October 2016

Exploration of variations in positions of upper and Lower incisors, overjet, overbite, and irregularity Index in orthodontic patients with dissimilar depths of Curve of spee.

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ORIGINAL ARTICLE

EXPLORATION OF VARIATIONS IN POSITIONS OF UPPER AND LOWER INCISORS, OVERJET, OVERBITE, AND IRREGULARITY INDEX IN ORTHODONTIC PATIENTS WITH DISSIMILAR DEPTHS OF CURVE OF SPEE

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Background: The position and arrangement of teeth as well as the entire scheme of occlusion differs from one individual to the other .The purpose of this study was to examine differences in position and inclination of incisors, overjet, overbite and lower arch crowding in subjects with different depths of curve of Spee and to determine correlations between depth of curve of Spee and these variables. **Methods:** The sample comprised of 114 patients (55 females and 59 males) with fully erupted permanent second molars (age 12–25 years), having no history of previous orthodontic treatment, no craniofacial anomalies, and no missing permanent teeth. Study parameters were assessed by using pretreatment lateral cephalograms and dental casts of orthodontic patients. The entire sample was divided into three groups according to depth of curve of Spee (mild Spee=38, moderate Spee=38, severe Spee=38). Descriptive statistics were calculated. Differences between the Spee groups were assessed by analysis of variance. In addition, correlation coefficients were calculated between curve of Spee and other parameters. **Results:** Statistically significant differences were found in upper incisor inclination (p=0.000), lower incisor inclination (p=0.003), Steiner's mandibular plane angle (p=0.000), overjet (p=0.001), overbite (p=0.000) and irregularity index (p=0.008) among the Spee groups. Moreover, statistically significant positive correlations were found between curve of Spee and overjet, overbite and irregularity index. Upper and lower incisor inclinations as well as mandibular plane angle were found to have statistically significant but negative correlations with curve of Spee. **Conclusion:** Overjet and overbite in severe Spee group are larger than in mild and moderate Spee groups. There is negative correlation between curve of Spee depth and inclinations of upper and lower incisors. There is positive correlation between curve of Spee depth and severity of lower anterior crowding and Steiner's mandibular plane angle.

Keywords: Deep bite; Curve of Spee; Irregularity index

J Ayub Med Abbottabad 2016;28(4):766–72

INTRODUCTION

Normal occlusion is defined as fitting together of teeth of lower jaw with the corresponding teeth of the upper jaw when the jaws are habitually closed. In contrast, malocclusion is demarcated as an occlusion in which there is an atypical relationship, or there are aberrations in tooth position beyond normal limits.[1] The position and arrangement of teeth as well as the entire scheme of occlusion differs from one individual to the other. The six keys of occlusion presented by Lawrence F Andrews[2] aid us in describing the ideal occlusion precisely, including, molar relationship, incisor angulations, incisor inclinations, spacing, rotations, and the curve of Spee. Andrews advocated leveling the curve of Spee to a flat curve, in order to facilitate construction of an optimal occlusion and he recommended that a flat plane should be given as a form of over treatment in order to improve the stability of the results.

Ferdinand Graf Von Spee[3] was the first who described curve of Spee, an essential feature of the mandibular dental arch. It was derived by studying skulls with abraded teeth to delineate a line of occlusion that lies on a cylinder tangential to the condyle's anterior border, second molar's occlusal surface, and the incisal edges of mandibular incisors. The curve of Spee is located in the center of this cylinder in the midorbital plane so that it had a radius of 6.5–7.0 cm. However, clinically the distal marginal ridges of the posterior teeth in the mandibular arch and the incisal edges of the lower central incisors outline the curve of Spee. This naturally occurring phenomenon has clinical significance in orthodontics and restorative dentistry.[4]

Calculation of Spee's curve is imperative not only for proper diagnosis and treatment planning of patients undergoing orthodontic procedures, but also for considering appropriate post orthodontic retention protocols as well as for evaluation of stability of treatment results.

