tissue profile, this study aimed to: 1. Study the difference in lip position in adolescents with skeletal Class I occlusion and skeletal Class III malocclusion. 2. To investigate sexual dimorphism within each group. 3. To determine which of profile lines and angles is more sensitive (has the greatest power) to differentiate between Class I and Class III facial profiles.

MATERIALS AND METHODS

The lateral cephalometric radiographs of 80 adolescents (40 males and 40 females) were used in this study. The sample was divided into 2 groups, the dental and skeletal Class I group and the dental and skeletal Class III group. The Class I group comprised 40 subjects (20 males and 20 females) who were selected from a larger dental Class I sample (115 adolescents) and were defined as having a mean ANB angle of $2^{o} \pm 2^{o}$. From a sample of 85 adolescents with dental Class III malocclusion, 40 subjects (equally divided as to sex) were allocated to the dental and skeletal Class III group with a mean ANB angle of $< 0^{o}$.

All cephalometric radiographs were traced and measured manually by the same investigator. The horizontal lip position was assessed using 7 linear and 2 angular measurements as depicted in Figure (1).

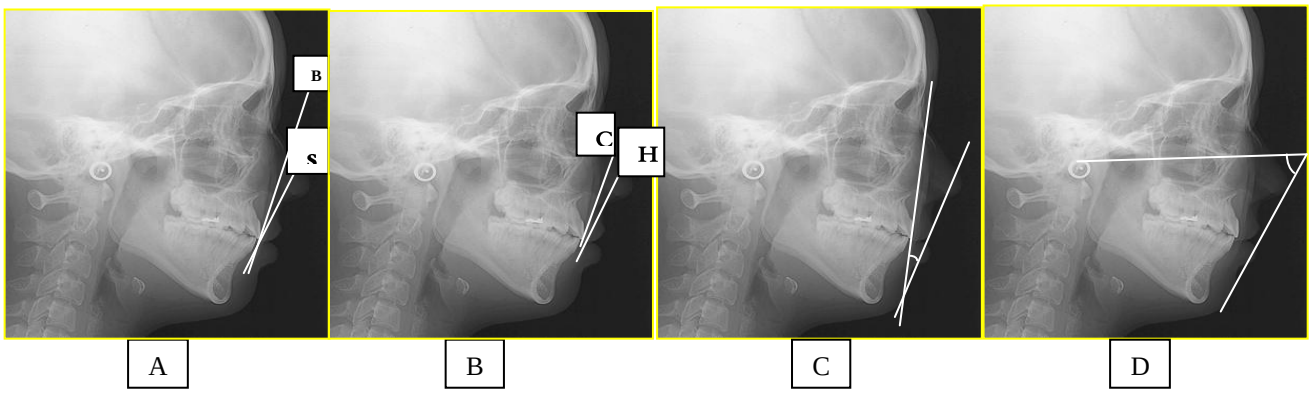

Figure (1): A- the distances from labral superius and labral inferius to Burstone's (B) and Steiner's (S) lines; B- the distances from labral superius and labral inferius to Canut's (C) and Holdaway's (H) lines; C- H angle; and D- Z angle

The linear parameters involved measuring the perpendicular distances between both upper lip (labrale superius) and lower lip (labrale inferius) to 4 reference lines. These lines are:

1. Steiner's S line: is the line drawn from soft tissue pogonion to the middle of S shaped curve between the tip of the nose and subnasal point.[10]
2. Burstone's B line: is the tangent drawn from soft tissue pogonion to subnasal point.[11]
3. H (harmony) line: the tangent drawn from soft tissue pogonion to the upper lip.[13]
4. Canut's C line: is the line drawn from subnasal point to supramental point.[14]

A positive reading indicates that the lip was in front of the reference line, a negative reading indicates that the lip was positioned behind the line, and zero indicates that the lip was tangent to the line.

the angular measurements included:

1.H angle: the angle formed between the soft tissue facial plane and the H line which is the tangent drawn from soft tissue pogonion to the upper lip.[13]

2.Z angle: the angle formed between the Frankfort horizontal plane and the line drawn from soft tissue pogonion to the most protruding lip.[16]

The data were analyzed using SPSS software package version 11. Independent samples *t*– test was used to study differences between skeletal Class I occlusion and Class III malocclusion groups and to explore sexual dimorphism within each group.

