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NON-EXTRACTION ORTHODONTIC TREATMENT OF CLASS 2 DIVISION ONE MALOCCLUSION IN ADULT POPULATION

R SUKHIA, BSC, BDS, MS
**ANJUM ZEHRA, BSC, BDS

ABSTRACT

The purpose of this study was to find the skeletal, dental & soft tissue changes following a non-extraction orthodontic treatment regimen in mild to moderate class 2 skeletal base relationships in the adult population.

46 mild to moderate class 2 skeletal base relationships were treated with fixed orthodontic appliances in the adult permanent dentition with non-extraction approach. The patients selected were assessed according to pre-treatment & post-treatment cephalometric records. 7 Sagittal, 7 vertical, 8 dento-skeletal and 6 soft tissue profile cephalometric parameters were measured for each patient.

Class one molar and incisor relationship was achieved mostly as a result of forward mandibular dento-alveolar movement as compared to skeletal and soft tissue changes. Camouflage orthodontic treatment by non-extraction approach for late adolescents and adults can be achieved with good results.

Key words: *Adult orthodontics, class 2 malocclusion, non-extraction orthodontic treatment.*

INTRODUCTION

Malocclusion has been defined as an appreciable deviation from normal or ideal occlusion1. 95 percent of malocclusions are due to a variation of normal development while 5 percent have identifiable causes'. Genetics tend to influence skeletal patterns and environment influences tooth positions, but both act synergistically to create a malocclusion[3].

According to the British standards institute', class 2 division one is defined when lower incisor edges are palatal to the cingulum plateau of the upper incisors, and the upper incisors are proclined or of average inclination, with an increased overjet of more than 2 mm . The prevalence of class two division one in the general adult population is 20 percent [4-5].The increasing demand for adult orthodontic treatment is due to social awareness and self motivations. Most commonly associated complications with adult patients are heavily restored carious lesions, root treated and periodontally involved teeth. Psychological complications are that adults may have higher expectations, are more demanding, and require more precision in finishing.

The aetiology of class two malocclusion is multi-factorial5 and is divided into underlying skeletal base relationship and soft tissue factors such as a lower lip trap and a short upper lip. Adult class two malocclusions are further exacerbated by periodontal involvement of teeth, which tend to flare and protrude the incisors, increasing the overjet.

Non extraction treatment is preferred by the adult population nowadays [6]. As Angle observed that everyone had the capacity to have 32 teeth in functional occlusion and believed that 32 teeth would provide the best aesthetics for each individual. Most adults especially females [8] prefer to be treated without extraction of healthy teeth due to fear of dental needles and concerns regarding detrimental effects of extractions on facial profile, TMJ disorders and recent research that extractions do not guarantee stability[8-9]. Closure of extraction spaces in adults is slow and difficult. Due to negligible growth, decreased tissue blood

* Assistant Professor & Head of Department of Orthodontics, Jinnah Medical & Dental College, Karachi. E-mail: hsukhia@cyber.net.pk

**Demonstrator of Orthodontics, Jinnah Medical & Dental College, Karachi

supply, and decreased cell turnover as compared to young patients, extractions and tooth movement should be kept as minimum as possible, except where required.

MATERIALS & METHODS

Forty six adult orthodontic patients were selected requiring treatment. The ages ranged from 18 to 24 years (mean age 21.5 years) and the male to female ratio was 27:19. Pre-treatment cephalometric tracing (tables 1 and 2) was done to confirm the underlying skeletal class 2 malocclusion. The chief presenting complaint of all patients was of upper incisor protrusion and esthetic reasons. Patients selected had good oral hygiene with no periodontal involvement and carious lesions.

Pre- and post treatment lateral cephalogram was taken, traced and analyzed for each patient. Composite cephalometric analysis was performed for each patient. Saggital, vertical, dento-skeletal and soft tissue parameters were measured (Table 1) to evaluate the skeletal, dento-skeletal and soft tissue changes with treatment.