Regarding functional significance of the curvature, it has been proposed that the curve of Spee has a biomechanical function during food processing by augmenting the crush-shear ratio between the posterior teeth and the efficacy of occlusal forces during mastication.[5,6] In case of flat curve of Spee , the pull of masseter muscle, is at perpendicular angle with line of occlusion and long axis of each lower posterior tooth is aligned nearly parallel to their individual arch of closure forming a series of sloped contact points. This geometrical arrangement produces maximum number of tooth contacts and favorable loading providing highest masticatory efficiency.

On the other hand, excessive curve of Spee alters the muscle balance, leading to the improper functional occlusion by imbalance between the anterior and the posterior components of occlusal force. In addition to that, unless the curve of Spee is leveled properly ideal incisal and canine guidance can not be established causing interferences in eccentric mandibular movements increasing the risk of temporomendibular joint disorders.[7,8]

Most investigators have described the treatment strategies using anterior bite plane,[9] functional appliances,[10] continuous arch wire mechanics,[11] utility arches,[12] and miniscrew implants[13,14]. If left untreated, deep curve of Spee can cause attrition of incisors, mobility and loss of upper incisors due to heavy non-axial occlusal loading, impingement of gingival tissues immediately palatal to the upper anterior teeth resulting in recurrent soft tissue ulcerations, gingival recession, dentine hypersensitivity, abnormal mandibular function and temporomandibular joint disorders.[7,8,15] Moreover, there is increased risk of crowding, supraeruption and retroclination of lower incisors leading to compromised periodontal support due to occlusal trauma and inadequate oral hygiene maintenance.[2]

Andrews[2] stated that there is a natural tendency for the curve of Spee to deepen with time because the lower jaw grows in downward and forward direction sometimes faster and lasts longer than that of the upper jaw. This results in supraeruption, crowding and retroclination of the lower anterior teeth, which are restrained by the upper front teeth and lips, leading to deeper overbite, deeper curve of Spee, increased overjet, and decreased arch depth. These findings suggested that the curve of Spee might be related to the position and inclination of the upper and lower incisors, lower arch crowding, overjet and overbite.

Although leveling the curve of Spee is done frequently in orthodontic practices, little research has been dedicated to the analysis of the correlations between the depth of the curve of Spee and the dentofacial structures. Thus, the determination of this relationship may be useful to assess the feasibility of leveling the curve of Spee by the orthodontic treatment. Therefore, this study aimed to examine differences in the position and inclination of the upper and lower incisors, overjet, overbite, and lower arch crowding in subjects with different depths of curve of Spee.

MATERIAL AND METHODS

A cross sectional study was conducted using the data from pretreatment orthodontic records of patients who visited the orthodontic clinics at the Aga Khan University Hospital, Karachi, Pakistan. Ethical clearance was obtained from the institutional ethical review committee (ERC No. 3505-Sur-ERC-15) prior to data collection. The duration of this study was from May to September 2015. The present study primarily focused on orthodontic patients with skeletal Class I malocclusion having variable depths of curve of Spee. The inclusion criteria were subjects having good quality pretreatment records, skeletal Class I malocclusion (ANB = 0–4°) and fully erupted permanent second molars (age 12–25 years). Patients with craniofacial anomalies, prior history of orthodontic treatment and clinically missing permanent teeth other than third molars were excluded. A non-probability purposive sampling technique was used. The sample size was calculated by using the findings of Baydas *et al*[16], who reported the correlation between curve of Spee and overbite as 0.42, power of the study 80% and *p*-value of ≤0.05, the sample size comes out to be 38 patients in each group to complete the objectives of the study.

