RESEARCH

Modified Tweeds Mechanotherapy - An Assessment of Treatment Results

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Abstract
The purpose of this study was to evaluate the treatment results obtained from deviations incorporated in the basic Tweed’s mechanics, with an objective to quantitatively evaluate dentoskeletal changes in Angle’s Class II division 1 malocclusion, changes in tooth position and the total time taken in treating Class II division 1 cases with this modified Tweed’s mechanotherapy. Study models, cephalometric records taken at pre and post-treatment and case sheets of 30 subjects treated with this modified mechanotherapy were analysed. The case sample aged 13 to 25 years were selected on the basis of Angle Class II division 1 malocclusion requiring first premolar extraction. To evaluate the treatment changes various angular and linear measurements were measured from pre and post-lateral cephalograms. Marked improvement in the treatment results was observed. An appreciable uprighting of lower mandibular incisors was achieved with lingual and labial tipping movement of the crowns and roots of mandibular incisors by a decrease in IMPA. ANB value was reduced mainly due to retraction of maxillary incisors. Overjet and overbite were decrease with improvement in facial profile and total treatment time was substantially shortened without compromising on the treatment results.

Keywords
Tweed mechanics, Dentoskeletal changes, Angle’s Class II div. 1 malocclusion

Introduction
E.H. Angle\(^1\) devised an edgewise appliance with a sacred principle of non-extraction\(^2\) in treatment. The basic mechanical component of this appliance was the edgewise bracket which consisted of a rectangular box with three walls within the bracket, 0.022 inch by 0.028 inch in dimension with horizontal slot. This new design provided more accuracy and thus a more efficient torquing mechanism. C.H. Tweed held to Angle’s firm conviction that one most never extract teeth\(^3\) for three years. However, Tweed found the results of cases treated with Angle’s methods to be unsatisfactory as patients reported with increased arch length, facial imbalances, unstable alignment of teeth and unhealthy tissue environment. He published his first paper\(^4\) on the extraction of teeth for orthodontic malocclusion correction and concluded that upright mandibular
incisors were frequently related to post-treatment facial balance and successful treatment. To position mandibular incisors upright, he concluded that one must prepare anchorage\(^6\) and extract teeth\(^6\). He laid emphasis on:

1. Upright teeth over the basal bone with emphasis on mandibular incisors.
2. Extraction of first premolars\(^6\).
3. Introduced Frankfort mandibular incisor angle\(^6\) (FMIA) and considered the attainment of 65° as one of the major basic objective of treatment mechanics.
4. Divided his treatment mechanics\(^7\) into four stages: leaving, anchorage preparation, distal en masse movement of the teeth and finishing and retention.

An insight into literature revealed that certain modifications have already been tried by many clinicians and deviations have ensued over the years from the basic Tweed’s mechanotherapy. Harry Bull (1959)\(^8\) presented his bull technique with modification of Tweed’s original procedure. His concept of treatment for Class II division 1 malocclusion was that correction must rely chiefly on tooth movement for correction of arch relationships without putting heavy demands on anchorage preparation. Ricketts (1971)\(^9\) came out with his bioprogressive therapy having edgewise as his background. Bioprogressive therapy took advantage of biologic progression of growth, development and function. Dr Ricketts believed that, the diagnosis and the desired results should guide us in selection and use of mechanical procedures. Anchorage in bioprogressive therapy generally means stabilizing and positioning of molars against forces during various stages of orthodontic treatment. In his technique the use of utility arch was the starting appliance for class II division 1 and class II division 2 cases. Angelis (1976)\(^10\) presented his amalgamated technique. The technique combined the biomechanical principles of both edgewise and Begg techniques\(^11\) for efficient and controlled tooth movement. Amalgamation of both the techniques gave positive results and lessened the treatment time. Correction of the overjet without displacement of the root apices in the opposite direction can be achieved with amalgamated technique. Controlled tipping with edgewise brackets and use of round light wires provides effective mechanics for corrections of malocclusion.