Standardized cephalometric radiographs measuring 8" X 10" were taken using a Siemens Orthophos-C cephalostat with settings of 14mA, and between 73 and 77 kV. Exposure time varied between 0.5 and 0.63 seconds. The film used was either Kodak TMG-RA1 or DuPont Ultravision G, with a developing time of 90 seconds using a Kodak N35 developer.

Treatment Regimen: All patients were selected by the orthodontic department with mild to moderate skeletal and dental class 2 division one malocclusion. Upper and lower pre-adjusted edgewise fixed appliances (straight wire technique) 0.022 X 0.028 inch slot Andrews prescription brackets were employed for all patients. The non-extraction treatment approach was followed as the mean average upper and lower incisor crowding was 5.4 mm (<6mm) and a mean overjet of 4.5 mm as measured with the arches in centric occlusion. These values confirm the mild to moderate degree of malocclusion in our study. The upper and lower arches were initially aligned with Niti super-elastic 0.014" round wires, which progressed finally to rectangular SS wires of 0.019 x 0.025" dimensions. Labial root torque was incorporated in the lower labial segment to decrease the proclination effects of class 2 elastics.

Bilateral 4/16" medium pull class two elastics were incorporated from upper canine bracket hooks to the lower 1st permanent molar bands, for an average of 68 months period to reduce the overjet. Average treatment duration was 14-18 months.

The mean values were calculated for each measurement. In our study, the pre-treatment ANB value of 4 ° confirmed the skeletal class 2 pattern. The mean ANB value of > 4° indicated skeletal class 2 prevalence amongst the selected patients[9]. The ANB >4° may be due to a hyperplastic maxilla and normal mandible or composite class 2 malocclusion. All the pre-treatment

TABLE 1: COMPOSITE CEPHALOMETRIC ANALYSIS

SAGITTAL ANALYSIS		**DENTO-SKELETAL ANALYSIS**	
SNA<	82 °	UI-SN<	102 °
SNB<	80 °	UI- Pal.Plane <	108 °
ANB<	2 °	IMPA <	90 °
AO-BO Distance Witts	0-1 mm	Inter.Inc <	135 °
Ant. Cranial Base length —	X mm	UI- NA distance	4 mm
Mandibular Corpus Length	X +7 mm	UI- NA <	22 °
Facial Depth Angle<	87 °	LI- NB distance	4mm
		LI- NB <	25 °
VERTICAL ANALYSIS		**SOFT TISSUE ANALYSIS**	
SN-Man. Plane<	32 ° ± 4 °	Upper Lip- esthetic plane	0 mm ± 2
SN-Max.Plane <	6 °± 4 °	Lower Lip-esthetic plane	0 mm ± 2
MMA	26 ° ± 5 °	Upper lip- S Line	Omm± 2
Y-Axis (with SN)	66 °± 4 °	Lower lip to S Line	0 mm ± 2
Sum of post.inner angles	396 ° ± 4 °	Naso-Labial <	100 °
Jarabak Ratio	65% ± 4%	Labio-mental <	135 °
Ratio L. AFH-Total Ant FH	54% ± 2%		

mean skeletal values (table 2) confirmed the skeletal and dental class two division one malocclusion.

RESULTS

Pre- & Post- Treatment Skeletal Sagittal Measurements: In our study, we measured 7 skeletal sagittal parameters(Table 2a). The mean pre-treatment SNA value obtained was 84°, indicating maxillary protrusion as observed by the forward positioning of the A point related to the Sella-Nasion Plane. SNB value of 76° indicated mandibular retrusion, while ANB pre-treatment value of 4° indicated skeletal class 2 malocclusion. The mean facial depth angle of 79° indicates that the major contribution to skeletal class 2 malocclusion is due to the mandibular retrognathism.

The post treatment mean SNA 83° showed slight maxillary retrusion of 1° from 84° to 83°. SNB value increased 1° from 76° to 77° showing slight forward positioning of Point B or supra-mentale post-treatment. The ANB value decreased by a mean value of 2° from 4° to 2° after completion of treatment.

