Changes in Skeletal and Dental Structures after Leveling the Curve of Spee with Continuous Archwire

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Abstract

Objective: To determine the changes in skeletal and dental structures after leveling the curve of Spee with continuous archwire.
Methods: Descriptive study was carried out in the orthodontics department of Alvi Dental Hospital, Karachi, from June to December 2011. Thirty one subjects requiring orthodontic treatment were included in this study. All patients received fixed appliance therapy and reverse curve continuous archwire for six months. Change in the mean values of L4-MP (measured from cusp tip of the first premolar perpendicular to mandibular plane), L6-MP (measured from cusp tip of the lower first molar perpendicular to mandibular plane), overjet, overbite, L1-APog (measured as the distance of mandibular incisor to the line drawn from point A to pogonion), IMPA (Incisor Mandibular Plane Angle), FOP-MP (measured as Functional Occlusal Plane angle to the Mandibular Plane) and LAFH (Lower Anterior Face Height) were measured on cephalogram and compared to pretreatment values.
Results: Mean change in dental variables; L4-MP, overjet, overbite, IMPA, L1-A-pog was significant whereas L6-MP was not significant. Mean change in both the skeletal variables FOP-MP and LAFH was found to be significant.
Conclusion: Continuous archwire technique effectively leveled curve of Spee in this sample of Class II Division 1 deep bite patients treated without extraction. Leveling of curve of Spee occurred mainly due to premolar extrusion, mandibular incisor protrusion and raised IMPA to a slightly higher limit from the normal range. In this study leveling curve of Spee with continuous archwire significantly increased functional occlusal plane to mandibular plane and lower anterior face height. Highly significant decreases in overjet and overbite were observed which can also be contributed to leveling of curve of Spee.
Keywords: Curve of Spee, deep bite. (AASH & KMDC 18(2):63;2013).

Introduction

Occlusal curvature is a naturally occurring phenomenon in human dentition when viewed in the sagittal plane. This curvature commonly known as Curve of Spee, was first described by Ferdinand Graf von Spee' in 1890[1]. Subsequent research has resulted in a widely accepted description of the curve as a line extending from the distal marginal ridges of the most posterior teeth to the incisal edges of the central incisors[2]. During facial development, the growth processes are continuously creating important imbalances between the different organs[3].

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The curve of Spee has been reported to develop as an adjustment that could provide intrinsic compensation for anteroposterior dental discrepancies. The deciduous dentition has a curve of Spee ranging from flat to mild, whereas the adult curve of Spee is more pronounced. Once established in adolescence, the curve of Spee appears to be relatively stable.

A significant curve of Spee is often evident in malocclusions with deep overbites and is frequently leveled as part of overbite reduction[4].The orthodontic correction of deep overbite can be achieved with several mechanisms that will result in true intrusion of anterior teeth, extrusion of posterior teeth, or a combination of both[5,6,7]. It has been advocated that deep bite and deep curve of Spee can be corrected by extrusion of molars, because the intrusion of anterior teeth has a high potential for relapse whereas

extrusion of posterior teeth remains relatively stable[1].

Changing the curve of Spee (leveling) influences other factors like lower incisors inclination, arch circumference or lower face height[8,9]. Several authors have also suggested that leveling curve of Spee requires additional arch length[10]. Clinically, reduction of arch circumference that accompanies leveling has been known to cause incisor protrusion.

Leveling with continuous archwire in both growing and non growing patients will produce extrusion in the premolar and molar area that corrects the vertical discrepancy primarily by posterior teeth extrusion and anterior teeth intrusion[2]. Vertical control during treatment enhances the dental and facial aesthetic result that can be achieved for patients[11]. Ability to determine the changes associated with leveling the curve of Spee may therefore assist in improving the profile of patients with deep bite. This study aims to determine the changes in functional occlusal plane, lower face height, overjet, overbite, lower incisor inclination, and posterior teeth extrusion after leveling curve of Spee with continuous archwire.

