THE RELATIONSHIP BETWEEN THE LOWER INCISORS CROWDING AND THE SAGITTAL JAWS IN ADOLESCENTS IN THE SYRIAN COAST

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ABSTRACT

Among the criteria required for orthodontics diagnosis and treatment planning, both Sagittal Jaws Relationship (S.J.R.) and Lower Incisors Crowding (L.I.C.) are critical. There have been no local data obtained and documented which relate interrelationship between (S.J.R.) and L.I.C. amongst adolescents (with permanent dentition) on the Syrian coast. It was the aim of this study to search this interrelationship amongst adolescents (with permanent dentition) on the Syrian coast using ANB angle for assessing the (S.J.R.)

The material of this study consisted of mandibular dental study casts, lateral cephalometric and panoramic graphs of 81 Caucasian patients (18 males and 63 females) from 13 to 19 years of age, from pretreatment patients undergoing orthodontic evaluation at the Department of Orthodontics and Dentofacial Orthopedics at Tishreen University. Mandibular dental study casts and lateral cephalometric were scanned and digitized, Little's Irregularity Index, (ANB) angle meanings were calculated digitally using Ceph Basic™ software.

This study reveals no statistical significant differences in crowding severity between the two sexes, except for the group of very severe irregularity ($p = 0.03$, $\alpha = 0.05$). Sex differences in distribution amongst the (S.J.R.) groups were noted, no subjects with perfect alignment, no group of L.I.C. have significant relationship with meanings of (ANB) angle, while the correlation analysis between every single class of (S.J.R.) and the meanings of Little index reveals significant correlation only between skeletal class II and L.I.C. ($r = -0.35$).

Only skeletal class II has slightly inverse relationship with L.I.C., but not with specific degree of L.I.C. severity, as this study revealed no specific relationship between the severity degree of L.I.C. and the meanings of (ANB) angle.

Key words: lower incisors crowding, sagittal jaws relationship, permanent dentition, adolescents on the Syrian coast

INTRODUCTION

It has been found that most of the patients who resorted to the Orthodontics and Dentofacial Orthopedic department of the dental school at Tishreen University during the last two years were adolescents with main complaint of Lower Incisors Crowding L.I.C. accompanied by different (S.J.R.) malocclusions.

L.I.C. appears in 9.62% of Syrian adolescents (1), and in 26.3% of the Syrian Coast School's students with mixed dentition (2) (S.J.R.) malocclusions appear in 40.34% of Syrian adolescents (1), and in 50.6% of the Syrian Coast School's students with mixed dentition (2).

Despite evidence for a strong tendency for the untreated lower arch to become more crowded during adolescence (3-5) especially after second molar eruption (6), no local data have been obtained and documented which relate the interrelation of (S.J.R.) malocclusions and L.I.C. amongst adolescents (with permanent dentition) on the Syrian coast.

However, it is still not clear why some develop crowding and others do not, studies showed differences in L.I.C. due to age (3-7), sex (8), interproximal attrition due to the type of the diet (9), race,

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genetic factor (10), various malocclusions, occlusal relations, functional disorders (11,12,13) and morphology of the lower jaw (14); crowding also could be because of an evolutionary trend towards a reduced facial skeletal size without a corresponding decrease in tooth size (15); furthermore, during facial growth, while maxilla and mandible translate downwards and forwards (16, 17), co-ordination of the development of the upper and lower dental arches is not always ideal (18, 19), dentoalveolar compensatory changes in the position and axial inclination of the upper and lower incisors were found between the different groups (20,21), this can be considered as a dentoalveolar compensation (22) and defined as a system which attempts to maintain stable inter arch relationships; Such compensation is very obvious in some variations of skeletal morphology, and sagittal jaw discrepancies where L.I.C. could appears as a result of a dentoalveolar compensation (23-25).

MATERIALS

The material of this study consisted of maxillary and mandibular dental study casts, lateral cephalometric and panoramic graphs of 81 Caucasian patients (18 males and 63 females) from 13 to 19 years of age (mean age of 16.1 years) The average age of the females was 16.1 years; the average age of the males was 15.7 years. To determine the minimum sample size to be statistically significant, a pilot study was realized on 20 patients to determine the sample size according to the following formula:

$$N = \frac{Z^2 pq}{e^2}$$

(N) is the sample size.