Data were collected from the standard pre-treatment lateral cephalograms at the Orthodontic Clinics, the Aga Khan University Hospital. These lateral cephalograms were recorded with rigid head fixation and a 165 cm film-to-tube distance using Orthoralix® 9200 (Gendex–KaVo, Milan, Italy). The following measures were taken for each subject to ensure a high degree of accuracy in obtaining cephalograms: the head was fixed in a way that the sagittal plane was at a right angle to the path of the x-rays and the Frankfort horizontal plane (FHP) was parallel to the horizontal plane; teeth were occluded in the centric occlusion and lips were kept in a relaxed position.

Cephalograms were traced manually by the principal investigator on acetate paper in a dark room. The linear and angular measurements[17] were taken with the help of a millimeter ruler and protractor, respectively as presented in (Table-1, Figure-1).

Dental cast parameters were measured on pretreatment study casts taken from each subject, with a digital vernier caliper (0–150 mm ME00183, Dentaurum, Pforzheim, Germany) with accuracy of 0.02 mm and reliability of 0.01 mm manufacturer's specification (Table-2, Figure 2–5). The entire sample of 114 subjects was divided into three groups according to the depth of curve of Spee. The three Spee groups were classified as follows:

- Mild Spee Group-I: the depth of curve of Spee 0–2 mm
- Moderate Spee Group-II: the depth of curve of Spee >2 mm but ≤4 mm

- Severe Spee Group-III: the depth of the curve of Spee >4 mm

The statistical analysis of data was done using the SPSS-19.0. Descriptive statistics such as means and standard deviations were calculated for all the variables in each Spee group. One-way ANOVA was used for comparison of means of cephalometric and dental cast measurements among the three Spee groups (Mild Spee Group-I = 0–2 mm, Moderate Spee Group-II = >2 mm but ≤4 mm, Severe Spee Group-III = >4 mm). Pearson's correlation analysis was used to determine correlation coefficients between the depth of curve of Spee and the other study variables. A *p*-value ≤0.05 was taken as statistically significant.

RESULTS

The sample size comprised of 114 subjects (55 females and 59 males). The means and standard deviations of the chronological ages for each Spee group are presented in Table-3. No statistically significant differences between the chronological age among the Spee groups were found (*p*=0.156).

The key results of this cross-sectional study showed that statistically significant positive correlations were detected between curve of Spee and overjet, overbite and irregularity index. Moreover, upper and lower incisor inclinations as well as Steiner's mandibular plane angle were observed to have statistically significant but negative correlations with the curve of Spee. Descriptive statistics were used to calculate means and standard deviations for all the study parameters, measured from pretreatment dental casts and lateral cephalometric radiographs for each Spee group, as displayed in Table-4 and V.

One-way ANOVA was used for comparison of mean values of dental cast and cephalometric measurements among the three Spee groups, as revealed in table 4 and 7 respectively. These results indicated that statistically significant differences were found in the mean values of linear dental cast parameters (overjet, *p*=0.001, overbite, *p*=0.000, and irregularity index, *p*=0.008). In contrast, mean values of arch depth and intermolar width were not found to have statistically significant differences between the Spee groups (arch depth, *p*=0.845, and intermolar width, *p*=0.093). Moreover, statistically significant differences were seen in the mean values of the angular cephalometric parameters measuring upper incisor inclination amongst Spee groups (U1- SN°, *p*=0.004, U1-PP°, *p*=0.001, and U1-NA°, *p*=0.000). Likewise, statistically significant differences were observed in the mean values of the angular cephalometric parameters measuring lower incisor inclination amongst Spee groups (L1-PP°, *p*=0.048, L1-OP°, *p*=0.000, and L1-NB°, *p*=0.003). Additionally, statistically significant difference was also detected in the mean value of the angular cephalometric parameter indicating vertical facial growth pattern of an individual between the Spee groups (SN:Go-Gn°, *p*=0.013).

Pearson's correlation analysis was used to determine correlation coefficients between the depth of the curve of Spee and other variables used in the study as shown in Table-8 and 9. Statistically significant but low negative correlations were perceived between the curve of Spee and angular cephalometric measurements representing upper incisor inclination (U1- SN°, R = - 0.195*, U1-PP°, R = - 0.258**, and U1-NA°, R = - 0.301**).