Although Tweed’s philosophy\(^12\) continues to be a guiding principle to obtain clinical objectives in our department, few modifications have been incorporated into this basic edgewise appliance. Major factors responsible for the alteration of this technique have been:

- Greater number of patients with severe malocclusion seeking treatment and increased pressure from them for early completion of treatment with desired results.
- The steps of anchorage preparations as described by Tweed were found to be rigorous and time consuming procedure for both patient and operator.

Certain modifications which were incorporated in basic Tweed’s mechanotherapy during treatment of Class II division 1 cases, requiring first premolar extraction are the use of siamese brackets against single brackets with eyelets, highly resilient wires like nitinol, elgilooy, triflex etc. during the initial stages of treatment. Edgewise arch wires with second order bends and hooks soldered distal to lateral incisors were used to high pool headgears for bite opening. Depending on the status of dentition light round and rectangular arch wires were used for retracting canines and incisors with the help of compressed coil springs and sliding hooks supported by class II or class III elastics and occipital pull or low pull headgears. The mechanics was modified from time to time as per the existing malocclusion situation.

Considering the above modifications the present study is being undertaken to evaluate the treatment results obtained from deviations incorporated in the basic Tweed’s mechanics with the following aim and objectives in mind:

- To assess the dentoskeletal changes in Angle class II div. 1 malocclusion cases after completion of active treatment.
- To evaluate changes in tooth position through pretreatment and post-treatment lateral head cephalograms.
- To evaluate the comparative time taken in treating class II division 1 cases with the modified Tweed's mechanotherapy.

**Material and method**

The present study was conducted on pre and post-lateral head cephalograms, study cast models and case sheet records of 30 patients treated with modified Tweed’s mechanotherapy.

**Selection of the Cases**

All the cases considered for the present study were selected after they had met the following criteria:
- Those who had Angle class II division 1 malocclusion before the treatment started.
- All four first premolars were extracted as a part of treatment.
- The same radiographic equipment and technique were used for each patient.
- The age of all patients selected for the study ranged from 13 to 25 years of both sexes with the mean age being 16 years.

**Cephalometric variables**

The following cephalometric variables were measured from the pre and post-treatment lateral cephalograms to evaluate the treatment changes.

**Incisor mandibular plane angle (IMPA):** The angle formed by the mandibular central incisor to the mandibular plane (Tweed).

**Frankfort mandibular plane angle (FMA):** Angle formed between Frankfort horizontal plane and the mandibular plane (Tweed).

**Frankfort mandibular incisor plane angle (FMIA):** Angle formed between the Frankfort horizontal plane and the long axis of the mandibular central incisor (Tweed).

**SNA:** The angle formed with Sella-Nasion plane and the line joining Nasion and point ‘A’ (Steiner).

**SNB:** Angle formed between sella-Nasion plane and the line joining Nasion and point ‘A’ (Steiner).

**ANB:** Difference of angle SNA and SNB. It expresses the mesio-distal relationship of the maxillary and mandibular basal bones (Steiner).

**Ar Na6:** Angle formed by articulare anterior point of the frontnasal suture and the mesial contact point of 6 (Krogman and Sassouni).

**Linear Measurement**

**T to AP:** The measurements being made on a line parallel to the mandibular plane recording the changes in the distance of crown and root to the AP line from the long axis of the lower incisor (FOGEL) \(^\text{17}\) (Fig. 2).

**6 to AP:** The measurements being made on a line parallel to the mandibular plane recording the changes in the distance of crown and root to the AP line from the long axis of the mandibular plane line (FOGEL) \(^\text{17}\) Fig. 2).

