CORRELATION OF OVERJET AND OVERBITE IN SUBJECTS WITH DIFFERENT DEPTHS OF CURVE OF SPEE

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ABSTRACT

Objective: *To determine the correlation of different depths of the curve of Spee with overjet and overbite.*

Materials and Methods: *This cross-sectional study was conducted on 85 participants by non-probability consecutive sampling technique from June 2018 to January 2019 at the Department of Orthodontics, Khyber College of Dentistry, Peshawar. Patients with healthy, complete permanent dentition and skeletal Class I was included. Patients with any previous orthodontic treatment, severe craniofacial disorders such as cleft palate, skeletal Class II, and Class III and any congenitally missing maxillary or permanent mandibular teeth, except for the third molars were excluded. The depth of curve of Spee, overjet, and overbite was measured on casts. Descriptive statistics were calculated in SPSS 20.0. Pearson's correlation test was used to determine correlation coefficients of the curve of Spee with overjet and overbite. P≤0.05 was considered significant.*

Results: *Out of total most were females n=49(57.65%), and the males were n= 36(42.35%). The mean overjet was 2.559±1.7379 mm; overbite was 2.553±2.6038 mm, age was 18.44±4.602 years and curve of spee was 2.6029±.93882mm. Correlation between the curve of Spee and overjet in the whole sample was positive but weak (r= 0.334, P=0.002). Similarly, the correlation between the curve of Spee and overbite in the whole sample was positive but weak (r= 0.352, P=0.001). In males, the Correlation between the curve of Spee and overjet was positive and moderate (r=0.447, P=0.006) while in females was positive and weak (r=0.307, (P=0.032). In males, the correlation between the curve of Spee and overbite was positive and strong (r=0.615, P<0.001) while in females was positive and weak (r=0.239, P=0.098).*

Conclusion: *The correlation between the curve of Spee, overbite was weak. The correlation between the curve of Spee and overjet was more in males than females. The correlation between the curve of Spee and overbite was more in males than females, and female the correlation was non-significant. With increasing age, the correlation reduces, and in later ages it becomes negative*

Keywords: *Curve of Spee, overjet, overbite, orthodontics*

INTRODUCTION

Occlusal curvature is a naturally occurring phenomenon in the human dentition. This normal occlusal curvature is required for an efficient masticatory system.[1] Lateral view of human dentition reveals an upward, concave curve in mandibular teeth extending from molars to incisors and a corresponding downward convex curve in the maxillary arch. These peculiarities of dentition were first described by Ferdin and Graf Von Spee[2] in 1890, using skulls with abraded teeth to define a line of occlusion, which is now termed as the Curve of Spee(COS). The curve of Spee is an important characteristic of the mandibular dental arch.[3] It is an anteroposterior curve, that is tangent to the anterior border of the condyle, the buccal cusp tips of the mandibular molars and the incisal edges of the mandibular incisors.[4] Clinically the distal marginal ridges of the posterior teeth in

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the arch and the incisal edges of the central incisors determine the curve of Spee.[5]

In the human dentition the curve of Spee is a natural occurring phenomenon. Curve of Spee is needed for a well-organized masticatory system. The exaggerated curve of Spee (ACS) is regularly found in dental malocclusions with deep bite cases. Such increase curve of Spee changes the muscle imbalance, eventually resulting to inappropriate functional occlusion.[6]

According to the literature, the development of the curve of Spee is due to the earlier eruption permanent mandibular teeth before their maxillary counterparts.[5] Mandibular first molar on average erupts 1-2 months earlier than the maxillary first molar and the eruption of permanent mandibular incisors precedes its maxillary counterparts by 12 months. Because of this difference in eruption timings, this could permit the mandibular first molars and incisors to erupt beyond the established occlusal plane.7This suggests that the curve of Spee is a dental phenomenon. However several other factors also contribute to the development of curve of Spee including development of neuromuscular system, growth of orofacial structures and dental eruption timings.[5, 7]