TABLE 2: PRE & POST MEAN CEPHALOMETRIC VALUES

VALUES	Normal	SD ±	Pre-treatment Mean	Post-treatment Mean	Mean Diff
a. Skeletal- Sagittal Parameter Measurements					
SNA	82 °	2 °	84 °	83 °	1 °
SNB	80°	2°	76°	77°	1°
ANB	2°	1°	4°	2°	2°
AO-BOWitts	0, -1 mm	-	+ 1.6 mm	+ 0.8 mm	1.2
ACB Length X	X mm	-	66.4 mm	66.4 mm	-
MCL (X + 7)	X + 7 mm	-	74.3 mm	74.2 mm	0.1
Facial Depth <	87 °	5 °	79 °	81 °	2 °
b. Skeletal- Vertical Parameter Measurements					
SN-Mn. P<	32°	4°	29 °	30.2°	1.2°
SN-Mx. P<	6 °	4°	5.7.	5.4°	0.3°
MM<	26 °	5°	24°	26°	2°
Y.Axis- SN	66 °	4°	64.4°	65.2°	0.8°
Sum PI <	396 °	4°	388.2°	387.5°	0.7°
Jarabak	65 %	4 %	63 %	61%	2%
Ratio(AFH/LFH)	54%	2%	48%	51%	3%
c. Dento-Skeletal Measurements					
UI- SN <	102°	5 °	108°	104°	4°
UI- Max.P <	108 °	5°	112°	106°	6°
IMPA	90°	5°	92°	96°	4°
Inter Inc <	135 °	5°	139°	127°	12°
UI- NA	4 mm	-	6.2 mm	4.4 mm	1.8 mm
UI-NA <	22°	-	25.8°	23.2°	2.2°
LI-NB	4mm		3.2 mm	6.4 mm	3.2 mm
LI- NB <	25°	-	23.2°	26.4°	3.2°
d. Soft Tissue Parameter Measurements					
U.Lip- E	0 mm	2 mm	+1.2 mm	- 0.5 mm	1.7 mm
L.Lip-E	0 mm	2 mm	-2 mm	-1.2 mm	0.8 mm
U.Lip- S	0 mm	2 mm	-1.8 mm	- 1.6 mm	0.2 mm
L.Lip- S	0 mm	2 mm	- 3.1 mm	-3.5 mm	0.4 mm
Naso-Labial <	100°	5°	95.4°	97.7°	2.3°
Labio-mental <	130°	5°	124°	121°	3°

The facial depth angle increased from the pre-treatment mean of 79° to 81 ° showing a mean 2 ° increase confirming the forward positioning of the pogonion as related to the Frankfort horizontal plane po st-orthodontically.

Pre- & Post- Treatment Skeletal Vertical Measurements: The 7 vertical parameters measured in our study (Table 2b) showed insignificant changes except for the lower facial height, which showed a mean 3% increase post-treatment. The mean pretreatment maxillary- mandibular plane angle of 24° is within normal range but is on the low side indicating that the selected patients were low angle cases. The pre-treatment maxillary mandibular plane angle of 24° increased to 26° due to the lower molar elastic extrusion effect. SN to mandibular plane showed a pre-treatment mean value of 29 °, which increased to a posttreatment mean value of 30.2°.

Pre- & Post-Treatment Dento-Skeletal Measurements: In our study, 8 dento-skeletal parameters were measured pre- and post-treatment (Table 2c). The dento-skeletal values showed the greatest post treatment changes. The mean pre-treatment upper incisor inclination to the maxillary plane was 112 ° indicating proclination of the upper labial segment, and the lower incisor to the mandibular plane was 92 indicating average value within the IMPA standard deviation of 90° + 5°. The upper and lower incisor angulation of 139° is within the normal standard deviation range for the angle.

The post treatment dento-skeletal values showed vast changes when measured post-orthodontically. The lower incisor to the mandibular plane angle IMPA showed a mean value increase of 4° from 92° pre-treatment to 96° post-treatment, indicating labial positioning or proclination of the lower labial segment on treatment completion.

