Skeletal and dental changes with nonextraction Begg mechanotherapy in patients with Class II Division 1 malocclusion

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This prospective cephalometric study was undertaken to assess the mode and magnitude of Class II correction with nonextraction Begg mechanotherapy in growing children. The sample comprised subjects with similar malocclusion and age range (9-12 years) who were specifically selected for nonextraction Begg mechanotherapy. Cephalograms were analyzed to assess the skeletal, dental, and soft tissue changes that occurred after correction of the molar relationship, the overjet, and the overbite during the 9-month treatment period. The results revealed a significant improvement in the anteroposterior jaw relationship, suggested by the significant reduction in the ANB angle (1.62°) and in Wits AO-BO (1.42 mm). The mandibular length increase of 0.56 mm suggests that the Class II elastics used in nonextraction Begg mechanotherapy had a minimal stimulatory effect on mandibular growth. There was a significant increase in the anterior and posterior facial heights and the ramal height. Almost all of the dental changes were significant. The most striking feature were a significant retraction and extrusion of the maxillary incisors and proclination and intrusion of the lower incisors accompanied by extrusion of the mandibular molars. The maxillary incisors extruded by 1.64 mm under the influence of the undesirable downward component of the Class II elastic forces. The major contribution to overjet and molar correction was predominantly dentoalveolar. (Am J Orthod Dentofacial Orthop 2000;118:641-8)

Successful correction of a skeletal Class II malocclusion characterized by a retrognathic mandible depends on a force system that stimulates mandibular growth to achieve long-term stability of the corrected relationship.[1] It has been observed that desired results can be achieved by nonextraction treatment and growth modification. Class II intermaxillary force is perhaps the most commonly used adjunct in fixed mechanotherapy to reposition the mandible anteriorly and thereby improve the dentoalveolar and skeletal relationships. Experimental studies conducted to determine the effects of intermaxillary traction (with Class II elastics) show evidence of remodeling changes in the glenoid fossa and the head of the condyle, but are of inadequate magnitude to correct the skeletal discrepancy.[2-5] Class II elastics act both as an orthodontic device and as a functional appliance capable of stimulating growth rate and increasing the amount of condylar cartilage, thus lengthening the mandible.[6] However, most clinical studies report that the effects of Class II elastics are primarily dentoalveolar.[7,8]

The Begg technique, originated by P. Raymond Begg, was proposed primarily for extraction treatment.[9] Begg recommended and propagated the idea that premolars be extracted for the correction of malocclusion in the presence of tooth size/jaw size discrepancies. His philosophy was based on the use of light forces to promote freedom of tooth movement . The principle of differential forces can be put to use to save or lose anchorage, depending on the case requirements. It has been observed by Barrer,[10] Swain,[11] and Cadman[12] that this technique can also be used successfully for nonextraction treatment in borderline cases and in patients having only minimal tooth size or no arch length discrepancies. Barrer[10] and Cadman[12] proposed that nonextraction treatment with Begg therapy would be effective in cases that present a combination of minimum treatment requirements, maximum intra-arch space, good growth potential, and substantial freedom to position the lower anterior teeth in relation to the A-Pg line.

Earlier studies conducted to determine the nature of treatment changes achieved with this technique showed a restriction of normal maxillary growth and a change in the functional position of the mandible.[10-12] Meistrell et al[13] observed that the skeletal factors contributing to Class II correction were a reduction of the SNA angle and an increase in the SNB angle. The

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major contributor to molar correction was the mesial and occlusal movement of the mandibular molars under the influence of Class II elastics.

Opinions have differed on how overbite reduction is achieved with the Begg appliance. Begg and Kesling[14] stated that it was due to the intrusion of mandibular incisors in response to anchor bends, while the molars remain stationary. Some authors reported considerable molar extrusion under the influence of Class II elastics, with mandibular incisor eruption merely restrained.[7,15] However, many clinicians have suggested that a combination of mandibular incisor intrusion and molar extrusion accounts for overbite correction.[16] It has been observed that such a mechanism may cause an increase in the Frankfort mandibular plane angle during treatment.