RESULTS

The descriptive statistics along with comparison of Class I occlusion versus Class III malocclusion for the combined, male and female samples are presented in Tables 1, 2 and 3 respectively. Adolescents with Class I occlusion possessed a significantly higher mean values for Ls/S line and H angle at the level $p \leq 0.001$ for male, female and pooled samples. They also showed a significantly higher mean value for Ls/C line at $p \leq 0.001$ in the combined and female samples and at $p \leq 0.05$ for male sample.

Ls/B line showed significantly higher mean value in Class I group at $p \leq 0.001$ for total and female samples. When lower lip position was assessed; significant differences were noticed for Li/H line, as Class III group showed a significantly higher mean value at $p \leq 0.001$ in combined and male samples and at $p \leq 0.05$ in female sample; and for Li/B line at $p \leq 0.05$ in combined and male samples. In addition, Z angle reported a significantly higher mean value in Class III subjects at $p \leq 0.01$ for combined and female samples.

The four reference lines showed variable degrees of sensitivity in differentiating Class I from Class III facial profiles in both male and female samples (Tables 1, 2 and 3). However, B line showed satisfactory power of differentiation for both upper and lower lips when the pooled sample was considered; also, H line was found to be the most sensitive reference line in the combined sample as well as in male and female samples.

In Table (4), the comparison between Class I adolescent males and females indicated that there is significant differences between genders for the Li/S line and H angle at $p \leq 0.05$, and for Ls/ S line at $p \leq 0.01$ with the males having the higher mean values, while females demonstrated significantly higher mean value for Z angle at $p \leq 0.01$.

Table (1): Descriptive statistics for Class I and Class III combined samples

Variable	Skeletal classification	No.	Mean	±SD	Sig.	*t*– value
Ls/S line	Class I	40	–0.219	1.491	0.000***	6.815
	Class III	40	–2.825	1.926		
Li/S line	Class I	40	0.292	1.767	0.887	–0.143
	Class III	40	0.362	2.567		
Ls/B line	Class I	40	4.304	1.166	0.000***	4.249
	Class III	40	2.862	1.811		
Li/B line	Class I	40	3.280	1.573	0.044*	–2.043
	Class III	40	4.137	2.163		
Li/H line	Class I	40	0.597	1.484	0.000***	–4.479
	Class III	40	2.275	1.860		
Ls/C line	Class I	40	5.939	1.199	0.000***	5.611
	Class III	40	4.190	1.583		
Li/C line	Class I	40	6.261	1.342	0.605	–0.519
	Class III	40	6.437	1.702		
H –angle	Class I	40	15.146	2.809	0.000***	8.462
	Class III	40	8.877	3.775		
Z –angle	Class I	40	74.792	4.712	0.004**	–3.035
	Class III	40	79.337	8.246		

No=Number; SD=standard deviation;* significant difference at $p \leq 0.05$; ** significant difference at $p \leq 0.01$; *** significant difference at $p \leq 0.001$.

Table (2): Comparison between Class I and Class III adolescent males.

Variable	Skeletal classification	No.	Mean	±SD	Sig.	*t*– value
Ls/S line	Class I	20	0.425	1.462	0.000**	4.627
	Class III	20	–2.150	2.013		
Li/S line	Class I	20	0.850	1.702	0.788	–0.271
	Class III	20	1.050	2.823		
Ls/B line	Class I	20	4.500	1.213	0.065	1.898
	Class III	20	3.525	1.949		
Li/B line	Class I	20	3.475	1.482	0.036*	–2.176
	Class III	20	4.800	2.284		
Li/H line	Class I	20	0.525	1.197	0.000**	–3.989
	Class III	20	2.575	1.961		
Ls/C line	Class I	20	6.025	1.292	0.015*	2.561
	Class III	20	4.830	1.638		
Li/C line	Class I	20	6.260	1.543	0.150	–1.469
	Class III	20	7.025	1.743		
H –angle	Class I	20	16.100	2.702	0.000**	5.902
	Class III	20	10.355	3.412		
Z–angle	Class I	20	72.800	4.705	0.122	–1.581
	Class III	20	75.925	7.485		

No=Number; SD=standard deviation;* significant difference at $p \leq 0.05$; ** significant difference at $p \leq 0.001$.