From functional perspective, curve of Spee has a biomechanical function by increasing the crush-shear ratio between posterior teeth and the efficiency of occlusal forces during mastication.[8] Spee also suggested that it should be considered during fabrication of dentures, to avoid lever effects and allow better mastication as this curve is the most efficient model allowing the teeth to remain in contact during chewing.[9]

Andrews[10] described six keys of normal occlusion and stated curve of Spee as the sixth key to good occlusion ranging from flat to mild. He also mentioned deepening of the curve of Spee with age as a natural tendency as mandible continues to grow downward and forward than that of maxilla, which causes the mandibular incisors, which are confined by maxillary incisors and lips to be forced back and up, resulting in crowded mandibular incisors, a deeper curve of Spee and deep overbite11. Therefore, leveling of the curve of Spee is recommended for better intercuspation and to establish a proper posterior occlusion in excursive movements along with a proper incisor relationship at the end of treatment. Hence it should be the treatment goal in orthodontics.[9, 12]

A deeper curve of Spee is usually associated with an increased overbite.[13] Orthodontic correction of the overbite often involves leveling the curve of Spee by the anterior intrusion, posterior extrusion, or a combination of these actions.[14] Baldridge reported that by decreasing the depth of Spee, lower incisors will be proclined and this will result in an increase in arch circumference.[15]

In one study, the correlation coefficient was found to be 0.30 and 0.42 for overjet and overbite, respectively.[16] The position and inclination of incisor teeth often dictate the overjet and overbite. The rationale for this study is to ascertain the relationship between overjet, overbite, and curve of Spee. Such a co-relation has been established internationally, but no such data exists for our population.

Moreover, since racial and ethnic variations do occur, it is important to establish if this relationship exists in a local sample. A relatively flat curve of Spee is often desirable at the end of orthodontic treatment, but the results of this study can conclude that a flat or absent curve of Spee is not only desirable but a pre-requisite for achieving ideal overjet, overbite relationship. The results of this study can also help us in understanding the etiology of the deep curve of Spee. This study can help us to improve our understanding of the dynamics of occlusion and can lead to further research on this topic plus can also be a valuable guide for the proper treatment, as a positive co-relation would further reinforce the need to level curve of Spee when attempting to correct the overjet and overbite. To determine the correlation of different depths of the curve of Spee with overjet and overbite.

MATERIALS AND METHODS

This cross-sectional study was carried out on 85 participants selected among patients visiting the Department of Orthodontics, Khyber College of Dentistry, Peshawar from May 2018 to November 2018. The Nonprobability consecutive sampling technique selected the sample. Pakistani nationals with healthy complete permanent dentition and with skeletal Class I (ANB angle between 2 and 4 degrees) were included. Patients having any previous orthodontic treatment, severe craniofacial disorders

such as cleft palate, skeletal Class II, and Class III malocclusion, any congenitally missing maxillary or permanent mandibular teeth, except for the third molars were excluded.

Approval of the hospital ethical committee was taken. The patients referred to the orthodontic department for the treatment of malocclusion, fulfilling the inclusion and exclusion criteria were invited to take part in the study. The purpose, procedures, risk, and benefits of the study were explained to them. Informed consent and their willingness to participate in the study were ensured. They were assured of the confidentiality of the data collected from them.

Impression was taken in Alginate (Alginate impression material..Lygin Chromatic, Dentamerica) and poured after taking an impression. Dental casts made up of orthodontic stone were prepared for each patient. The canine and molar relationships were assessed on dental casts and 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 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. The measurement was made on the right and left the side of the dental arch, and the mean value of these two measurements will be used as the depth of curve of Spee. 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 the incisal edge of the labial surface of the most labially positioned maxillary central incisor, and 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.

Data were entered and analyzed in SPSS (version 20.0). Mean, and Standard deviation was calculated for numerical variables like the Curve of Spee, Overjet, and Overbite. Frequencies and percentages were calculated for categorical variables like gender. Pearson's correlation analysis was used to determine correlation coefficients of the curve of Spee with overjet and overbite. Effect modifiers like age and gender were addressed through stratification. The post-stratification Pearson coefficient of correlation was calculated. $P \leq 0.05$ was considered significant. All results were presented in the form of tables and graphs.