Patients and Methods

This descriptive study was carried out in the Orthodontics department of Alvi Dental Hospital from June to December 2011. Convenience sampling technique was used.

A total of 31 patients requiring orthodontic treatment were selected from the outpatient department. Patients were diagnosed on the basis of clinical and radiological examination. History of any previous orthodontic treatment or traumatic injuries was recorded through patient interviews, clinical and radiographic examination. The procedures were explained and informed consent was taken from each patient.

The inclusion criteria was both male and female patients of 10 to 16 years with curve of Spee (COS) ranging from 2 mm to 10 mm, skeletal Class II and ANB angle ranging from 4º - 10º. Subjects with premolars out of occlusion (which can give false readings of COS), any missing tooth, previously orthodontically treated cases, trauma to dentition were excluded from study.

All patients were treated with multibonded, pre adjusted 22x25 bracket slot fixed orthodontic appliance. No extractions were done. Leveling of curve of Spee was done by a senior consultant. For leveling of curve of Spee patients were given 0.018 inch stainless steel wire with reverse curve, in the lower arch, for six months and lateral cephalograms were taken before (T1) and after (T2) placing the wire.

Data for measurement of changes were obtained from lateral cephalograms which were taken according to a standardized technique at predetermined stages of treatment. The radiographs were taken, with the patient in a standing position, the teeth in occlusion and lips relaxed. The patients were asked to close on the molars and not to stress the lips. The cephalograms were oriented with the facial profile to the right.

Data was collected by the principal investigator, and skeletal and dental structures including L4-MP (measured from cusp tip of the first premolar perpendicular to mandibular plane), L6-MP (measured from cusp tip of the lower first molar perpendicular to mandibular plane), overjet, overbite, L1-APog (measured as the distance of mandibular incisor to the line drawn from point A to pogonion), Incisor Mandibular Plane Angle (IMPA), FOP-MP (measured as Functional Occlusal Plane angle to the Mandibular Plane) and LAFH (Lower Anterior Face Height) were measured. Change in the mean values of L4-MP, L6-MP, overjet, overbite, L1-APog, IMPA, FOP-MP and LAFH were measured as mentioned in the operational definition and compared to pretreatment values. All the cephalometric measurements were adjusted for the radiographic magnification error. The landmarks were identified and traced on acetate tracing paper with a sharp 3H drawing pencil and checked for accuracy of location. Radiographs were assessed for quality and resolution.

Data analysis was done on software SPSS version [11]. Mean and standard deviation for variables like age, skeletal and dental cephalometric measurements before and after treatment were computed. Paired t test was used to compare the mean difference for cephalometric measurements between pre and post-treatment readings of the sample at 5% level of significance.

Results

In this study 31 patients, requiring orthodontic treatment and fulfilling the inclusion and exclusion criteria were included. Their mean age was found to be 14.03 ± 1.60 years and age range was 11-16 years. There were 10 (32%) male while 21 (68%) female subjects.

The mean changes (T2-T1) for L4-MP, L6-MP, overjet, overbite, IMPA, LI-APog, FOP-MP, LAFH are shown in Table 1. The mean (T2-T1) changes for L4-MP were statistically significant (p= 0.0005), where as non significant for L6-MP (p= 0.091). The mean treatment changes were 2.24 ± 2.43 mm for L4-MP, and 0.96 ± 3.08mm for L6-MP. The mean overjet at T1 was 5.73 ± 2.76 mm, range 2.97-8.49 mm. At T2, the mean overjet significantly decreased to 1.98 mm ± 0.85; range, 1.13-2.83 mm. The mean reduction in overjet, (T2-T1), was found to be 3.74 ± 2.78 mm (p=0.0005).

The mean overbite at T1 was 4.97 ±1.49 mm. At T2, the mean overbite was 2.31 ± 1.13 mm. The mean reduction in overbite, six months after placing the continuous archwire with reverse curve (T2-T1), was found to be 2.66 ± 1.93 mm (p= 0.0005).