Anchor bends in the upper arch are expected to cause maxillary incisor intrusion. Most orthodontists regard the vertical component of force from Class II elastics as a direct resistance to the intrusive force of the anterior part of the archwire, thereby preventing intrusion.[17,18] In some cases it may even cause maxillary incisor extrusions. On the other hand, some clinicians observed good control of the vertical position of maxillary incisors and stated that the effect of Class II elastics in reducing the intrusive force of an archwire on maxillary anterior teeth is less than what was previously believed.[19-21]

Although treatment effects of the Begg technique have been presented in numerous articles, the existing literature is not clear on the nature of changes that occur with nonextraction Begg mechanotherapy. This clinical and cephalometric study was undertaken to assess the mode and magnitude of Class II correction with Begg mechanotherapy nonextraction treatment in growing children.

MATERIALS AND METHODS

The design of this study was prospective and comprised patients with similar malocclusions and ages who were specifically selected for nonextraction Begg mechanotherapy. Only subjects with Class II Division 1 malocclusions, normally developing maxilla and retrognathic mandible, low to normal FMA, low to normal anterior facial height, and well-aligned dental arches were considered for this study. Seven girls (aged 9-12 years) who met these criteria were treated by P. Reddy according to the conventional nonextraction Begg mechanotherapy. All 7 patients were bonded from second premolar to second premolar with Begg ribbon arch brackets (TP Orthodontics, La Porte, Ind) in both arches. Molar bands were made on all first molars, and round buccal tubes (0.036-in internal diameter, 0.250-in length) were soldered on them.

The brackets were centered mesiodistally on the labial or buccal surfaces of the teeth with the base of the archwire slots at a height of 4 mm from the incisal edges or cusp tips. The only exception to this vertical placement was the maxillary lateral incisal edge, which was kept at 3.5 mm. The initial leveling arches used were of 0.016-in Australian special plus wires. Anchor bends were placed 2 mm mesial to the molar tubes, the severity of which was sufficient to keep the passive wire in the upper/lower labial vestibule. The wires that followed were gradually increased from 0.018- to 0.020-in dimensions. Bypass clamps were used on premolars during the period of leveling alignment, bite opening, and reduction and correction of the overjet. After sufficient bite opening was achieved, the 0.020-in finishing wires were also pinned to the premolars. Patients were instructed to wear light continuous Class II intermaxillary elastics that exerted a force of 1.5 to 2 ounces during the entire course of treatment.

For each patient, a clinical examination was performed and data were recorded at the time of insertion of the appliance and again 1 month, 3 months, 6 months, and 9 months later. Lateral cephalograms, diagnostic casts, and clinical photographs were taken before the start of treatment and after 9 months of treatment. At the end of the 9-month treatment all 7 patients had sufficient bite openings, Class II molar correction, and complete reduction in the overjet. The maxillary incisors did not require torquing on clinical assessment; however, the mandibular incisors appeared significantly proclined in 5 of the 7 cases (the mean increase in IMPA was approximately 5°). Reverse torquing auxillaries were placed to upright the proclined mandibular incisors.

Lateral cephalograms were taken by a standard method before the start of treatment and at the end of 9 months of treatment for all patients. A Class I molar relationship and normal overjet and overbite were achieved at the end of the treatment. Digi-Ceph (ETRT, New Delhi, India), an indigenous analysis program, was used to analyze the angular and linear measurements for each radiograph (Figs 1 and 2). Pitchfork cephalometric analysis, developed by L. E. Johnston Jr,[22] was used to measure the anteroposterior skeletal and dental effects that combined to produce the overjet and molar corrections (Fig 3). The intra-investigator digitizing error was assessed by digitizing 10 randomly selected cephalograms on 2 separate occasions. The standard error between the 2 measurements was determined according to Dahlberg's formula.[23] The mean standard error was 0.20 mm for linear measurements and 0.37° for angular measurements. The coefficient of reliability was calculated according to the concept given by Midtgard et al.[24] The error of variance in the study was 5.78%, within the 3% to 10% range proposed by Midtgard et al.[24]