(z) is the value corresponding to a confidence level, estimated at 95% (z = 1.96)

(pq) is population variance. It is estimated in the pilot study at 0.541.

(e) is desired level of precision (established in 5%).

According to this pilot study, we determined that for a standard error of 5% it is required a sample size of 78 patients as minimum.

The sample was selected from pretreatment patients undergoing orthodontic evaluation at the Department of Orthodontics and Dentofacial Orthopedics at Tishreen University.

The criteria for selecting the subjects were taken as follows:

1) No history of decayed tooth/restorations in deciduous dentition.

2) Each subject must have fully erupted permanent dentition up to second molar tooth.

3) No supernumerary tooth/supplementary tooth/missing tooth/impacted tooth.

4) No restorations in permanent tooth.

5) No history of trauma to the dento-facial structures.

6) No history of previous orthodontic treatment.

7) No periodontal disease.

8) Subjects could exhibit varying degrees of skeletal and/or dentoalveolar malocclusions.

9) Exclusion criteria were for subjects with lower incisors spacing, congenital anomalies/ syndromes and marked asymmetries.

METHOD

Upper and lower alginate impressions with maximum displacement of soft tissues, created by maximum extension of the impression were taken and poured with dental stone to prepare the study models. Since sagittal jaws relationship evaluation can be done effectively using digital method (26-28), each patient's lower casts was scanned and digitized for sagittal jaws relationship evaluation, measurements were taken from the direct occlusal view (27), later Little Irregularity Index (29) was digitally calculated (27) using Ceph Basic™ software. Sizes were to the nearest 0.01 mm, a 15.6-in LCD laptop screen with resolution of 1366 X 768 pixels and 0.26-mm diagonal dot pitch with 32-bit color was used (30).

Little's Irregularity Index technique involves measuring the linear distance from anatomic contact point to adjacent anatomic contact point of mandibular anterior teeth (Fig.1), the sum of the five measurements represents the irregularity index (29).

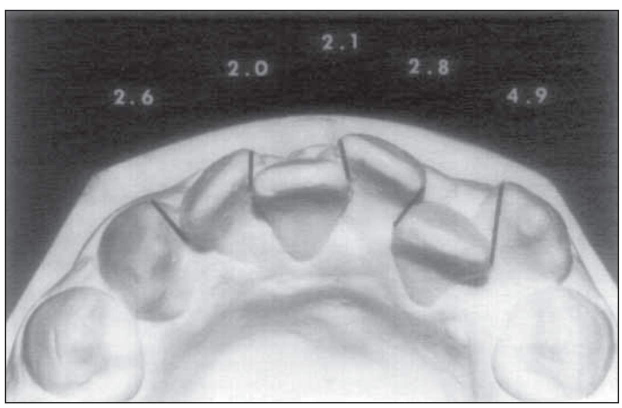

***FIGURE 1.** Calculation of Little's Irregularity Index – figure from Little (29)*

Patients were classified according to L.I.C., which were analyzed through Little index (29) into five groups (Table 1).

TABLE 1. Scaling of the Little index (29)

0 Perfect alignment.
1-3 Minimal irregularity
4-6 Moderate irregularity
7-9 Severe irregularity
10 Very severe irregularity

Error analysis: all measurements on digital models were taken independently by the two researchers (measurements sessions were at least 2 weeks apart) to test for reliability and were examined using paired t-tests. None of the measurements between observers were found to be statistically significantly different at the P < 0.05 level.

For assessing (S.J.R.), we used ANB angle, suggested by Riedelin in 1952 (31), since it could be an accepted method of assessing the sagittal jaw base relationship (32-38); the ANB angle is formed with the vertex at point N (Nasion, the most anterior aspect of the frontonasal suture, located by visual inspection on the tracing) and two sides respectively extending to A-point (the deepest point on the contour of the premaxilla) as well as B-point (the deepest point on the contour of the mandible); in fact, ANB angle is the difference between the SNA and the SNB angles which usually are used to assess skeletal positions of the upper and the lower jaws, respectively (32, 33, 39-41).

