COMPARION OF DEPTH OF CURVE OF SPEE IN CLASS I, II AND III MALOCCLUSIONS

¹SADIA NAUREEN, ²HAMEED ULLAH JAN, ³HUMA GHAZANFAR KIANI , ⁴TARIQ HAMEED, ⁵UMER HAMEED

ABSTRACT

Curve of spee is a normal occlusal curve which helps in mastication and normal occlusal function. The objective of this study was to compare the depth of curve of Spee in class I, II, and III malocclusions.

This study was conducted at the department of Orthodontics, Rawal Institute of Health Sciences (RIHS) Islamabad from January 2017 to July 2017 on 300 participants. It was a retrospective comparative study. One hundred patients from each class of malocclusions (I, II and III) were selected with the age 11-35 years by non-probability consecutive sampling technique. Lower arch impressions and depth of curve of Spee (COS) was taken on the study casts in each of the malocclusion group. Data was analyzed using SPSS 20.0. Analysis of variance (ANOVA) was applied to compare the depth of COS among three classes of malocclusion setting p-value < 0.05 to be of significance.

The total participants were 300 in which 141(47%) were males and 159(53%) were females. The mean age was 17.92 ± 4.98 years. The mean value for COS was 3.146 ± 3.403 mm. The mean COS was highest in class I (3.32 ± 1.33 mm) followed by class III (2.63 ± 0.576 mm) and least was in class II (2.54 ± 1.205 mm). The difference was statistically significant (P<0.000). The difference in COS among different malocclusion classes was significant only for age group 11-15 and 16-20 years. The difference among three classes of malocclusion in both males and females was statistically significant (P<0.05). COS was statistically significant among three Angle classes of malocclusions. Up to age 30 the difference was significant among three Angle classes of malocclusions. There was no sexual dimorphism for COS.

Key Words: Curve of Spee COS, malocclusion, orthodontics, class of malocclusion.

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INTRODUCTION

COS is a curved line that is a tangent to the anterior border of the condyle, the buccal cusps of the second molar and the incisal edges of the mandibular incisors. Graf Von Spee stated that maximum tooth contact could be achieved in chewing by means of this

 ⁵ Capt Umer Hameed, BDS, Dental officer MDC, CMH Skardu. E mail; umerhameed0@gmail.com
Received for Publication: Sept 13, 2019 Revised: March 14, 2020 Approved: March 20, 2020 geometric arrangement.¹ Chewing is the major function of maxillomandibular complex and effective chewing is related to crush/shear ratio of the teeth. In food processing, crushing and shearing forces of buccal teeth increases, then effective mastication can be achieved by virtue of COS. This indicates that, COS has also a mechanical as well as its morphological function.²

The depth of curve of Spee is greatly influenced by sagittal relationship of maxilla and mandible and variation in the depth of COS ultimately influences the overbite, overjet and the angulation of mandibular first molar.³ Nayar et al⁴ reported that the cos is deepest in class II subjects and flatter in class III subject. Another study by Veli et al⁵ reported that no significant differences were found in the depth of COS between Class I and II malocclusions. Most of the cases in which the COS is excessively deep, it is associated with increased overbite.⁶ Exaggerated COS alters the muscle imbalance, leading to the improper functional

¹ For Correspondence: Dr Sadia Naureen, BDS, FCPS, Assistant Professor Orthodontics, Rawal Institute of Health Sciences. E-mail: drsaadis@hotmail.com Cell: +92 3134146936

² Col Hameed Ullah Jan (R), BDS, Dip Orth, MCPS, FCPS, (Pak) OJT (USA), Profoforthodontics & Chairman H.U.J, Smile Orthodontics, Dental Professionals & Research. Centers: Peshawar, Rawalpindi & Islamabad. Email: Huj100@hotmail.com Cell: 03335124949

³ Dr Huma Ghazanfar Kiani, BDS, FCPS Assistant Professor and Head Orthodontics, Rawal Institute of Health Sciences. E-mail: humakiani@gmail.com Cell: +92 3202233768

⁴ Dr Tariq Hameed, BDS, ex resident MDS, Maxillofacial Surgery, Peshawar. E mail; drtariqhameed@live.com

occlusion and altered distribution of occlusal forces7.

Levelling of the COS is one of the essential component of nearly every orthodontic treatment case. It is necessary as a part of the traditional goals to achieve ideal anterior over bite and overjet relationships, proper posterior intercuspation, and an overall functional occlusion¹¹. Proclination of the lower incisors has been used in some cases as a method to treat deepbite.¹³

This study will help us to understand the patterns of expression of COS in our local population having different malocclusions, which can in turn act as a yardstick for treatment planning focusing on the levelling of COS by various modalities of orthodontic treatment. The aim of this review was to increase our knowledge regarding the development and effects of COS in different malocclusions. It would be useful for future diagnosis and treatment planning of orthodontic cases.

MATERIALS AND METHODS

This study was conducted at the department of Orthodontics, Rawal Institute of Health Sciences Islamabad from January 2017 to July 2017 on 300 participants. A sample size of 300 (100 in each class of malocclusion) was selected by non-probability consecutive technique using the digital power calculator for ANOVA²² in which values for effect size, number of groups and significance level were entered.. This is a cross sectional observational study aimed to compare the depth of COS in class I, II and III malocclusion.