Similarly, statistically significant but low negative correlations were also identified between curve of Spee and angular cephalometric parameters demonstrating lower incisor inclination (IMPA°, R = - 0.185*, and L1-NB°, R = - 0.362**). Additionally, statistically significant but low negative correlation was also observed between curve of Spee and Steiner's mandibular plane angle (SN:Go-Gn°, R = - 0.259**). Besides that, low, medium and high positive correlations were appreciated between irregularity index, overjet, and overbite with the curve of Spee respectively (irregularity index, R = 0.269**, overjet, R = 0.455**, and overbite, R = 0.639**).

Table-1: Cephalometric measurements[17]

Measurement	Definition
Angular Cephalometric Parameters	
Upper Incisor to NA Line (U1-NA, °)	Angle formed between the extension of the long axis of the maxillary incisor and NA line
Upper Incisor to SN Plane (U1-SN, °)	Angle formed between the extension of the long axis of the maxillary incisor and the sella-nasion plane
Upper Incisor to Palatal Plane (U1-PP, °)	Angle formed between the extension of the long axis of the maxillary incisor and palatal plane
Lower Incisor to NB Line (L1-NB, °)	Angle formed between the extension of the long axis of the mandibular incisor and NB line
Lower Incisor to Palatal Plane (L1-PP, °)	Angle formed between the extension of the long axis of the mandibular incisor and palatal plane
Lower Incisor to Occlusal Plane (L1-OP, °)	Angle formed between the extension of the long axis of the mandibular incisor and occlusal plane
Incisor Mandibular Plane Angle (IMPA, °)	Angle formed between the extension of the long axis of the mandibular incisor and mandibular plane
ANB Angle, °	Angle formed between lines NA and NB lines
Interincisal Angle (IIA, °)	Angle formed between long axes of upper and lower incisors
Down's Mandibular Plane Angle (FMA, °)	Angle formed between the mandibular plane and the Frankfort horizontal plane
Steiner's Mandibular Plane Angle (SN : Go-Gn, °)	Angle formed between the mandibular plane and the SN plane
Linear Cephalometric Parameters	
Upper Incisor to NA Line (U1-NA, mm)	The horizontal distance between the labial surface of the maxillary central incisor and NA line.
Lower Incisor to NB Line (L1-NB, mm)	The horizontal distance between the labial surface of the mandibular central incisor and NB line.

Table-2: Dental cast measurements[1]

Measurement	Definition
Overjet, mm	It is horizontal distance in millimeters, extending from labial surface of mandibular central incisor to labial surface of most prominent maxillary incisor.
Overbite, mm	It is vertical distance in millimeters, representing total crown length of mandibular incisors that is overlapped by maxillary incisors.
Curve of Spee (COS, mm)	Line formed between deepest point on mandibular buccal segment and a horizontal line formed between most over erupted mandibular incisor and molar.
Intermolar Width, mm	Breadth of dental arch, determined by measuring distance between the right and left central fossa of first molars.
Arch Depth, mm	Perpendicular distance in midsagittal plane from most labial midpoint between central incisors to a line connecting distal surfaces of second premolars.
Irregularity Index, mm	Linear shift of anatomic contact points of mandibular incisor from respective points of adjacent teeth, sum of these five shifts represents lower anterior crowding.

Table-3: Age distribution

Curve of Spee Groups	n	Mean age (years±SD)	*p*-value
Mild Curve (0–2 mm)	38	15.9±3.8	0.857
Moderate Curve (3–4 mm)	38	16.05±3.6	
Severe Curve (> 4 mm)	38	16.4±3.4	
Total	114	16.1±3.6	

n=114; SD-Standard Deviation; *p*-value ≤0.05; One-Way Analysis of Variance (ANOVA)

Table-4: Descriptive statistics: Dental parameters (n=114)