IMPA was found to be 94.94+18.07° at T1 and 104.81+ 6.51° at T2. Mean change (T2-T1) in IMPA was statistically significant (p=0.008). L1-APog significantly increased 2.38 ± 1.99 mm (p= 0.0005). At T1, mean distance of L1 to A-Pog line was -0.03 ±2.07 mm where as at T2, L1-Pog was 2.35±1.97 mm. FOP-MP angle showed a mean increase of 3.29±5.3° which was statistically significant (p=0.002). The mean change in LAFH was 1.56 ±1.23% (p= 0.0005). At T1 mean LAFH was 53.48 ±2.46%) and at T2 was 55.05 ±2.4 mm.

Table 1. Pre and post changes in skeletal and dental structures after leveling the curve of Spee (n=31)

Parameter	# T1	□T2	Mean change (T2-T1)	Percent Change(%)	p-Values
L4-MP (mm)	33.50±3.5	35.74±3.49	2.24± 2.43	7.3	0.0005*
L6-MP (mm)	28.9±3.41	29.87±2.93	0.96±3.08	3.4	0.091
Overjet (mm)	5.73±2.76	1.98±0.85	-3.74±2.78	-65.4	0.0005*
Overbite (mm)	4.97±1.49	2.31±1.13	-2.66±1.93	-53.5	0.0005*
IMPA (o)	94.94±18.07	104.81±6.51	9.87±19.17	10.4	0.008*
L1-Apog (mm)	-0.03±2.07	2.35±1.97	2.38±1.99	77.3	0.0005*
FOP-MP (o)	13.9±5.18	17.19±5.27	3.29±5.3	23.7	0.002*
LAFH (%)	53.48±2.46	55.05±2.4	1.56±1.23	2.9	0.0005*

Legend: For leveling of curve of Spee patients were given 0.018 inch stainless steel wire with reverse curve, in the lower arch, for six months and lateral cephalograms were taken: # T1 before placing the wire and □T2 after placing the wire.

L4-MP (measured from cusp tip of the first premolar perpendicular to mandibular plane)
L6-MP (measured from cusp tip of the lower first molar perpendicular to mandibular plane),
L1-APog (measured as the distance of mandibular incisor to the line drawn from point A to pogonion)
IMPA (Incisor Mandibular Plane Angle)
FOP-MP (measured as Functional Occlusal Plane angle to the Mandibular Plane)
LAFH (Lower Anterior Face Height)

* $p < 0.05$ is considered statistically significant

Discussion

It is generally accepted with a few notable exceptions that levelling deep curve of Spee makes an important contribution to the success of orthodontic treatment. Different studies compared sectional and continuous archwire treatments of adolescent patients with Class II, deepbite, low-angle malocclusions showed that both techniques corrected deep bites[12,13,14,15].The cephalometric landmarks used in our study were specifically chosen to evaluate significant skeletal and dental changes associated with leveling curve of Spee. Result indicated statistically significant changes in L4-MP, overjet, overbite, IMPA, L1-APog, FOP-MP and LAFH where as changes in L6-MP were found to be non-significant.

Although there are speculations in the literature about the contributions of various skeletal and dental elements involved in levelling the curve of Spee[16,17,18,19], these reports do not quantify the contributions of these elements and no attempt was made to compensate for the affects of growth on L4-MP and L6-MP. The perpendicular heights of the mandibular first premolar (L4) and for the mandibular first molar (L6), were measured with reference to the mandibular plane (MP). The mean (T2-T1) changes for L4-MP and L6-MP were found to be statistically significant for L4-MP ($p < .05$), where as non significant for L6-MP.