Table (3): Comparison between Class I and Class III adolescent females.

Variable	Skeletal classification	No.	Mean	±SD	Sig.	*t*– value
Ls/S line	Class I	20	–0.833	1.268	0.000***	5.898
	Class III	20	–3.500	1.614		
Li/S line	Class I	20	–0.238	1.700	0.886	0.145
	Class III	20	–0.325	2.138		
Ls/B line	Class I	20	4.119	1.116	0.000***	4.827
	Class III	20	2.200	1.417		
Li/B line	Class I	20	3.095	1.670	0.495	–0.689
	Class III	20	3.475	1.860		
Li/H line	Class I	20	0.667	1.741	0.021*	–2.398
	Class III	20	1.975	1.750		
Ls/C line	Class I	20	5.857	1.130	0.000***	6.161
	Class III	20	3.550	1.265		
Li/C line	Class I	20	6.261	1.157	0.325	0.996
	Class III	20	5.850	1.478		
H –angle	Class I	20	14.238	2.658	0.000***	6.933
	Class III	20	7.400	3.607		
Z–angle	Class I	20	76.690	3.954	0.004**	–3.152
	Class III	20	82.750	7.683		

No=Number; SD=standard deviation;* significant difference at $p \leq 0.05$; **significant difference at $p \leq 0.01$; *** significant difference at $p \leq 0.001$.

Table (4): Comparison between males and females in adolescents with Class I occlusion.

Variable	Gender	No.	Mean	±SD	Sig.	*t*– value
Ls/S line	Male	20	0.425	1.462	0.005**	2.948
	Female	20	–0.833	1.268		
Li/S line	Male	20	0.850	1.702	0.047*	2.047
	Female	20	–0.238	1.700		
Ls/B line	Male	20	4.500	1.213	0.302	1.046
	Female	20	4.119	1.116		
Li/B line	Male	20	3.475	1.482	0.447	0.769
	Female	20	3.095	1.670		
Li/H line	Male	20	0.525	1.197	0.764	–0.302
	Female	20	0.667	1.741		
Ls/C line	Male	20	6.025	1.292	0.660	0.443
	Female	20	5.857	1.130		
Li/C line	Male	20	6.260	1.543	0.996	–0.004
	Female	20	6.261	1.157		
H –angle	Male	20	16.100	2.702	0.032*	2.224
	Female	20	14.238	2.658		
Z–angle	Male	20	72.800	4.705	0.007**	–2.871
	Female	20	76.690	3.954		

No=Number; SD=standard deviation; * significant difference at $p \leq 0.05$; ** significant difference at $p \leq 0.01$.

DISSCUSSION

Several analyses have been suggested to evaluate lip position and its influence on facial profile, among those used reference lines are Steiner's S line, Holdaway's H line, Burstone's B line and Canut's C line. It could be said that S line eliminates half of the change in integumental profile due to growth of the nose. However, H, B and C lines eliminate the influence of nasal

growth in the evaluation of lip posture.[17] Thus, since the size of the nose is largely influenced by individual variations; the use of reference line that crosses the nose will not be quite reliable in differentiating Class I from Class III facial profiles. The findings of this study showed that H line is the most sensitive in both males and females, as well as B line which was the most sensitive for both upper and lower lips in the combined sample. Thus, it can be inferred that B line and H line can be used satisfactorily in orthodontic diagnosis for judging skeletal Class III facial profile. This study revealed that subjects with skeletal and dental Class III malocclusion possessed significant retrusion of upper lip in relation to Steiner's, Burstone's and Canut's lines and significant protrusion of lower lip in relation to B and H lines as compared to skeletal and dental Class I group, this finding indicates facial profile concavity which is associated with underlying Class III skeletal pattern either due to maxillary retrognathism or mandibular prognathism or both; and it comes in agreement with the findings of Nojima *et al*.,[18] and Tzortzopoulou[19] who reported that Class III subjects have a concave soft tissue profile with more anteriorly positioned mandibular soft tissue landmarks.