All lateral cephalograms were scanned into digital format at 300 dpi, traced, then ANB angle was digitally calculated (42) using the same Ceph Basic™ software, sizes were to the nearest 0.01 mm, a 15.6-in LCD laptop screen with resolution of 1366 X 768 pixels and 0.26-mm diagonal dot pitch with 32-bit color was also used.

Error analysis: all measurements on the digital cephalograms were also taken independently by the two researchers (measurements sessions were at least 2 weeks apart) to test for reliability and were examined using paired t-tests. None of the measurements between observers were found to be statistically significantly different at the P < 0.05 level. Later, the sample was divided into three groups according to the sagittal skeletal malocclusion through ANB angle value suggested by Steiner 32, 33) (Table 2).

TABLE 2. Classification of the (S.J.R.) according to the ANB angle value suggested by Steiner (32,33)

(S.J.R.) class	ANB angle value
I	0-4°
II	>4°
III	< 0°

All statistical analyses were performed with the SPSS statistics program version 19.

RESULTS

No subject with perfect alignment (according to Little index) was found in the sample of this study.

Although sex distribution for the L.I.C. groups showed some difference (Table 3), the P values of T-test (Table 3) showed no statistical significant differences in crowding severity between males and females except for the group of very severe irregularity (p = 0.03, α = 0.05).

TABLE 3. Sex distribution by severity of crowding (according to Little index scaling) and P values of T-test of crowding severity between the two sexes.

	n	%	♀	♂	p
Minimal irregularity	6	7.4	2	4	0.2
Moderate irregularity	45	55.5	38	7	0.2
Severe irregularity	18	22.2	15	3	0.4
Very severe irregularity	12	14.8	8	4	0.03
Total	81	100	63	18	

Calculated statistics values of Little index in millimeters (its min., max., mean values, and standard deviations) are presented in Table 4. The table demonstrates that most of the sample fell within moderate (55.5%) and severe irregularity (22%), no subjects with perfect alignment.

TABLE 4. Distribution of the sample's L.I.C. with respect to the scaling of the Little index (mm)

	Min	Max	Mean	Std. Deviation
Perfect alignment	0	0	0	0
Minimal irregularity	1.95	3.48	3.05	0.56
Moderate irregularity	3.54	6.41	4.78	0.85
Severe irregularity	6.55	9.38	7.78	0.85
Very severe irregularity	10.27	13.73	11.93	1.18

Sample's distribution by (S.J.R.) classes for each sex is illustrated in Table 5. Sex differences in distribution amongst the (S.J.R.) groups were noted.

TABLE 5. Distribution by (S.R.J.) classes for each sex

	♀	♂	n	%
Class I	28	12	40	49.38
Class II	30	6	36	44.44
Class III	5	0	5	6.17
Total	63	18	81	100

Calculated mean values, standard deviations and distribution of measured ANB angle values (in degrees) with respect to the (S.J.R.) groups, are presented in Table 6.

Table 6. *Distribution of ANB angle (degrees) with respect to (S.J.R.) groups.*

	Min	Max	Mean	Std. Deviation
Class I	0.26	3.99	2.45	1.09
Class II	4.17	8.71	5.91	1.13
Class III	-2.46	-0.43	-0.95	0.86

A correlation analysis was performed between every single group of L.I.C. groups distributed through Little index (except the Perfect alignment group because there were no subjects with perfect alignment), and the meanings of (ANB) angle (Table 7). The findings for correlation coefficients (**r**) were between -0.006 and 0.075. No group of L.I.C. have significant relationship with meanings of (ANB) angle, It was concluded that there were no definite linear or nonlinear relationships between any group of L.I.C. and the meanings of (ANB) angle, there was no need for further detecting of the prevalent of the three (S.J.R.) classes in every single group of L.I.C..

TABLE 7. *A correlation coefficient (r) between every group of L.I.C. (distributed through Little index) and the meanings of (ANB) angle.*

	r
Perfect alignment	No subjects with perfect alignment
Minimal irregularity	0.075
Moderate irregularity	-0.006
Severe irregularity	-0.075
Very severe irregularity	-0.076

A correlation analysis was performed between every single class of (S.J.R.) and the meanings of Little index (Table 8). The findings for correlation coefficients (**r**) were between -0.35 and 0.54.