The patient above age 12 -30 years, both genders, Pakistani nationals having all teeth present in lower arch were included. Cases were classified into class I, II and III on the basis of Angles classification which is based on molar relationship only. It is important to highlight that incisal relationship was ignored while selecting the sample. Patients having syndromes, cleft lip and palate and severely distorted lower arch were excluded.

Permission to conduct this study was taken from the ethics committee of the hospital. Patients were selected from the outdoor patients department at Rawal Institute of Health Sciences Islamabad. All the patients as well as their parents were appropriately informed about the details of the study. Impressions of the lower arch were taken in alginate (cavex ca 37 cavex Holland) impression material and casts was poured in with hard stone (Imperial dental supply). A horizontal plane was made on the top of mandibular cast touching the central incisors and distal cusp tips of the most posterior teeth then a millimeter ruler was used to measure the depth of COS by measuring the perpendicular distance with a pointed divider between the deepest cusp tip and a plane that was laid in the lower arch. According to the depth in millimeters the COS was divided into three categories.

- Normal curve of Spee =1 mm to 2 mm
- Flat curve of Spee <1 mm
- Deep curve of Spee >2 mm

The depth of COS measurement was made on the right and left side of the dental arch and the mean value obtained was used as the mean depth of COS. All patient cast measurements for depth of COS was done by the same investigator to minimize the inter-observer bias.

Data was analyzed in statistical package for social sciences (SPSS version 20).The mean and standard deviation of the COS was calculated for class I, II and III malocclusions. Frequency as percentage was calculated for gender. The comparison of COS among three classes (I, II and III) of malocclusion was evaluated using the one- way ANOVA setting the level of statistical significance at $p \leq 0.05$.¹⁰

RESULTS

The total participants were 300 in which 141(47%)were males and 159(53%) were females. Age range was from 11 to 20 years with mean age of 17.92 ± 4.981 years. The mean value for curve of spee was 3.146 ± 3.403 mm.

The most common age group was 11 to 15 year (n=126, 42%), followed by 16-20(n=82, %). The details are shown in the Fig 1. The mean curve of spee was highest in class I (3.32 ± 1.33 mm) followed by class II (2.54 ± 1.205 mm) and least in class III (2.63 ± 0.576 mm). The difference was statistically significant (P<0.000). The details are depicted in Table 1. Post hoc analysis showed that difference was due to class II malocclusion. The detailed statistics are given in Table 2.



TABLE 1: COMPARISON OF CURVE OF SPEE IN DIFFERENT CLASSES OF MALOCCLUSION							
Malocclusion	Mean ± SD	95% CI(Lower Bound-Upper	Minimum	Maximum	p-value		
	(mm)	Bound)					
Class I	3.32 ± 1.33	3.05 - 3.58	1.00	6.00	0.000		
Class II	2.63 ± 0.576	2.52 - 2.74	2.00	3.50			
Class III	2.54 ± 1.205	2.30-2.77	.00	5.00			
Total	2.83 ± 1.142	2.7-2.961	.00	6.00			

TABLE 2: POST HOC ANALYSIS FOR COMPARISON OF COS IN VARIOUS MALOCCLUSION

*AN OVA test

(I) Malocclusion	(J) Malocclusion	Mean Difference	Sig.	95% Confidence Interval		
class class (I-J) Lo		Lower Bound	Upper Bound			
Class I	Class II	.78000*	.000	.4163	1.1437	
	Class III	.68500*	.000	.3213	1.0487	
Class II	Class I	78000*	.000	-1.1437	4163	
	Class III	09500	.812	4587	.2687	
Class III	Class I	68500*	.000	-1.0487	3213	
	Class II	.09500	.812	2687	.4587	

TABLE 3: COMPARISON OF COS IN VARIOUS MALOCCLUSIONS STRATIFIED BY AGE GROUP

Age Groups		Sum of Squares	df	Mean Square	F	Sig.
11-15	Between Groups	72.724	2	36.362	39.078	0.000
	Within Groups	114.452	123	.931		
	Total	187.177	125			
16-20	Between Groups	23.785	2	11.893	15.701	0.000
	Within Groups	59.837	79	.757		
	Total	83.622	81			
21-25	Between Groups	3.445	2	1.723	2.271	0.110
	Within Groups	50.826	67	.759		
	Total	54.271	69			
26-30	Between Groups	10.800	1	10.800	2.950	
	Within Groups	47.600	13	3.662		
	Total	58.400	14			
31-35	Between Groups	.000	1	.000		
	Within Groups	.000	5	.000		
	Total	.000	6			

TABLE 4: COMPARISON OF COS IN VARIOUS MALOCCLUSIONS STRATIFIED BY GENDER

Gender	,	Sum of Squares	df	Mean Square	F	Sig.
Male	Between Groups	11.833	2	5.917	7.433	.001
	Within Groups	109.851	138	0.796		
	Total	121.684	140			
Female	Between Groups	39.377	2	19.689	14.185	.000
	Within Groups	216.522	156	1.388		
	Total	255.899	158			