The upper incisor to the maxillary plane showed a mean difference of 6 ° from a pre-treatment mean value of 112° to 106° post-orthodontically, showing upper labial segment retrusion or incisor retroclination during treatment. The upper incisor showed a mean 4° reduction post-treatment when measured to the SN plane. While the lower incisor to the NB line (linear & angular) measurement showed a mean 3.2 mm and 3.2° increase post-treatment, indicating post-treatment proclination of the lower incisors.

Inter-incisor angle decreased from a mean pre-treatment value of 139° to 127° post-orthodontically showing a mean difference of 12 °. The decrease could be attributed to more forward movement or proclination of the lower incisors during treatment with the class 2 elastics.

Pre- & Post- Treatment Soft Tissue Measurements: In our study we measured 6 soft tissue parameters for each patient (Table 2d). Post-treatment soft tissue profile parameters showed mild to insignificant changes. The upper lip retracted 1.7 mm to Ricketts esthetic plane [17] while the lower lip came forwards 0.8 mm to the esthetic plane. Parameter changes were noted in the naso-labial angle, which showed a mean difference increase of 2.3 ° post-treatment, while the labio-mental angle showed a mean difference decrease of 3 from 124° to 121 post-treatment.

DISCUSSION

It is noted that 6% of adults have overjet greater or equal to 7mm[9-10]°. The patients in our study group presented due to proclination and crowding of the upper incisors with a mean overjet of 4.5 mm. As observed, the main motivation for adult orthodontics is improvement of esthetics and improvement of function[1011] However, adults may have higher treatment expectations and may hide true motives for orthodontic therapy[11]. In the present study, the patients were verbally confirmed that the main complaint was upper incisor proclination and increased overjet. No headgear was prescribed for the present study group as adults are reluctant to wear extra-oral headgears[12].

Our patient samples presented with a mean crowding of 4-6 mm in both arches. As observed by Proffit[13] the amount of crowding may decide the extraction or non extraction of patients. When provided with an option between the extraction and non-extraction orthodontic treatment approach, the patients preferred the non-extraction regimen. As noted that 0-4 mm crowding is regarded as mild, 5-9 mm crowding as moderate and greater than 10 mm as severe crowding. Therefore our mean crowding value of 4-6 mm is towards the mild to slightly moderate side, indicating a non-extraction treatment approach in our patient treatment planning.

In this study, hard tissue skeletal, dental and soft tissue point changes were noted. As shown by various investigations that soft tissue changes do accompany tooth movement[14-16]. However, as observed in our study, soft tissue profile changes were mild to insignificant. The naso-labial angle showed a mean value increase of 2.3°, which could be attributed to upper incisor retroclination. However, the naso-labial angle increases further and more efficiently in 1st premolar

extraction cases as compared to non-extraction cases [16]. The labio-mental angle showed a decrease mean value of 3° post-treatment which could be due to forward tipping of the lower labial segment during treatment.

Class 2 elastics or inter-maxillary traction was incorporated to transfer anchorage from one arch to another, and class 2 molar relationship was corrected via mesial movement of the buccal dento-alveolar segment with elastics. The disadvantage as noted in our study was that the class one incisor relationship obtained at the end of elastic therapy was due to proclination of the lower incisors and retroclination of the upper incisors. In our sample the IMPA value was increased to a post treatment mean of 96°, which is slightly higher than the standard deviation of 5° for Caucasian norms [17]. It was investigated that IMPA values are higher for Afrocaribean (101°) and Chinese (98°) populations[18-19]

As obvious from the results obtained, dento-alveolar changes accounted for the maximum antero-posterior overjet correction in our study (Table 2c). However, maxillary changes are more stable than mandibular changes. Good buccal inter-digitation post-orthodontically reduces dental relapse[29] Maxillary dental expansion to accommodate the wider posterior mandibular segment was achieved with consecutive preformed archwires with 0.019 X 0.025" SS final finishing wire. Expansion is more likely to be stable in the absence of extractions [21]. Increase in maxillary inter-molar width produces linear reduction in arch depth[22]. According to Higgins and Lee[23], 1 mm of dental arch expansion causes 0.3 mm reduction in arch length, which equates to 0.6 mm space creation within the arch. Class 2 elastics depended on patient cooperation during our study, which could be rated as excellent in our patient group. Elastics were advised to be worn atleast 16 hours/day or more. No untoward complaints were recorded during elastic wear.