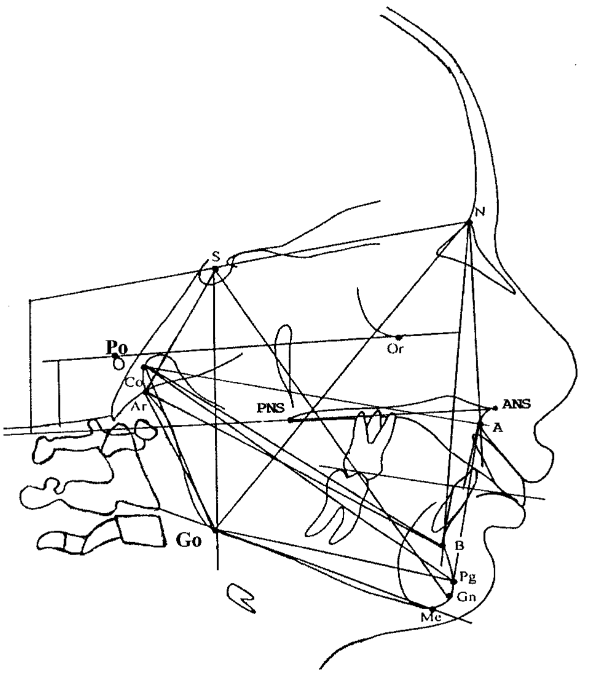

Fig 1. Cephalometric skeletal angular and linear parameters.

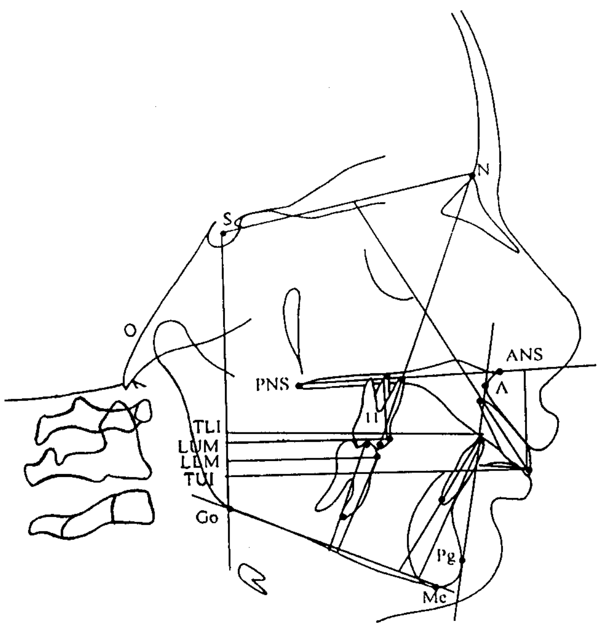

Fig 2. Cephalometric dental angular and linear measurements.

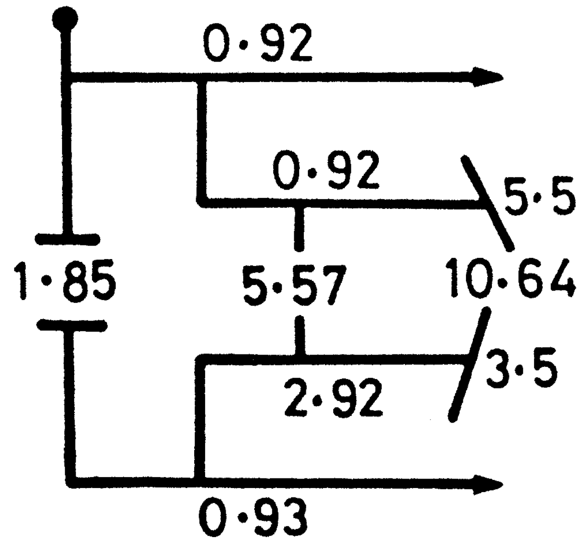

Fig 3. Skeletal and dental components of overjet and molar correction according to Pitchfork analysis.

Fig 4. A representative case of dental and soft tissue changes with nonextraction Begg treatment at the end of 9 months (superimposition at SN plane). *Solid line,* Pretreatment; *dashed line,* posttreatment.

The pretreatment and posttreatment values of all variables were entered into a computer, and a master file was created under dBase (dBase Inc, Vestal, NY) for the purpose of statistical analysis. The mean and standard deviation for each variable were calculated. A paired *t* test was used to compare the pretreatment and posttreatment changes within the group.