Holdaway[13] stated that H angle increases as the basic skeletal convexity increases in order to maintain a harmonious soft tissue drape. This coincides with the results of present study as Class I occlusion sample showed significantly larger H angle compared to Class III sample who were selected on the basis of having ANB angle of less than 0^{o}. This finding is also justified by greater upper lip prominence reported for Class I subjects which will produce larger angle. On the other hand, Merrifield's Z angle (which is formed by 2 lines, Frankfort Horizontal and the profile line from soft tissue pogonion to the most protrusive lip) was significantly larger in Class III adolescents and as Tables 1, 2 and 3 show; Class III subjects demonstrated a lip profile in which lower lip was always ahead of upper lip in relation to all reference lines which means that Merrifield's profile line will mostly pass through lower lip in Class III subjects. Thus, a more obtuse Z angle will be produced in Class III group as they reported a significant protrusion of lower lip compared to Class I group. Sexual dimorphism was reported for some variables in both groups. Males with Class I occlusion reported a significantly more protrusive upper and lower lips than females in relation to S line, which comes in agreement with the findings of Hsu,[20] Fernandez– Riveiro,[21] Hamdan[22] and Mzizana.[23] Class I adolescent males also reported a significantly larger H angle than females, this finding coincides with the results obtained for Jordanian adolescents[22] and is attributed to the fact that males demonstrated more prominent upper lip in relation to all reference lines used in this study; also it may indicate that males have more convex profile than females. However, this study revealed that Class I adolescent females possessed larger Z angle than males, which comes in agreement with the finding of Merrifield[16] who reported larger Z angle in females in 11–15 years age group. Similar findings were also reported for Suadis[24] and Turkish[25] but, in those studies; the difference did not reach the level of significance. This finding along with the smaller H angle reported in females indicate that Class I females have less convex profile than males, which can be attributed to the fact that mandibular growth occur earlier in females than males.[26]

The main feature concerning sexual dimorphism in Class III group was a significantly more retrusive upper lip in females which comes in agreement with Baccetti *et al*.,[6] who considered retruded lip position to be a characteristic of Class III female subjects from the age of 13 to 16 years. On the other hand, Class III males demonstrated a significantly larger H angle which is justified by the more prominent lips reported for males in this study. They also showed significantly smaller Z angle than females, this finding may indicate a lesser degree of mandibular prognathism in Class III males during adolescent years. Comparison between adolescent males and females with Class III malocclusion demonstrated that males possessed significantly higher mean values for the Ls/S line, Ls/B line, Li/C line and H angle at $p \leq 0.05$ and for Ls/C line at $p \leq 0.01$. While females

possessed significantly higher mean value for Z angle at $p \leq 0.01$ as illustrated in Table (5).

CONCLUSIONS

The present study investigated the difference in lip profile between adolescents with skeletal Class I occlusion and skeletal Class III malocclusion using certain reference lines. Holdaway's H line and Burstone's B line were found to be the most sensitive in differentiating the difference between the two groups. Also, this study revealed that Class III adolescents have more retruded upper lip in relation to Steiner's S line, Burstone's B line and Canut's C line and more protruded lower lip relative to B and H lines. In addition, they possessed a smaller H angle and larger Z angle indicating concavity of facial profile. Sexual dimorphism was reported in both groups as Class I males showed significantly more protrusive upper and lower lips than females in relation to S line. While, Class III males showed more protrusive upper lip relative to S, B, and C lines and more protrusive lower lip relative to C line than females. In both groups males possessed larger H angle and smaller Z angle than females.

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