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**Fig. 1:** Angular Measurements used in Cephalometric Analysis

**Fig. 2:** Changes in Position of Chronic and Roots of Mandibular Incisors and Molars

**Fig. 3:** Soft Tissue Profile Improvement After Treatment
To determine the pre and post treatment changes different superimposition were used:

For measuring angular variables pre and post-treatment tracings were superimposed on the SN plane at 'S' and, for measuring the net changes in mandibular incisor and molar crown the root position tracings were superimposed at the cortical plates of symphysis, mandibular planes and the AP planes.

Labial or mesial movements of crowns and roots were given a positive (+) sign and lingual or distal movements of crowns and root were given a negative (-) sign and the measurements were recorded in mm.

Upper and lower lip position in front of E plane were recorded as positive (+) and behind the E plane as negative (-).

Statistical Analysis

All the pre and post-treatment cephalometric variables and changes in the position of the teeth were subjected to statistical evaluation.

Fig. 4: Diagram showing the measurements of Overbite and Overjet

Evaluation from Cast Records (Fig. 4)

For each pair of dental casts the parameters were recorded with the help of fine tipped precision divider and a millimeter scale having a least count of 0.5 mm.

Overbite: Measured as the vertical distance from the incisal edge of the maxillary central incisors to the incisal edge of the mandibular central incisors when the jaws are in the centric occlusion (Summers)19.

Overjet: Measured as the horizontal distance from the labial surface of the maxillary central incisors to the labial surface of the mandibular central incisors (Summers)19.

Evaluation of Pre and Post-treatment Records

To determine the pre and post treatment changes different superimposition were used:

For measuring angular variables pre and post-treatment tracings were superimposed on the SN plane at 'S' and, for measuring the net changes in mandibular incisor and molar crown the root position tracings were superimposed at the cortical plates of symphysis, mandibular planes and the AP planes.

Labial or mesial movements of crowns and roots were given a positive (+) sign and lingual or distal movements of crowns and root were given a negative (-) sign and the measurements were recorded in mm.

Upper and lower lip position in front of E plane were recorded as positive (+) and behind the E plane as negative (-).

Statistical Analysis

All the pre and post-treatment cephalometric variables and changes in the position of the teeth were subjected to statistical evaluation.

Observations

Seen angular and six linear measurements were obtained from pre-treatment and post-treatment lateral and cephalograms, two linear measurements from study casts alongwith evaluation of history case-sheet records. After recording the measurements the data was subjected to statistical evaluation. The results of the present study are presented in Table I to VII

A. Change in Pre-treatment and post-treatment cephalometric parameters Angular Measurements

Among the seven angular cephalometric parameters used in the present study, the values of which are presented in Table I revealed that the post-treatment values of angles FMA, FMIA and SNB were higher than their pre-treatment values indicating rotation of the mandible, uprightening of the lower incisors and residual growth of the mandible in the antero-posterior direction. The mean post-treatment values of IMPA, SNA, ANB and ArNa6 angles showed a decrease which reflected that there was a reduction an axial inclination of the mandibular incisors, distalisation/retraction of the upper incisors together with distal tipping of the lower molar crowns. The range of FMA after treatment was found to be (15°-38°), quite close to Tweed's norm. However, FMIA was found to be only 57° (with a range of 41°-70° ) being quite low as compared to Tweed's norm of 65°. The IMPA values in the present study ranged between (85°-105°) with a mean of 95°. This was found to be considerably more than Tweed's norm of 90° suggesting that North Indians have more proclined mandibular incisors as compared to Caucasians.

Linear Measurements

The mean values of pre-treatment and post-treatment linear measurements, which are presented in Table I showed that the value of upper lip to E plane and lower lip to E plane showed a marked decrease indicating overall soft tissue profile changes due to orthodontic treatment.

