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A Comparative Study of Curve of Spee and Arch Circumference Between Class I Normal Occlusion and Class II Division 1 Malocclusion

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الخلاصة

أهداف الدراسة: تهدف الدراسة إلى قياس منحنى سبي في الأحداث الذين لديهم إطباق أسنان من الصنف الأول أو الصنف الثاني. وقد تم التحري أيضا عن وجود أي علاقة بين عمق منحنى سبي و محيط قوس الأسنان و عدد من المتغيرات الأخرى بين هذين الصنفين من الإطباق. **طرق و مواد البحث:** تم اخذ أمثلة سنية لعينة من 60 من الأحداث في المدارس المتوسطة في مدينة الموصل. شملت العينة 30 طالبا و 30 طالبة من الذين تراوحت أعمارهم بين 12–15 سنة. قسمت العينة إلى مجموعتين متساويتين من 30 شخصا، حيث ضمت كل مجموعة 15 ذكرا و 15 أنثى.كان لدى المجموعة الاولى إطباق أسنان من الصنف الأول و المجموعة الثانية كان لديها إطباق من الصنف الثاني–الفرع الأول. تم قياس عمق منحنى سبي و محيط قوس الأسنان على أمثلة سنية للفك السفلي لكلا المجموعتين. كذلك تم قياس تراكب العضة و بروز الأسنان الأمامية للمجموعتين. جرى استخدام اختبار(t) لمقارنة المتغيرات المدروسة بين كلتا المجموعتين فضلا عن استخدام معامل الارتباط لدراسة العلاقة بين عمق منحنى سبي و المتغيرات المدروسة بين كلا الصنفين من الاطباق. **النتائج:** اظهرت النتائج عدم وجود فروق معنوية بين كلا الجنسين في جميع المتغيرات المدروسة ضمن المجموعة التي تمتلك نفس النوع من الإطباق بينما كان الفرق معنوي بينهما عندما قورنت مجموعة الإطباق من الصنف الأول مع المجموعة التي تمتلك الصنف الثاني من الإطباق. اظهرت النتائج أيضا وجود علاقة معنوية بين عمق منحنى سبي و كل من تراكب العضة، و بروز الأسنان الأمامية و محيط القوس السني في كلتا المجموعتين.

ABSTRACT

Aims: The purpose of this study was to determine the curve of Spee in class I and class II division 1 malocclusion groups to investigate whether there is a relationship between the depth of Curve of Spee with arch circumference and other variables (overjet and overbite) between two classes of occlusion. **Materials and Methods**: 60 dental casts of untreated adolescents, 30 girls and 30 boys aged 12–15 years, were obtained from secondary schools at Mosul City. The sample included 2 groups; the class I occlusion group and class II_1 malocclusion group, each group comprised from 30 subjects (15 boys and 15 girls). The depth of curve of Spee and arch circumference were measured on mandibular dental casts. Overjet and overbite were assessed with a vernia. Description of the variables within each class and comparison of the variable between two classes were assessed by student *t*–test. In addition, a correlation coefficients between the depth of curve of Spee and other variables were calculated. **Results:** the results showed that there were no significant differences between genders within the groups for all variables. However, these variables showed sexual differences between two groups. Statistically significant correlation was also found between the depth of Spee and overbite, overjet and arch circumferences in both groups.

Key words: Curve of Spee, lower arch circumference, class I, class II division 1 malocclusion.

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INTRODUCTION

The curve of Spee was first described by F Graf Von Spee in 1890, who used skulls with abraded teeth to define a line of occlusion. This line lies on a cylinder that is tangent to the anterior border of the condyle, the occlusal surface of the second molar, and the incisal edges of the mandibular incisors [(1)]. Spee located the center of this cylinder in the midorbital plane, so that it had a radius of 6.5 to 7.0 cm[(1,2)].

The functional significance of the curvature has not been completely understood[(3)]. However, it has been suggested that the curve of Spee has a biomechanical function during food processing by increasing the crush shear ratio between the posterior teeth and the efficiency of occlusal forces during mastication[(4)].