As our study depended on cephalometrics, radiographic and tracing errors should not be ruled out as all lateral cephalograms were hand traced and measured under illuminator[24-25]. In the present study, we used standardized cephalometric radiographs using the Siemens Orthophos-C cephalostat with settings of 14mA, and exposure time of between 0.5 — 0.63 seconds. Errors of projection arise due to radiographs being a 2 dimensional representation of a 3 dimensional object. Points not in the mid-sagittal plane are distorted according to the law of perspective[26] ie. Angular measurements become too obtuse and linear measurements are fore-shortened. Errors of hard tissue points identification during tracing could have accounted for minor deviations in the mean values in the present study. All points have an 'envelope of error' which is dependant on anatomic characteristics of landmark ie. Points on edges are easier to locate than points within structures as superimposition is less[27]. Most reliable point is sella turcica, while least reliable points are gonion and lower incisor apex[28].

The proclination effect of lower labial segment was reduced by utilizing heavy SS rectangular wires with tight cinch back. Labial root torque was incorporated in the wire to prevent proclination of the lower labial segment by class 2 elastics [29] Labial root torque was incorporated in the lower central and lateral incisors. Class 2 elastics have a disadvantage of over-proclining the lower labial segment due to forward mesial pressure on the lower arch. Incorporation of torque limited this movement and gained more alveolar movement to correct the overjet.

In our study, stability of the treated occlusion was not evaluated. However, adult occlusions after correction of class two division one malocclusion are as stable as compared to adolescents with respect to molar relation[30]. Permanent retention after adult orthodontic treatment could be incorporated in the treatment plan if there is reduced periodontal support suspected. It should be noted that any change in arch form is likely to relapse so lengthening must be kept to the minimum. In adults, teeth are more prone to tipping than bodily movement[31].

In our study, as mentioned, skeletal and soft tissue parameters showed mild to insignificant changes. As investigated by previous authors[32-33], that naso-labial and labio-mental angles show changes when the incisors are retroclined or proclined. Few studies have confirmed the mild esthetic effects of non-extraction adult orthodontic treatment on facial profiles[34-35]. In our study, the soft tissue profile did not change except for the mild increased naso-labial angle due to the overjet reduction and class 2 elastic effects. However, the upper lip showed more retraction with a mean difference value of 1.7 mm as compared to the lower lip, which showed a mean difference of 0.8 mm forward movement. Over-proclined mandibular incisors and soft tissue changes in adults beyond the soft tissue balance zone are liable to relapse ifpermanent or semipermanent retention is not planned[35]. Therefore, further investigations are required concerning the long-

term profile changes in adults treated by non-extraction approach.

CONCLUSION

1. Mild to moderate class 2 division one malocclusion can be treated on a non-extraction basis in < 6mm crowding cases.
2. Dento-alveolar changes are greater than skeletal changes for resolution of the anterior posterior discrepancy. However, cephalometric tracing errors should not be ruled out.
3. Overjet decrease was due to dento-alveolar changes in the upper and lower labial segments. Labial root torque should be incorporated to limit over-proclination effect of class 2 elastics on the mandibular incisors.
4. Adult orthodontic cases can be treated by camouflage, but the changes are mostly due to dental tipping rather than bodily movement of the teeth.
5. Mild to insignificant soft tissue profile changes were noted post-treatment.
6. Long term stability and relapse of the corrected malocclusion after active orthodontic treatment phase should be investigated.

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