Table I. Skeletal changes following nonextraction Begg therapy (n = 7)

		Pretreatment		*Posttreatment*		*Difference*	
Subject No.	*Variables*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
	Max						
1	SNA°	80.48	1.55	80.13	1.44	–0.35	0.72
2	Co-A mm	89.23	3.06	88.38	2.33	–0.84*	1.04
3	N-A x A-Pg°	9.89	2.68	7.72	3.19	2.17**	1.22
	Mand						
4	SNB°	74.37	1.48	75.79	2.27	1.41*	1.21
5	Co-B mm	96.11	4.54	98.57	4.47	2.46**	1.18
6	Co-Pg mm	107.5	7.31	109.87	7.27	2.34*	2.20
7	Co-Go mm	52.70	5.49	55.78	4.32	3.08**	2.43
8	Ar-B mm	90.23	4.80	93.76	4.12	3.52**	2.15
9	Mand.base mm	72.11	8.16	72.67	8.57	0.56	2.00
	Max-mand						
10	ANB°	6.10	1.09	4.48	1.15	–1.62**	0.71
11	AO / BO mm	4.32	2.12	2.94	2.20	–1.42***	0.52
12	N-A-Pg°	169.7	4.61	171.36	4.47	1.62**	0.71
	Vertical						
13	N-Me mm	113.6	6.74	117.04	6.10	3.39**	0.77
14	N-ANS mm	51.89	4.48	53.14	2.99	1.25	2.93
15	ANS-Me mm	61.76	6.17	63.90	4.90	2.14*	2.77
16	S-Go mm	75.40	6.97	77.95	6.45	2.55*	1.68
17	S-Ar mm	32.42	3.09	32.44	2.39	0.02	2.37
18	Ar-Go mm	42.98	4.95	45.51	4.66	2.52**	1.91
19	PFH/AFH	65.29	2.76	66.65	3.12	1.17**	1.11
20	FMA°	23.97	3.44	25.92	4.94	1.95	3.27
21	Y axis°	60.56	2.09	61.16	2.53	0.60	2.21
	Functional						
22	N-S-Ar°	125.5	5.21	126.11	5.35	0.53	0.96
23	S-Ar-Go°	141.8	6.50	142.37	4.97	0.48	1.88
24	Ar-Go-Me°	124.8	7.94	125.66	8.42	0.82	1.43
25	SUM°	392.5	4.09	394.16	5.03	1.34*	1.79
26	Ar-Go-N°	53.72	8.42	52.38	3.98	–1.34*	1.79
27	N-Go-Me°	71.13	4.36	73.35	5.30	2.21**	2.09
28	OP-SN°	18.23	4.30	18.12	2.95	–0.10	2.80
29	OP-MP°	11.78	2.95	11.84	4.03	0.05	2.97

*$P < .05$; **$P < .01$; ***$P < .001$.
Max, Maxillary, *Mand*, mandibular, *Max-mand*, maxillomandibular.

RESULTS

Skeletal Changes

The effective maxillary length decreased by 0.84 mm, which indicated significant ($P < .05$) retraction of A point (Table I). The SNA angle decreased 0.35°, which was not significant. The angle of convexity decreased 2.17°. A significant increase of 1.41° in the SNB angle was observed. There were significant increases in linear measurements of the mandible: Co-Pg increased 2.34 mm ($P < .05$), Co-B increased by 2.46 mm ($P < .01$), and Ar-B increased by 3.52 mm ($P < .01$). The ramus length (Co-Go) also increased significantly ($P < .01$) by 3.08 mm. There was a significant reduction ($P < .01$) in angle ANB, of 1.62°, and a 1.42° improvement in the skeletal profile angle. A highly significant ($P < .001$) improvement, of –1.42 mm, was seen in AO-BO. The total anterior facial height and lower anterior facial height increased significantly, by 3.39 mm ($P < .01$) and 2.14 mm ($P < .05$), respectively. Increases of 2.55 mm in posterior facial height and of 2.52 mm in lower posterior facial height were also significant ($P < .05$). The 1.95° increase in the mandibular plane angle and 0.60° increase in the Y axis angle were not significant.

Although the saddle, articular, and gonial angles did not increase significantly, the sum of these angles did increase significantly ($P < .05$), by 1.34°, which indicated a downward rotation of the mandible. The upper gonial angle decreased by 1.34° and the lower gonial angle increased significantly ($P < .01$), by 2.21°, which also indicated a downward rotation of the mandible.