Leveling of the curve of Spee represents a routine procedure in orthodontic practice. The deviation of the occlusal

plane from a flat plane has practical consequences when considering the arch circumference requirements necessary to flatten the curve. In disputably, a curved arch has a greater circumference than a flat arch. However, the amount of additional arch circumference required to flatten the curve is not as apparent. A popular theory is that 1 mm of arch circumference is needed to level each millimeter of the curve of Spee[5]. Yet, Germane *et al*.,[6] found that less 1 mm of arch circumference is required to level each millimeter of the curve of Spee. According to Woods[7], the amount needed is variable depending on the type of mechanics used.

Later on, the curve of Spee and/or leveling of this has related to incisor overbite[8–10] and lower arch circumference[8].

A deep curve of Spee is usually associated with an increased overbite. Orthodontic correction of the overbite often involves leveling the curve of Spee by anterior intrusion, posterior extrusion or a combination of these actions[11].

The purpose of this study was to determine the depth of the curve of Spee and lower arch circumference in class I occlusion and compare it with that of class II division I malocclusion and to investigate the relationship of depth of curve of Spee with over jet, overbite and arch circumference.

MATERIALS AND METHODS

This study was performed by using the dental casts of 60 subjects aged 12–15 years. These casts were taken from Pedodontic, Orthodontic, and Preventive Department, College of Dentistry, University of Mosul. The samples were collected from secondary schools at Mosul City. It was divided in to two groups:

1. Class I Occlusion Group: It consisted of dental casts of 30 adolescents (15 boys and 15 girls) with Class I canine and molar relationship with minor or no crowding, normal overbite (1–4) mm and overjet (2–4) mm. all teeth present except third molar, no history of trauma and no previous orthodontic treatment[12].
2. Class II_1 Malocclusion Group: It consisted of dental casts of 30 adolescents (15 boys and 15 girls) with Bilateral class II molar relationship in centric occlusion with the distobuccal cusp tip of the maxillary first molar occlude on within one mm anterior from the buccal groove of the mandibular first molar and protrusive maxillary incisors. All teeth present except third molar, no history of trauma and no previous orthodontic treatment[13].

The depth of curve of Spee was measured as the perpendicular distance between the deepest cusp tip and a flat plane that was laid on the top of the mandibular dental cast, touching the incisal edges of the central incisors and the distal cusp tips of the most posterior teeth in the lower arch[1,14]. The measurement was made on the right and left side of the dental arch and the mean value of these two measurements was used as the depth of curve of Spee (Figure 1).

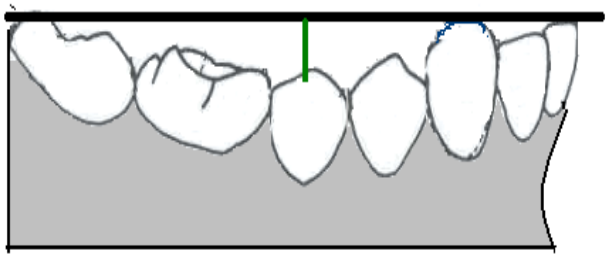

Figure (1): measurement of curve of Spee.

The lower arch circumference was taken from the mesio–occlusal line angle of the first permanent molar to the corresponding point on the other side of lower dental cast. This was measured by adapting a length of 0.5mm soft brass wire to the proximal contact points of the standing teeth. The wire was cutoff at the correct

length and gently straightened manually before measuring[8].

The overjet was measured as the distance (in millimeters) along a horizontal plane between the incisal edge of the labial surface of the mandibular central incisor and incisal edge of the labial surface of the most labially positioned maxillary central incisor, using a vernia[15].

The overbite was measured as the vertical distance (in millimeters) between the incisal edge of the maxillary central incisor and the incisal edge of the mandibular central incisor[15].

Data were analyzed, using statistical package program (SPSS). Descriptive statistics, including the mean and standard deviation (SD) values were calculated for all variables in each occlusion group. Student *t*– test analysis was used between the 2 groups and between the genders.

In addition, Pearson's correlation analysis was used to determine correlation coefficients between the depth of the curve of Spee and over jet, overbite and arch circumference at *p* value of 0.05 or less.

RESULTS

The mean, standard deviation (SD), minimum and maximum values of all variables used in this study for both sexes and for two groups are presented in Table (1) and Table (2), respectively.