The only significant correlation (**r** = -0.35) was between the second skeletal class and L.I.C. at the 0.05 level (tow tailed), which means that skeletal class II and L.I.C. are related in a slightly negative linear sense.

TABLE 8. *A correlation coefficient (r) between every single class of (S.J.R.) and the meanings of Little index*

	r	
Class I	0.14	
Class II	-0.35	Correlation is significant at the 0.05 level (2-tailed).
Class III	0.54	

DISCUSSION

Among the criteria required for orthodontics diagnosis and treatment planning, both (S.J.R.) and L.I.C. are critical, even so, no local data have been obtained and documented which relate the interrelation of (S.J.R.) and L.I.C. amongst adolescents (with permanent dentition) on the Syrian coast. It was the aim of this study to search any interrelationship between (S.J.R.) and L.I.C. amongst adolescents (with permanent dentition) on the Syrian coast utilizing ANB angle for assessing the skeletal sagittal jaw base relationship. No subjects with perfect alignment (according to Little index) were found in the sample of this study, although subjects with perfect alignment were not an exclusion criteria, this could be due to low oral hygiene amongst Syrian children with mixed dentition (2) as a contributory role in the development of future crowding in the permanent dentition stage (43). No statistical significant differences in crowding severity between males and females except for the group of very severe irregularity. Ibraheem (2) and Richardson (6) also found no differences in crowding between the two sexes in the young adult, Richardson (6): states "that this cannot be regarded as an accurate measure of the incidence of crowding, but it does give some idea of its prevalence in the population from which this sample was drawn". Nevertheless, other researchers (8, 44) concluded that there are significant differences in L.I.C. between the two sexes.

No group of L.I.C. has significant relationship with meanings of (ANB) angle. Turkkahraman (45) considering early mixed dentition patients, found the same conclusion. This was contrary to Berg (34) and Rasul (46) who found a significant relationship between meanings of (ANB) angle and (L.I.C).

Furthermore, in our study, the correlation analysis between every single class of (S.J.R.) and the meanings of Little index means revealed that skeletal class II and L.I.C. are related in a slightly inverse relationship.

This can be explained, somehow, by the fact that, the more sagittal discrepancy between upper and the lower jaws, the less possibility of occurrence of L.I.C., because the mandibular incisors will be more able to avoid lingually forced inclination due to early and/or abnormal contact with the cingulum of the antagonist maxillary incisors during the lower jaw function. Nevertheless, Lundström (47) and Richardson (48) were unable to demonstrate a direct relationship between change in crowding and change in incisor angulation.

Berg (34) and Rasul (46) found that the incidence of crowding was higher in patients exhibiting features of Class I and Class II as compared to Class III patients. Anyway, the inconsistencies between the results of our study and findings of Berg (34) and Rasul (46) can be explained through the difference in the sample's age groups, and the ethnic factor.

Performing Wits analysis, Turkkahraman (45) reported that Class II skeletal patterns were more likely to be associated with lower incisor crowding in the early mixed dentition subjects. Leighton (14) points out that the mandibular corpus of subjects with severely crowded dentitions is shorter compared with subjects who have spaced mandibular dentitions. Sakuda (49) found some correlation between L.I.C. and short mandibular body lengths, Ronnerman (50) found that linear measurements depicting the amount of prognathism were greater in cases with no crowding. However, we can't compare our results with findings of Leighton (14), Sakuda (49) and Ronnerman (50) because they tried to find a correlation between L.I.C. and the sagittal dimensions of the jaws, while our study is investigating the correlation between the L.I.C. and the positional variants of sagittal jaws interrelationship.

CONCLUSION

The following conclusions may be applied to the adolescents (with permanent dentition) on the Syrian coast, which the studied groups were taken from:

1) Only skeletal class II has a slightly inverse relationship with L.I.C., but not with specific degree of L.I.C. severity, as this study revealed no specific relationship between the severity degree of L.I.C. and the meanings of (ANB) angle.

2) Perfect alignment was missing amongst the subjects of this study's sample, which means a need for further researches to confirm this result with larger samples randomly taken from the population of adolescents (with permanent dentition) on the Syrian coast.

3) No statistical significant differences in crowding severity between males and females have been found except for the group of very severe irregularity.

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