Table II. Dental changes after nonextraction Begg therapy (n = 7)

Subject No.	Variables	Pretreatment Mean	Pretreatment SD	Posttreatment Mean	Posttreatment SD	Difference Mean	Difference SD
	Incisor position						
1	*1*-SN °	114.7	5.92	93.87	3.77	–20.89**	6.25
2	*1*-NA mm	9.48	1.62	1.62	1.73	–7.85***	2.46
3	*1*-APg mm	12.28	2.38	5.36	1.33	–6.92***	1.99
4	*1*-PP mm	28.21	2.72	29.86	2.45	1.64*	1.81
5	*1*-MP mm	40.84	3.19	38.22	2.61	–2.61**	1.55
6	*1*-NB mm	5.88	1.35	8.26	1.07	2.37**	1.37
7	*1*-MP °	99.73	5.18	105.4	4.82	5.72**	3.41
8	*1*-APg mm	1.53	1.05	3.10	1.66	1.57**	1.29
9	*1*-FHp mm	65.65	4.22	70.20	3.91	4.55**	3.09
	Molar position						
10	*6*-SN °	70.84	6.04	64.19	6.17	–6.65***	3.30
11	*6*-NA mm	24.59	1.95	26.19	1.25	1.60*	1.45
12	*6*-FHp mm	42.87	2.68	39.06	1.40	–3.81*	2.78
13	*6*-PP mm	19.99	2.32	21.21	2.14	1.21	1.39
14	*6*-MP mm	25.06	2.64	27.88	2.82	2.81*	2.50
15	*6*-MP °	86.59	4.19	86.91	6.42	0.31	6.52
16	*6*-NB mm	19.65	1.55	16.88	2.37	–2.76**	1.84
17	*6*-FHp mm	39.20	4.33	43.19	4.71	3.99**	3.20

*$P < .05$; **$P < .01$; ***$P < .001$.

Table III. Treatment effect of nonextraction Begg therapy on overjet and overbite

Subject No.	Variables	Pretreatment Mean (mm)	Pretreatment Range (mm)	Pretreatment SD	After 9 months Mean (mm)	After 9 months Range (mm)	After 9 months SD	Difference Mean (mm)	Difference SD	P
1	Overjet	10.64	7-14	2.65	1.35	1-2	0.47	9.29	1.18	*
2	Overbite	4.21	1-5.5	1.52	1.28	1-2	0.41	2.93	1.15	*

*$P < .05$.

Dental Changes

The maxillary incisors underwent a huge retraction (*1*-SN) of 20.89° ($P < .01$) (Table II) . This reduction in proclination was associated with a significant ($P < .001$) retraction of the maxillary incisor position with respect to the N-A line and the A-Pg line, by 7.85 mm and 6.92 mm, respectively. Extrusion of the maxillary incisors by 1.64 mm was significant ($P < .05$). The mandibular incisor moved forward significantly ($P < .01$) as seen by the increase in the linear distances between the lower incisor and the N-B line (2.37 mm), the A-Pg line (1.57 mm), and the FH perpendicular (4.55 mm). There was a significant ($P < .01$) intrusion of the mandibular incisors, 2.61 mm, and an increase in IMPA of 5.72° ($P < .01$). A significant reduction ($P < .01$) of 9.29 mm in overjet was the major effect of nonextraction Begg mechanotherapy along with the mean reduction in the overbite of 2.93 mm (Table III) .

Distal tipping of maxillary molars by 6.65° was significant ($P < .001$). Distal movement of the maxillary molar was seen by an increase of 1.60 mm in the distance between the maxillary molar and N-A line and a decrease of 3.81 mm in the linear distance between the upper molar and FHp line. The 1.21-mm extrusion of the upper molars was not significant. The mandibular molar tipped mesially 0.31°, along with significant mesial movement, as shown by a decrease of 2.76 mm in the linear distance between the lower molar and the N-B line and an increase of 3.99 mm in the linear distance between the lower molar and the FHp. This change in molar position was highly significant compared with the growth changes in the control group.