Measurement	COS 0–2 mm (n=38) (Mean±SD)	COS 3–4 mm (n=38) (Mean±SD)	COS >4 mm (n=38) (Mean±SD)
Overjet, mm	4.2±2.4	5.1±2.6	7.3±5.1
Overbite, mm	2.7±1.6	3.4±2.1	6.3±1.6
Intermolar Width, mm	33.6±2.3	32.3±4.0	32.2±2.5
Arch Depth, mm	26.0±3.5	25.7±3.3	25.5±3.1
Irregularity Index, mm	2.9±3.1	4.2±2.3	5.1±3.4

Table-5: Descriptive statistics: Cephalometric parameters (n=114)

Measurement	COS 0–2 mm (n=38) (Mean±SD)	COS 3–4 mm (n=38) (Mean±SD)	COS >4 mm (n=38) (Mean±SD)
U1-NA, mm	7.8±3.5	5.6±2.7	7.1±7.9
U1- SN, °	110.7±7.6	105.9±7.4	104.7±8.9
U1-PP, °	119.1±6.0	111.1±13.9	110.4±10.1
L1-NB, mm	6.9±2.6	7.7±8.6	6.1±3.3
L1-PP, °	55.3±10.7	57.2±8.1	60.4±7.4
L1-OP, °	68.5±15.6	69.0±11.0	84.7±15.9
FMA, °	25.2±10.6	26.8±6.1	23.7±4.0
IMPA, °	98.3±8.8	97.3±6.8	96.2±7.0
IIA, °	117.7±13.4	121.7±9.9	126.9±14.1
SN : Go-Gn, °	30.9±6.0	32.4±6.2	28.5±4.5
U1-NA, °	29.5±6.8	24.3±9.1	21.3±9.0
L1-NB, °	28.9±7.7	29.2±6.5	24.1±6.8

Table-6: Comparison of dental parameters amongst groups

Measurement	COS 0–2 mm (n=38) (Mean±SD)	COS 3–4 mm (n= 8) (Mean±SD)	COS >4 mm (n=38) (Mean±SD)	*p*-value
Overjet, mm	4.2±2.4	5.1±2.6	7.3±5.1	0.001
Overbite, mm	2.7±1.6	3.4±2.1	6.3±1.6	0.000
Intermolar Width, mm	33.6±2.3	32.3±4.0	32.2±2.5	0.093
Arch Depth, mm	26.0±3.5	25.7±3.3	25.5±3.1	0.845
Irregularity Index, mm	2.9±3.1	4.2±2.3	5.1±3.4	0.008

n=114; SD-Standard Deviation; *p*-value ≤0.05; One-Way Analysis of Variance (ANOVA)

Table-7: Comparison of cephalometric parameters amongst groups

Measurement	COS 0–2 mm (n=38) (Mean±SD)	COS 3–4 mm (n=38) (Mean±SD)	COS >4 mm (n=38) (Mean±SD)	*p*-value
U1-NA, mm	7.8±3.5	5.6±2.7	7.1±7.9	0.173
U1- SN, °	110.7±7.6	105.9±7.4	104.7±8.9	0.004
U1-PP, °	119.1±6.0	111.1±13.9	110.4±10.1	0.001
L1-NB, mm	6.9±2.6	7.7±8.6	6.1±3.3	0.449
L1-PP, °	55.3±10.7	57.2±8.1	60.4±7.4	0.048
L1-OP, °	68.5±15.6	69.0±11.0	84.7±15.9	0.000
FMA, °	25.2±10.6	26.8±6.1	23.7±4.0	0.211
IMPA, °	98.3±8.8	97.3 ± 6.8	96.2 ± 7.0	0.492
IIA, °	117.7±13.4	121.7 ± 9.9	126.9 ± 14.1	0.008
SN : Go-Gn, °	30.9±6.0	32.4 ± 6.2	28.5 ± 4.5	0.013
U1-NA, °	29.5±6.8	24.3 ± 9.1	21.3 ± 9.0	0.000
L1-NB, °	28.9±7.7	29.2 ± 6.5	24.1 ± 6.8	0.003

n=114; SD-Standard Deviation; *p*-value ≤0.05; One-Way Analysis of Variance (ANOVA)