The mean post-treatment values of 1-AP crown, and 6-AP crown showed an increase indicating thereby lingual tipping of the lower incisor crowns and distal tipping of the crowns of the mandibular molar. The roots of T-AP incisors and 6-AP mandibular molars showed a decrease indicating that the roots of the lower incisors and mandibular molars have moved labially and mesially respectively in most of the cases.
Table I: Mean standard deviation and standard error of pre- and post-treatment values

<table>
<thead>
<tr>
<th>Cephalometric variables Angular (in degrees)</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FMA</td>
<td>26.33</td>
<td>7.40</td>
<td>1.35</td>
<td>17-39</td>
<td>27.27</td>
<td>7.33</td>
<td>1.34</td>
<td>15-38</td>
</tr>
<tr>
<td>2. IMPA</td>
<td>99.37</td>
<td>7.01</td>
<td>1.28</td>
<td>80-114</td>
<td>95.83</td>
<td>4.47</td>
<td>0.82</td>
<td>85-105</td>
</tr>
<tr>
<td>3. FMIA</td>
<td>54.33</td>
<td>9.38</td>
<td>1.71</td>
<td>39-70</td>
<td>57.00</td>
<td>8.68</td>
<td>1.58</td>
<td>41-70</td>
</tr>
<tr>
<td>4. SNA</td>
<td>80.90</td>
<td>3.16</td>
<td>0.58</td>
<td>74-87</td>
<td>79.57</td>
<td>3.09</td>
<td>0.56</td>
<td>73-85</td>
</tr>
<tr>
<td>5. SNB</td>
<td>75.80</td>
<td>3.17</td>
<td>0.58</td>
<td>71-82</td>
<td>75.93</td>
<td>3.53</td>
<td>0.65</td>
<td>69-82</td>
</tr>
<tr>
<td>6. ANB</td>
<td>5.63</td>
<td>2.43</td>
<td>0.44</td>
<td>2-11</td>
<td>3.37</td>
<td>2.13</td>
<td>0.39</td>
<td>1-8</td>
</tr>
<tr>
<td>7. ArNA6</td>
<td>42.70</td>
<td>1.32</td>
<td>0.24</td>
<td>40-45</td>
<td>42.53</td>
<td>2.37</td>
<td>0.43</td>
<td>39-48</td>
</tr>
</tbody>
</table>

Linear (in mm)

<table>
<thead>
<tr>
<th>Cephalometric variables Linear (in mm)</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. l-AP (Crown)</td>
<td>4.73</td>
<td>0.99</td>
<td>0.18</td>
<td>3.5-6</td>
<td>6.32</td>
<td>1.70</td>
<td>0.31</td>
<td>3.5-12</td>
</tr>
<tr>
<td>2. l-AP (Root)</td>
<td>5.35</td>
<td>1.12</td>
<td>0.21</td>
<td>4-8</td>
<td>6.27</td>
<td>0.96</td>
<td>0.18</td>
<td>4-8</td>
</tr>
<tr>
<td>3. 6-AP (Crown)</td>
<td>37.50</td>
<td>1.25</td>
<td>0.23</td>
<td>35-42</td>
<td>38.17</td>
<td>1.69</td>
<td>0.31</td>
<td>35-40</td>
</tr>
<tr>
<td>4. 6-AP (Root)</td>
<td>38.20</td>
<td>1.44</td>
<td>0.26</td>
<td>36-40</td>
<td>36.90</td>
<td>1.44</td>
<td>0.26</td>
<td>32-39.5</td>
</tr>
<tr>
<td>5. U lip to E plane</td>
<td>0.45</td>
<td>3.17</td>
<td>0.58</td>
<td>(-)8-6</td>
<td>-1.51</td>
<td>2.31</td>
<td>0.42</td>
<td>(-)5-5</td>
</tr>
<tr>
<td>6. L lip to E plane</td>
<td>2.43</td>
<td>3.27</td>
<td>0.60</td>
<td>(-)4.5-7</td>
<td>-0.10</td>
<td>2.45</td>
<td>0.45</td>
<td>(-)5-4</td>
</tr>
</tbody>
</table>