Pitchfork Analysis

The mean apical base change, at 1.85 mm, was not significant (Table IV). The maxilla moved distally 0.92

Table IV. Pitchfork analysis

Subject No.	Variable	Mean (mm)	Range (mm)	SD
	Skeletal			
1	Max	1.00	0-1.5	0.57
2	Mand	2.00	0-5	1.80
3	ABCh	1.85	–1.5-4	1.84
	Dental			
4	Upper molar	0.92	–1-2	1.39
5	Lower molar	2.92	1-6.5	1.92
6	Upper incisor	5.5	3.5-9	2.21
7	Lower incisor	3.5	1.5-7	1.73
	Total correction			
8	Molar (6/6)	5.57	2-8.5	2.18
9	Overjet (1/1)	10.64	8-14	2.85

Max, Maxillary displacement; *Mand*, mandibular displacement; *ABCh*, apical base change.
Positive (+) values indicate change towards Class I; negative (–) values indicate change towards Class II.

mm with respect to the cranial base and there was forward mandibular movement of 0.93 mm.

The maxillary molar showed 0.92 mm of distal movement, and there was significant (2.92 mm) mesial movement of the mandibular molar. Both contributed to improvement of the Class II molar relationship. The maxillary incisor was retracted significantly, by 5.5 mm. The mandibular incisor also showed significant mesial movement (3.5 mm) with respect to the mandibular bone.

Total Correction

The net tooth movement of 3.84 mm was a significant contribution to the total molar correction when compared with the mean apical base change (skeletal) of 1.85 mm. Both resulted in a significant mean molar correction of 5.57 mm. There was a significant overjet correction of 10.65 mm (range, 8-14 mm), of which 8 mm was due to dental correction and 1.85 mm was skeletal in nature.

DISCUSSION

In this study, we analyzed the nature of skeletal and dental changes in young adolescent female patients after 9 months of nonextraction Begg mechanotherapy. Significant improvement was seen in the soft tissue profile and the anteroposterior jaw relations.

The maxillomandibular relationship improved by both slight restriction of the maxilla and forward positioning of the mandible. The increase in effective mandibular length was not significant. The most striking feature was a significant retraction of the maxillary incisors and a consequential upper lip retraction, accompanied by slight proclination of the mandibular incisors.

Skeletal Response

There was significant improvement in the maxillomandibular relationship, suggested by decreases in the ANB angle and the skeletal convexity angle. The improvement was contributed to both a decrease in the SNA angle and an increase in the SNB angle. The ANB angle decreased by 1.62°, which was similar to the decrease observed by Meistrell et al[13] (1.27°). The 0.35° decrease in the SNA angle is also comparable to the findings of Meistrell et al.[13] Since the position of A point is influenced by the incisor root position, it is unlikely that the decrease in SNA angle reflects a complete orthopedic response. Gianelly et al[25] believed that 50% of the SNA reduction represents tooth movement.

The anterior positioning of the mandible was 1.14°, represented by an increase in the SNB angle. This value was on the higher end compared with the values reported by Meistrell et al[13] (0.34°) and Gianelly et al[25] (0.58°). Significant maxillomandibular improvement was also reflected by the decrease in Wits AO-BO (–1.42 mm) and the decrease in the angle of convexity (–2.17°). Though not significant, the 2.34-mm increase in effective mandibular length (Co-Pg) is in accordance with a reported value of 2.9 mm.[13] The corpus length increased by only 0.56 mm, suggesting that the Class II elastics used in nonextraction Begg mechanotherapy had a minimal stimulatory effect on mandibular growth.

The forward shift and lengthening of the mandible were accompanied by changes in the vertical dimensions of the face as well. The ramal height registered an increase of 3.08 mm, which can be attributed to the significant molar extrusion caused by Class II elastics. Our findings suggest a significant extrusion of the mandibular molars and an increase in the FMA angle with the Begg appliance.