Table-8: Correlations between curve of spee & cephalometric variables

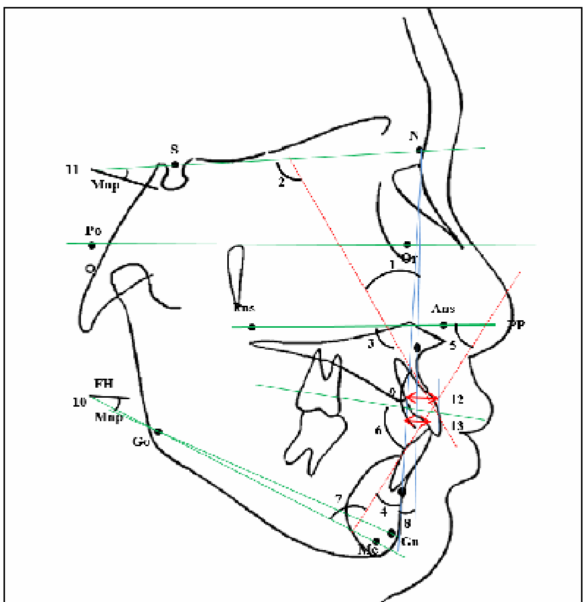
Measurement	R-value	*p*-value
Angular Cephalometric Parameters		
U1-NA, °	- 0.301**	0.001
U1-SN, °	- 0.195*	0.038
U1-PP, °	- 0.258**	0.006
L1-NB, °	- 0.362**	0.000
L1-PP, °	0.244**	0.009
L1-OP, °	0.378**	0.000
FMA, °	- 0.139	0.142
IMPA, °	- 0.185*	0.049
IIA, °	0.313**	0.001
SN : Go-Gn, °	- 0.259**	0.006
Linear Cephalometric Parameters		
U1-NA, mm	- 0 .025	0.791
L1-NB, mm	- 0.140	0.140

**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed) n=114

Table-9: Correlations between curve of spee & dental cast variables

Measurement	R-value	*p*-value
Overjet, mm	0.455**	0.000
Overbite, mm	0.639**	0.000
Intermolar Width, mm	- 0.168	0.075
Arch Depth, mm	- 0.150	0.114
Irregularity Index, mm	0.269**	0.004

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). n=114



1. U1-NA, °	2. U1-SN, °	3. U1-PP, °
4. L1-NB, °	5. L1-PP, °	6. L1-OP, °
7. IMPA, °	8. ANB, °	9. IIA, °
10. FMA, °	11. SN : Go-Gn, °	12. U1-NA, mm
13. L1-NB, mm		

Figure-1: Cephalometric measurements[17]