RESULTS

The total participants were 85 in which most were females were n=49(57.65%), and males were n= 36(42.35%).

The mean overjet was 2.559±1.7379 mm; overbite was 2.553±2.6038 mm, age was 18.44±4.602 years and curve of spee was 2.6029±.93882mm. The minimum overjet recorded was 0mm, and the maximum overjet was 7mm. The range for overbite was from -5mm to 9mm. The minimum curve of spee was 1mm while the maximum was 5mm depth. The age was ranged from 11 to 30 years. (Table 1)

Correlation between the curve of Spee and overjet in the whole sample was weak but positive (r= 0.334, P=0.002). The details are shown in (Table 2). Similarly, the correlation between the curve of Spee and overbite in the whole sample was weak and positive (r= 0.352, P=0.001).

Correlation between the curve of Spee and overjet stratified by genders showed that in males, the correlation between the curve of Spee and overjet was positive and moderate (r=0.447, P=0.006). While the Correlation between the curve of Spee and overjet in females was weak and positive (r=0.307, P=0.032). (Table 4)

Correlation between the curve of Spee and overbite stratified by genders showed that in males, the correlation between the curve of Spee and overbite was strong and positive (r=0.615, P<0.001). While the Correlation between the curve of Spee and overbite in females was weak but positive (r=0.239, P=0.098). (Table 5).

DISCUSSION

The objective of this study was to determine the correlation of different depths of the curve of Spee with overjet and overbite in a sample of Peshawar Population. Our findings showed that the correlation between the curve of Spee and overjet and overbite was weak and statistically significant.

Although the curve of Spee leveling is a daily occurrence in orthodontic practices, minute research has been conducted to examine the relationship between the depth of the curve of Spee and dentofacial structures. In our study relationships between the depth of the curve of Spee, overjet and overbite were

Table 1: Descriptive statistics for overjet, overbite, age, and curve of Spee

Variable	Mean ± SD	Range (mm)
Overjet (mm)	2.559±1.7379	0.0-7.0
Overbite(mm)	2.553±2.6038	-5.0-9.0
Age (years)	18.44±4.602	11-30
Curve of Spee(mm)	2.6029±.93882	1.00-5.00

Table 2: Correlation between the curve of Spee and overjet in the whole sample

		Overjet
Curve of Spee	Correlation Coefficient*	0.334**
	Sig. (2-tailed)	0.002
	N	85

*Pearson correlation test
**. Correlation is significant at the 0.01 level (2-tailed); Pearson Correlation

Table 3: Correlation between the curve of Spee and overbite in the whole sample

		Overbite
Curve of Spee	Correlation Coefficient*	0.352**
	Sig. (2-tailed)	0.001
	N	85

*Pearson correlation test
**. Correlation is significant at the 0.01 level (2-tailed); Pearson Correlation

Table 4: Correlation between the curve of Spee and overjet stratified by genders

Gender			Overjet
Curve of Spee	Male	Pearson Correlation	.447**
		Sig. (2-tailed)	0.006
		N	36
	Female	Pearson Correlation	.307*
		Sig. (2-tailed)	0.032
		N	49

*Pearson correlation test
**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

Table 5: Correlation between the curve of Spee and overbite stratified by genders

Gender			Overbite
Curve of Spee	Male	Pearson Correlation	.615**
		Sig. (2-tailed)	0.00
		N	36
	Female	Pearson Correlation	0.239
		Sig. (2-tailed)	0.098
		N	49

*Pearson correlation test
**. Correlation is significant at the 0.01 level (2-tailed).

assessed. In the previous study, the relationships between the depth of the curve of Spee and the positions of upper and lower incisors, overjet, overbite, and anterior lower crowding were investigated.[16]

We measured overjet, overbite, and curve of spee on plaster models. The similar methodology had been used in the previous study by Baydaş et al.[16] on the investigation of the changes in the positions of upper and lower incisors, overjet, overbite, and irregularity index in subjects with different depths of the curve of Spee

In our study, the males were n= 36(42.35%), and females were 49(57.65%). The high frequency of females may be due to more aesthetic awareness among females than males as we conducted a study on orthodontics patients.