There was a significant increase in the total anterior facial height, of 3.39 mm. The lower posterior facial height, represented by Ar-Go, demonstrated an increase of 2.52 mm. Both the anterior and the posterior facial heights increased significantly, resulting in a significant increase in the PFH/AFH ratio, of 1.17. The increase in this ratio was indicative of favorable control of the vertical dimension and successful correction of the Class II malocclusion, as suggested by Merrifield[26] and Gebek.[27] The mandibular plane angle exhibited an increase of 1.59°, comparable to the increase of 1.2° observed by Meistrell et al.[13] The increase in the mandibular plane angle and the gonial angle may have been due to extrusion of the mandibular molars under the influence of the vertical forces of Class II elastics. The OP-MP angle increased minimally, and the decrease in the OP-SN angle was –0.10°. The cant of the occlusal plane showed a great degree of stability during treatment. The findings of Meistrell et al[13] (–0.37°) for nonextraction Begg therapy are in agreement with the present findings.

Dental Response

The major contributors to overjet correction were a decrease in maxillary incisor proclination and an increase in IMPA, with a small forward shift of the mandible caused by Class II elastics. The overjet correction of 9.29 mm using the Begg appliance was predominantly dentoalveolar. There was significant proclination of the mandibular incisors under the effect of the anchorage bends and sagittal intermaxillary elastic force. This apparent increase in proclination of the mandibular incisors in the Begg group masks the amount of true intrusion.

The mechanism of overbite correction appears to be complex, with dentoalveolar compensations contributing most to it. The stage I bite opening wires were constructed according to the design recommended by Begg and Kesling[14]: The wires were not pinned to the premolars (bypass clamps were used). The intrusive force from the arches was delivered to 6 anterior teeth as a unit. It has been reported that such a design delivers a maximum intrusive effect to the canines that are closest to the anchor bends and least intrusive force to the central incisors that are farthest from the anchor bends. Therefore, the design of arches used in our study may not have been effective in achieving the intrusion of maxillary incisors.

There was significant extrusion of the mandibular molars (2.81 mm) as well as proclination (5.72°) and intrusion (2.61 mm) of the mandibular incisors. The deepbite improved by 2.93 mm. While there was significant intrusion of mandibular incisors (–2.61 mm), maxillary incisors extruded 1.64 mm under the undesirable influence of the downward component of the Class II elastic forces. Since these were not extraction cases, the vertical vector of Class II elastics may have exceeded the horizontal vector and thereby caused the undesirable extrusion of the maxillary incisors. Anchor bends of the traditional Begg appliance could not effectively negate these extrusive forces. The vertical component of the Class II elastic forces resulted in mandibular molar extrusion of 2.6 mm. These findings are in agreement with those of Meistrell et al.[13]

The skeletal contribution to the total molar correction according to the Pitchfork analysis was only 1.78 mm of the total of 5.77 mm. The molar correction was dentoalveolar in nature with significant distal movement of the maxillary molar and mesial movement of the mandibular molar, as reported. The anchor bends and the distal component of the Class II elastic force caused significant distal tipping of the maxillary molar and partially restrained its eruption. In contrast, Meistrell et al[13] reported mesial movement of the maxillary molar with the Begg appliance.

Newman[19] observed that the influence of the horizontal force component of Class II elastics was larger than the vertical forces exerted on the molars. The anchor bend in the lower arch acted as a neutralizing factor to give the molars support against the displacing mesial force component of the elastics and also to keep the molars upright.[10] In our study, the mandibular molar exhibited slight distal tipping and moved mesially significantly, despite the use of light forces (2 ounces) and adequate anchorage bends. The forward movement may be explained as a loss of anchorage, which suggests that the use of lighter elastics (1.5 ounces) and reverse torquing auxiliaries may enhance anchorage conservation in the mandibular arch. Distal tipping of the maxillary molars was settled with finishing arches.

CONCLUSIONS

It was concluded that

1. The nonextraction Begg appliance treatment is capable of producing significant improvement in the soft tissue profile, overjet, overbite, and the sagittal molar relationship.
2. Major contributors to the overjet correction were a significant decrease in the maxillary incisor proclination and an increase in the IMPA, with minimal skeletal changes.
3. Significant mandibular incisor intrusion, accompanied by proclination and some mandibular molar extrusion contributed to overbite correction.
4. Anchor bends in the maxillary arch restricted the forward movement of the maxillary molars but they were not capable of causing intrusion of maxillary incisors.
5. The mild Class II elastic forces caused significant retraction of the maxillary incisors, an increase in IMPA, and correction of the sagittal molar relationship. They also had the undesirable effect of counteracting the maxillary incisor intrusion.

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