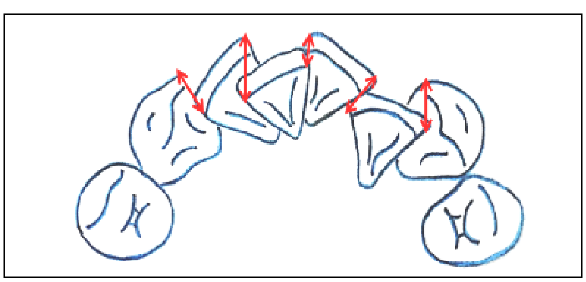


Figure-2: Irregularity index

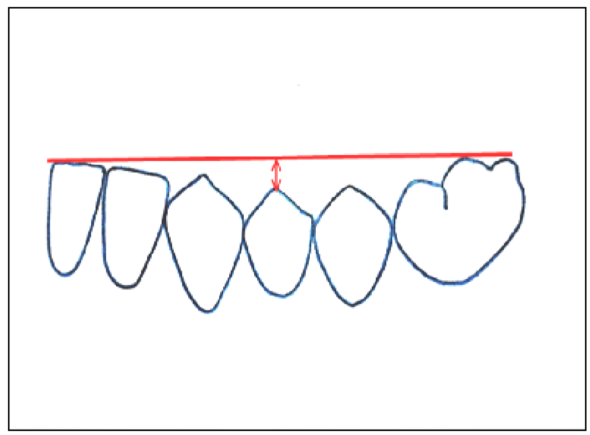


Figure-3: Curve of spee

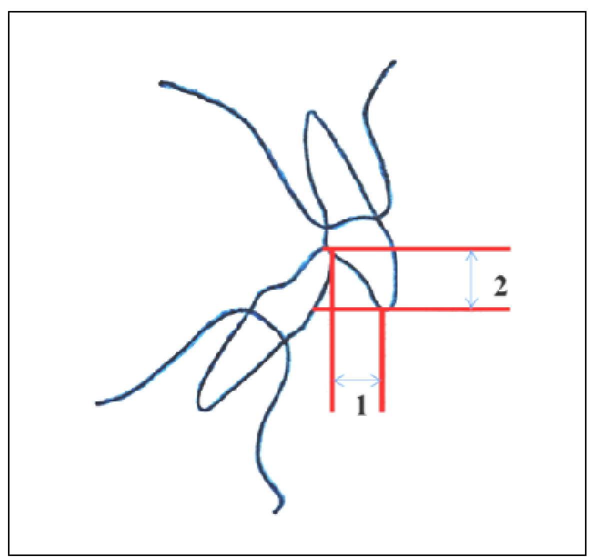


Figure-4: Overjet and overbite (1.Overjet, 2.Overbite)

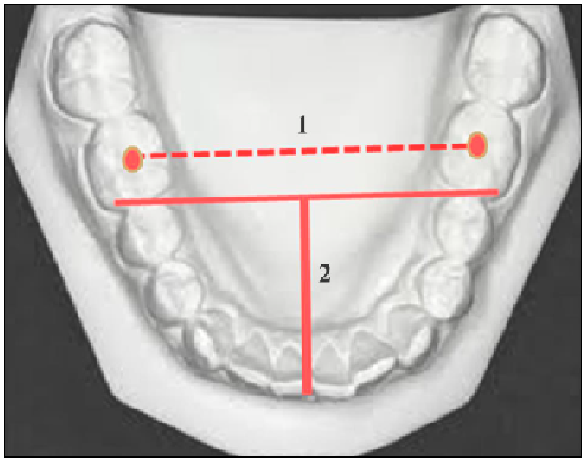


Figure-5: (1) Intermolar width and (2) Arch depth

DISCUSSION

Leveling of the Spee's curve is a routine occurrence in orthodontic practices, but little research has been devoted to the inspection of the relationship between the depth of the curve of Spee and the dentofacial structures. Hence, in this study, the associations between the depth of the curve of Spee and the incisors position, overjet, overbite, lower anterior crowding and lower arch dimensions were scrutinized. In addition to that relationship between curve of Spee and the vertical facial pattern was also evaluated.

The data acquired in this study specified that there were statistically significant differences in the mean values of overjet, overbite, and irregularity index amongst three Spee groups. Besides that, statistically significant low, medium and high positive correlations were appreciated between irregularity index, overjet, and overbite with the curve of Spee respectively. It identifies that the Individuals having exaggerated curve of Spee are more likely to have deepened overbite, increased overjet and higher possibility of lower anterior crowding. On the contrary, the mean values of arch depth, and intermolar width were not found to have statistically significant differences between the Spee groups.

Moreover, statistically significant differences were seen in the mean values of parameters representing the upper and lower incisor inclination among the Spee. In addition to that, significant but low negative correlations were perceived between curve of Spee and cephalometric measurements demonstrating upper incisor and lower incisor inclination. It specified that upper and lower incisors are relatively in a retroclined position in patients having severe curve of Spee.