In our study there was mean 2.24 ± 2.43 mm extrusion of first premolars which is slightly greater than the extrusion observed by Shannon and Nanda[1]. In their study first premolar extruded 1.44 ± 2.00 mm. There was 3.4% increase in L6-MP which was not significant. However, Shannon and Nanda[1] found statistically significant extrusion of first molar in their study. In their study first molar extruded 2.33 ± 1.58 mm whereas in our study first molar extrusion was 0.96 ± 3.08 mm. The non-significant changes in L6-MP might be due to the small sample size of the study.

The mean overjet at T1 for 31 patients treated with the continuous archwire technique was 5.73 ± 2.76 mm (range 2.97- 8.49 mm). At T2, the mean overjet was reduced to 1.98 ± 0.85 mm (range 1.13-2.83 mm). The mean reduction in overjet, six months after placing the continuous archwire with reverse curve (T2-T1), was found to be -3.74 ± 2.78 mm, this is equivalent to a 65.4% decrease in overjet. Shannon and Nanda[1] also observed 2.36 mm decrease in overjet in their study which is comparable to the decrease observed in our study. However, other treatment elements happened in the upper jaw which may have contributed to certain changes were not measured in our study.

The mean overbite at T1 was 4.97 ± 1.49 mm. At T2, the mean overbite was 2.31 ± 1.13 mm. The mean reduction in overbite, six months after placing the continuous archwire with reverse curve (T2-T1), was found to be -2.66 ± 1.93 mm. This is equivalent to 53.5% decrease in overbite. Highly significant decrease in overbite was observed ($p=0.0005$). These findings are similar to the findings of Shannon and Nanda[1]. From this study, it seems that the continuous archwire technique is an effective orthodontic approach for leveling a curve of Spee in Class II Division 1 non extraction deep bite patients whose initial curve of Spee was 2 to 4 mm.

IMPA was found to be 94 ± 18.07 mm at T1 and raised to 104.81 ± 6.51 mm at T2. Mean change (T2-T1) in IMPA was statistically significant ($p=0.008$). In another study[1], mandibular incisors flared 0.50 ± 6.93°. In our study incisors flared up to 9.87±19.17°. Greater incisor flaring can be prevented by placing cinch back in the reverse curve arch wire.

Associated with orthodontic treatment, the mandibular incisors advanced a mean distance of 2.38 ± 1.99 mm relative to the A-Pog line, which is highly statistically significant ($p=0.0005$). At T1, mean distance of L1 to A-Pog line was -0.03 ±2.07 mm where as at T2, L1-A Pog was 2.35 ±1.97 mm In a study conducted by Bernstein et.al[16] this distance was found to be distance of 1.51 mm relative to the A-Pog line. They also found that after treatment, the incisors retroclined a mean distance of -0.10 mm relative to the A-Pog line, resulting in an overall mean proclination of 1.41 mm.

Associated with treatment (T2-T1), the FOP-MP angle showed a mean increase of 3.29± 5.3° which was statistically significant (p=0.002). There was 23.7 % increase in FOP-MP. This increase was greater than increase observed by Shannon and Nanda[1]. In their study the FOP-MP angle increased an average of 1.06 ± 2.95° with treatment.

The mean change in LAFH associated with reverse curve continuous archwire was a clockwise rotation that resulted in mean increase of 1.56 ± 1.23% in LAFH (p=0.0005). At T1 mean LAFH was 53.48 ± 2.46% and at T2 was 55.05 ± 2.4%, resulting in overall increase of 2.9%. Our findings are similar to the findings of Bernstein et.al[16], who found 2.85% increase in LAFH.

Conclusion

In our study continuous archwire technique effectively leveled curve of Spee of Class II Division 1 deep bite in patients treated without extraction. Leveling curve of Spee occurred mainly due to premolar extrusion, mandibular incisor protrusion and raised IMPA to a slightly higher limit from the normal range. Leveling curve of Spee with continuous archwire significantly increased functional occlusal plane to mandibular plane and lower anterior face height. Highly significant decrease in overjet and overbite was observed which occurred due to leveling curve of Spee.

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