Table (1): Descriptive of the variables within class I occlusion.

Variable	Sex	Mean*	SD	Minimum	Maximum
Overjet	Male	1.70	0.59	1.0	2.0
	Female	1.80	0.54	1.0	2.5
Overbite	Male	2.2	0.59	1.0	3.0
	Female	3.08	1.05	1.0	5.0
Curve of Spee	Male	2.65	0.47	2.0	3.0
	Female	2.20	0.44	1.5	3.0
Arch circumference	Male	87.75	4.68	81.0	96.5
	Female	82.60	2.65	78.5	85.0

* Measurement in millimeters.SD=Standard deviation.

Table (2): Descriptive of the variables within class II_1 malocclusion.

Variable	Sex	Mean*	SD	Minimum	Maximum
Overjet	Male	6.25	2.09	3.0	10.0
	Female	5.90	1.88	3.0	8.0
Overbite	Male	4.35	1.20	2.0	5.0
	Female	4.05	0.83	2.0	5.0
Curve of Spee	Male	3.85	0.85	3.0	5.0
	Female	3.15	1.13	2.0	5.0
Arch circumference	Male	87.65	3.84	82.0	95.0
	Female	85.95	2.76	83.0	90.0

* Measurement in millimeters.SD=Standard deviation.

The results of *t*–test analysis between both sexes for 2 groups showed no sexual dimorphism for all variables as shown in Table (3) and Table (4), respectively. Whereas the comparison between two groups for males as represented in Table (5) demonstrated a significant increase for over jet and overbite and a significant decrease in the curve of Spee.

Otherwise, the comparison for females between two groups in Table (6) showed a significant decrease for overjet, curve of Spee and arch circumference in Class II_1.

Table (3): Comparison between males and females for class I occlusion.

Variable	Sex	Mean*	SD	Significance
Overjet	Male	1.70	0.59	0.71
	Female	1.80	0.54	NS
Overbite	Male	2.2	0.59	0.89
	Female	3.08	1.05	NS
Curve of Spee	Male	2.65	0.47	0.90
	Female	2.20	0.44	NS
Arch circum-ference	Male	87.75	4.68	0.17
	Female	82.60	2.65	NS

* Measurement in millimeters. SD=Standard deviation; NS= not significant.

Table (4): Comparison between males and females for class II_1 malocclusion.

Variable	Sex	Mean*	SD	Significance
Overjet	Male	6.25	2.09	0.69
	Female	5.90	1.88	NS
Overbite	Male	4.35	1.20	0.58
	Female	4.05	0.83	NS
Curve of Spee	Male	3.85	0.85	0.89
	Female	3.15	1.13	NS
Arch circum-ference	Male	87.65	3.84	0.27
	Female	85.95	2.76	NS

* Measurement in millimeters. SD=Standard deviation; NS= not significant.

Table (5): Comparison between class I and class II_1 malocclusion for males.

Variable	Occlusion	Mean*	SD	Significance
Overjet	I	1.70	0.59	0.00
	II	1.80	0.54	S
Overbite	I	2.2	0.59	0.00
	II	3.08	1.05	S
Curve of Spee	I	2.65	0.47	0.00
	II	2.20	0.44	S
Arch circum-ference	I	87.75	4.68	0.96
	II	82.60	2.65	NS

* Measurement in millimeters. SD=Standard deviation, NS= not significant.

Table (6): Comparison between class I and class II_1 malocclusion for females.

Variable	Occlusion	Mean*	SD	Significance
Overjet	I	6.25	2.09	0.00
	II	5.90	1.88	S
Overbite	I	4.35	1.20	0.06
	II	4.05	0.83	NS
Curve of Spee	I	3.85	0.85	0.04
	II	3.15	1.13	S
Arch circum-ference	I	87.65	3.84	0.01
	II	85.95	2.76	S

* Measurement in millimeters. SD=Standard deviation, NS= not significant.

Pearson's correlation coefficient was calculated between all variables for class I occlusion as shown in Table (7) and for class II division 1malocclusion as appeared

in Table (8).

The largest positive correlation was present between the depth of curve of Spee and overbite for both groups. In addition, statistically significant positive correlation was found between the depth of curve of Spee and overjet, and arch circumference with overjet and negative correlation between arch circumference and curve of Spee.