Statistically significant difference was also detected in the mean value of the Steiner's mandibular plane angle between the Spee groups. Additionally, significant but low negative correlation was also observed between the curve of Spee and Steiner's mandibular plane angle, demonstrating tendency towards short facial morphology in subjects having exaggerated curve of Spee.

Balridge[18] stated that leveling of Spee's curve causes an increase in arch circumference and proclination of lower incisors. Braun and Hnat[19] appreciated a relationship amongst mandibular incisor proclination and shrinking of mandibular intercanine width. The present study found a low negative correlation of the curve of Spee with lower incisor proclination signifying that flattening of Spee's curve may lead to lower incisor proclination. On the other hand, Woods[20] presented that incisor flaring might be predominantly associated to the mechanics of leveling the Spee's curve and not necessarily due to the disparity in arch circumference.

AlQabandi *et al*[21] described that there is no significant association amongst leveling of the Spee's curve and lower incisor flaring. But, they appreciated substantial correlation of lower incisor proclination with decrease in intercanine width and reduction of crowding. Likewise, Baydas *et al*[16] reported that there were no statistically significant differences in inclinations of the upper and lower incisors and lower anterior crowding between the Spee groups. On the other hand, present study observed statistically significant differences in incisors inclinations and lower anterior crowding amongst groups. Baydas *et al*[16] further reported significant differences in the measurements of overjet and overbite between the groups. In addition, they showed significant correlation coefficients between the depth of curve of Spee, overjet and overbite. Our results were in agreement with their study in this perspective.

It was remarkable to perceive the statistically significant variations in the overjet and overbite among the Spee groups with significant alterations in the axial inclinations of the upper and lower incisors. These findings contradict the results of Woods[20] and Braun *et al*[22] who have revealed that the reduction of the curve of Spee and overbite may be accomplished without flaring of the incisors.

Trouten *et al*[23] and Orthlieb[24] found negative curve of Spee in open-bite cases, and deep curve of Spee in deep-bite cases. Furthermore, Farella *et al*[25] specified that the curve of Spee is more conspicuous in short-face individuals and less conspicuous in long-face individuals. Similarly, Baydas *et al*[16] found that the overbite in the deep Spee group was significantly larger than in the normal and flat Spee groups. Likewise in current study, the negative correlation was found between depth of Spee's curve and Steiner's mandibular plane angle validating the predisposition towards short facial pattern in subjects with increased depth of curve of Spee.

In present retrospective study, substantial evidence on the validity and reliability of the data was not attainable. Moreover, the present study was implemented only on orthodontic population, hence, results cannot be applied on generalized Pakistani population. To obtain more precise data, a large study on community basis would need to be executed through valid and reliable measures of parameters of interest and calibration of the surveyors.

Leveling of the Spee's curve is crucial to attain best static and dynamic occlusal contacts. It helps in establishing ideal canine and incisal guidance, ideal incisor relationship, overjet and overbite. Moreover, in addition to reducing the risk of temporomandibular joint disorders it also increases the stability of the results attained at the end of orthodontic treatment.

CONCLUSION

The study concluded that Overjet and overbite in severe Spee group are larger than in mild and moderate Spee groups.There is statistically significant negative correlation between curve of Spee depth and inclinations of upper and lower incisors.The study found a statistically significant positive correlation between curve of Spee depth and severity of lower anterior crowding and Steiner's mandibular plane angle.There is weak negative correlation of arch length with overjet, overbite and curve of Spee.

Conflicts of Interest: There are no conflicts of interest to the authors in the present study.

ACKNOWLEDGEMENTS

All the dental faculty and residents

AUTHORS' CONTRIBUTION

Topic selection and conceptualization of study design was done by MF and AS. Literature search, data collection, data analysis, data interpretation and write-up was performed by NKB. Proof reading was performed by all the authors.

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Received: 15 December, 2015	*Revised: 26 August, 2016*	*Accepted: 10 September, 2016*

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