The difference in COS among different malocclusion classes was significant only for age group 11-15 and 16-20 years. It was not significant for age group 21-25 years. (Table 3). The difference among three classes of malocclusion in both males and females was statistically significant (P<0.05). (Table 4)

DISCUSSION

Andrews ¹² and other authors ² mentioned that in deep bite cases the goal of orthodontic treatment is to level the deep COS. Optimal intercuspal relation due to flattening of cos results in better occlusal and muscular function. Orthodontic treatment planning includes the depth measurement of COS as a set standard, so it is of paramount instance to know the depth of COS before the start of orthodontic treatment. ^{14, 15}. Although there are different opinions about the development of the COS, it is important to know in which type of malocclusion this curve is more severe. Therefore, this study was performed to assess the relationship between different sagittal dental malocclusions and the depth of the COS. The inference obtained from our study indicated that there was a difference between the mean depth of COS in class I, class II and class III malocclusion groups. The mean COS was highest in class I $(3.32\pm1.33$ mm) followed by class II $(2.63\pm0.576$ mm) and least in class III (2.54±1.205mm). COS is deep in all malocclusions according to the set criteria of our study. A relatively deeper curve was seen in class I malocclusion group and a relatively flatter curve was observed in class II and III malocclusion groups. When we compare these results to local studies we find that COS has been found deeper in class II by Ahmed et al.⁹ He conducted a study on 100 casts reported that the mean depth of COS in class I malocclusion was 2.4 mm, in class II div 1 malocclusion was 2.8mm, in class II div 2 malocclusion 4.3 mm, in class II subdivision 2.5 mm and in class III malocclusion mean depth was 2 mm. These results are different from our study, this may be due to the difference in selection criteria. We ignored the incisal relationship and selected the cases only on molar relationship in the sample which might have led to the selection of lesser class II div 2 cases in the class II malocclusion group and more deep bite cases in class I malocclusion group, thus showing deeper COS in class I malocclusion and relatively less deeper COS in class II. According to Veli etal¹³ vertical overbite of anterior teeth does not differ much among the different malocclusion groups and had a significant contribution to the depth of the COS in subjects with Class I and II malocclusions. In permanent dentition, the global distributions of Class I, Class II, and Class III malocclusion were 74.7% [31 - 97%], 19.56% [2 -63%] and 5.93% [1 - 20%], respectively.¹⁶ Naeem et al¹⁴ found that 76% of Pakistani patients showed varying values of deep bite. In another study overall deep bite

was found to be 60.1 % of the dental casts while class I was found to be (43.3%), Class II div 2 is 46.3% and class III is 5%. So Class II was most prevalent category of malocclusion and deep bite is its key feature, which in turn is always associated with deep COS. This difference was found mainly because in this study cases were selected on the basis of incisal relationship only.

Nayar et al¹⁶ evaluated the depth of COS in class I, class II, and class III malocclusion in a cross sectional study on Indian population on 30 casts. They reported that the highest value for COS was in class I maloc-clusion and lesser in class II and III. Their results are similar to our study although the sample size of Nayar et al (n=30) is small as compared to the current study (n=300).

The normal depth of COS is considered to be 1-2mm however some authors have considered 2-4 mm as normal COS, less than 2mm as a flat curve and a value greater than 4mm as a deep COS^{18} . This difference of standardization in different studies can also lead to wide variation in results. Furthermore skeletal morphology also affects the COS 21 which was not assessed in sample selection.

It is very well known that a deeper COS is frequently associated with deep-bite malocclusion, inspite of the limited knowledge of the functional properties of the COS. 2,13,16

Research has shown that an imbalance between the anterior and the posterior components of occlusal forces can result in deep COS, because of the overeruption of the lower incisors, infra-eruption of premolars, and low mesial tipping of molars.⁸

In the current study during growing age the difference of COS was significant among different malocclusion classes but not for adults age. This may be due to continued eruption of posterior teeth and attrition of anterior leading flattening of COS. In this study the gender of the subjects had no significant effect on the variables assessed which confirms previous reports of the absence of sexual dimorphism in the COS in class I, II and III malocclusion.^{8,19} This study was designed as a cross-sectional retrospective research in which pre-treatment models were evaluated. Both the design of the study and measurement materials were the limitations of this study. Evaluation of longitudinal changes of the depth of COS could give more detailed knowledge about the issue. Furthermore, radiographic measurements could be added to model measurements to increase the effect of the study. Plaster models, photographs, 3D study models can be used for measurements. The plaster models were used in our study due to easy measurement of that materials.²⁰

CONCLUSION

COS in patients with Class I, II and III malocclusion are deep according to the values allocated in materials and methods i-e greater than 2mm, however the values are significantly different in all three malocclusions. Class I malocclusion demonstrated deepest COS because of high prevalence of deep bite in Class I.

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1 Sadia Naureen:

4 Tariq Hameed:

5 Umer Hameed:

2 Hameed Ullah Jan:

3 Huma Ghazanfar:

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CONTRIBUTIONS BY AUTHORS

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