In our study, the mean value for overjet was 2.559±1.7379 mm with a range of 0 to 7mm. Up to 3 mm overjet is classified normal, which can provide incisal guidance and maintains the stomatognathic system in optimal health.[81] The mean value of overjet is within the normal range, which may because we only used skeletal class I patients with ANB up to 4^0. However, the maximum value is 7mm, which showed that the other factors might be responsible for increased overjet other than the skeletal relationship.[82] The factors responsible for increased other than skeletal may be increased inclination of upper incisors and decreased inclination of lower incisors.[83]

Our findings showed that the mean age was 18.44±4.602 years, with a range from 11 to 30 years. We select this age range because, after 30 years, there is a maximum chance of missing teeth, which can affect the measurement of overjet, overbite, and curve of spee.

The results of the current study showed the correlation between the curve of Spee and overjet in the whole sample was weak (r= 0.334) but statistically significant (P=0.002). The significant correlation showed that in the case of increased overjet, there is also increases the depth of the curve of spee. The underlying mechanism is when the mandible is short, and there is no stop of upper incisors to inhibit the eruption of lower incisors; it leads to supra-eruption of mandibular incisors. The supra-eruption of lower incisors produces curve of Spee with high depth.[9]

Baydaş et al.[16] performed a study on investigation of the changes in the positions of upper and lower incisors, overjet, overbite, and irregularity index in subjects with different depths of the curve of Spee. They reported that the correlation between the curve of Spee and overjet in the whole sample was weak (r= 0.3) but statistically significant (P<0.05). These results are inconsistent with our study.

Similarly, the correlation between the curve of Spee and overbite in the whole sample was weak (r= 0.352) but statistically significant (P=0.001). The weak correlation between the overbite and curve of Spee discloses the fact that cause for an increased deep bite may be other than supra- the eruption of lower incisors. There are many causes of increased overbite which are supra-eruption of upper incisors, lack of eruption of posterior teeth, mandibular deficiency, and convergent jaw rotation.[84]

The current study showed that correlation between the curve of Spee and overjet stratified by genders showed that in males, the Correlation between the curve of Spee and overjet was moderate (r=0.447) and statistically significant (P=0.006). While the Correlation between the curve of Spee and overjet in females was weak (r=0.307) and statistically significant (P=0.032). The genetic and environmental factors may be responsible for this sexual dimorphism for the curve of Spee. No study was traced in the literature on such comparison.

Our study showed that correlation between the curve of Spee and overbite stratified by genders showed that in males, the Correlation between the curve of Spee and overbite was strong (r=0.615) and statistically significant (P<0.001). While the correlation between the curve of Spee and overbite in females was weak (r=0.239) and statistically non-significant (P=0.098). The non-significant results for females may because of other causes of overbite in these selected females which are supra-eruption of upper incisors, lack of eruption of posterior teeth, mandibular deficiency, and convergent jaw rotation.[84]

Our research showed that the correlation between the curve of Spee and overjet stratified by age groups showed that the highest correlation was in the age group 11 to 15 years (r=0.558, P=0.001) followed by 21 to 25 years (r=0.16, P=0.526). The only significant correlation between the curve of Spee and overjet was found in the age group 11 to 15 years. This may occur due to the reason that vertical growth

is up to 20 years. With vertical growth eruption of molars and backward jaw, rotation occurs which decreases the depth of curve of Spee and reduces the correlation.[85]

Strength and weakness of the study

This the kind of study on the local population on relation curves of speed and overbite and overjet, which provide local statistics to the clinician. However, this a hospital-based study that may not represent the Peshawar population accurately. So further studies on community-based and randomized clinical design are required on this topic.

CONCLUSION

Our findings showed that the correlation between the curve of Spee, overbite, and overjet was weak but statistically significant. The correlation between the curve of Spee and overjet was more in males than females, but both were significant. The correlation between the curve of Spee and overbite was more in males than females, and female the correlation was non-significant. With increasing age, the correlation reduces and in later ages, it becomes negative.

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