Table (7): Correlation of the variables within class I occlusion.

Variable	Sex	Overjet	Overbite	Curve of Spee
Overbite	Male	0.44		
	Female	0.52		
Curve of Spee	Male	0.42	0.43	
	Female	0.48	0.55	
Arch circum-ference	Male	0.51	–0.25	–0.50
	Female	0.47	0.20	–0.47

Table (8): Correlation of the variables within class II_1 occlusion.

Variable	Sex	Overjet	Overbite	Curve of Spee
Overbite	Male	0.13		
	Female	0.05		
Curve of Spee	Male	0.30	0.58	
	Female	0.50	0.67	
Arch circum-ference	Male	–0.31	–0.16	0.40
	Female	–0.44	0.11	0.30

DISCUSSION

In this study, attempt was made to separate the sample according to gender, type of occlusion and select the limited range of age to evaluate the variables more precisely.

The data obtained in this study indicated that there were no significant differences in any of the variables between two genders for both groups. These results come in accordance with Braun and Schmidt[16].They compared non–growing white males and females with class I and class II occlusion and they reported that the shape of the curve of Spee was the same for men and women based on the contact points between the mandibular teeth taken from lateral cephalometric radiographs. Also Cartor and McNamara[17] reported no difference in the overbite, overjet, curve of Spee and arch perimeter between males and females when measured from the dental casts taken before treatment.

HuiXu *et al*.,[18] showed that there is no significant difference in curve of Spee between Japanese men and women.

As expected, the class II subjects had significantly larger overjet than the subjects with normal occlusion. Within each occlusion group, the 2 sexes exhibited similar dimensions.

Our result were very similar to those of Stalay *et al*.,[19]. The males of class II division I group had significantly larger mean values for overbite than males of class I group, while the females in both groups had nearly similar mean values for overbite. Our findings were coordinated with those of Stalay *et al*.,[19] who found that there are no significant difference in vertical relationship for females in both classes.

In this study, the curve of Spee for class II division I subjects shows a significant differences than that of class I subjects. As we know a deep curve of Spee is usually associated with an increased overbite. Bernstein *et al*.,[20] showed that orthodontic correction of the class II division I cases often involves leveling the curve of Spee either by anterior intrusion, posterior extrusion or a combination. This indicates that the curve of Spee is more deeper in class II division I samples than class I occlusion sample. Also, Shannon and Nanda[21] showed that the class II occlusions

had significantly deeper curve of Spee measurement than did class I occlusion. Our findings were greatly differs from that Braun and Schmidt[16] who reported that the curve of Spee was found to be identical for class I and class II occlusions. The results of this study showed that the arch circumference of males in both classes was identical, while it is significantly greater in females of class II_1 group, indicated that the females in class II occlusion had larger arch circumference than the females of class I occlusion. Pearson's correlation coefficient were calculated between the curve of Spee and other variables for class I occlusion indicated that there is a significant correlation between overbite and overjet for both sexes. Our results come in accordance with finding of Bayda *et al*.,[22] who found that the amount of overjet and overbite was significantly influenced by the variation of the curve.

The largest correlation is appeared between curve of Spee and overbite indicated that increased in overbite is coinciding with increasing in the depth of curve of Spee. Al Qabandi *et al*.,[11] showed that a deep curve of Spee is usually associated with an increased overbite. The result of correlation also showed that there was a positive correlation between overjet and curve of Spee and between overjet and arch circumference. On other hand, the result showed that there was negative correlation between arch circumference and curve of Spee in both sexes. This mean that increase in arch circumference coincide with decreasing in depth of curve of Spee. This result is similar to the finding of Baldrige[23], who reported that decreasing the depth of the curve of Spee leads to an increase in arch circumference and that often the lower incisors will be proclined in direct response to this increase.

CONCLUSIONS

Correlation coefficient of the variables within class if malocclusion showed that there was a weak correlation between overbite and overjet. Also, there is a significant correlation between curve of Spee, overbite and overjet, similar to that with class I occlusion. Arch circumference showed negative correlation with overjet and weak correlation with overbite, moderate positive correlation with curve of Spee.

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