B. Mean Standard deviation and Level of Significance of Treatment changes

The purpose of deriving standard deviation, mean difference and level of significance (Student’s ‘t’ test) was to evaluate the level of significance of the changes in various cephalometric parameters brought about by treatment.

i) Angular Measurements: The mean standard deviation, mean difference and level of significance of the treatment changes presented in Table II revealed that the change in the angles FMIA, IMPA, ANB, SNA were found to be highly significant (p<0.05) implying that treatment produced a retraction and distalisation of the upper incisors, whereas values of the angles FMA, SNB, ArNA6 were found to be statistically insignificant.

ii) Linear Measurements: Among the six linear measurement used in the study the data (Table II) showed that the linear values before and after treatment of upper lip to E plane, lower lip to E plane, T-AP crown, T-AP root and 6-AP root showed a highly significant (p<0.05) change whereas 6-AP crown parameter was found to be insignificantly changed.

<table>
<thead>
<tr>
<th>Cephalometric variables Angular (in degrees)</th>
<th>Mean</th>
<th>SD</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FMA</td>
<td>0.93</td>
<td>3.00</td>
<td>1.70</td>
</tr>
<tr>
<td>2. IMPA</td>
<td>-3.53</td>
<td>5.80</td>
<td>-3.34*</td>
</tr>
<tr>
<td>3. FMIA</td>
<td>3.67</td>
<td>5.96</td>
<td>3.37*</td>
</tr>
<tr>
<td>4. SNA</td>
<td>-1.33</td>
<td>1.30</td>
<td>-5.64*</td>
</tr>
<tr>
<td>5. SNB</td>
<td>0.13</td>
<td>1.98</td>
<td>0.37</td>
</tr>
<tr>
<td>6. ANB</td>
<td>-2.27</td>
<td>1.33</td>
<td>-9.28*</td>
</tr>
<tr>
<td>7. ArNA6</td>
<td>-0.17</td>
<td>2.20</td>
<td>-0.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cephalometric variables Linear (in mm)</th>
<th>Mean</th>
<th>SD</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. l-AP (Crown)</td>
<td>-1.58</td>
<td>2.52</td>
<td>-3.44*</td>
</tr>
<tr>
<td>2. l-AP (Root)</td>
<td>0.91</td>
<td>1.85</td>
<td>2.71*</td>
</tr>
<tr>
<td>3. 6-AP (Crown)</td>
<td>-0.67</td>
<td>2.53</td>
<td>-1.45</td>
</tr>
<tr>
<td>4. 6-AP (Root)</td>
<td>1.30</td>
<td>2.42</td>
<td>2.94*</td>
</tr>
<tr>
<td>5. U lip to E plane</td>
<td>-2.53</td>
<td>3.33</td>
<td>-4.17*</td>
</tr>
<tr>
<td>6. L lip to E plane</td>
<td>-1.97</td>
<td>3.71</td>
<td>-2.91*</td>
</tr>
</tbody>
</table>

*Significant at 5% level of significance.
C. Linear Movement of Crowns and Roots of the mandibular Incisors

Different linear movement of the crown and roots of the mandibular incisors were taken into consideration are presented in Table III. The data showed that 67% of the crowns moved lingually and 20% labially. The movement of the roots of the mandibular incisors revealed that 60% moved labially, 20% lingually and 20% showed no change. When the bodily movement of the lower incisors was taken into consideration, it was found that 17% moved lingually and 13% labially. In cases where both crowns and roots moved lingually the average lingual movement of the crown found to be twice as great as the lingual movement of the root.

Table III: Different types of the movement of the crowns and roots of the thirty mandibular incisors

<table>
<thead>
<tr>
<th>Type</th>
<th>Lingual Movement</th>
<th>Labial Movement</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown</td>
<td>20 (67%)</td>
<td>6 (20%)</td>
<td>4 (13%)</td>
</tr>
<tr>
<td>Root</td>
<td>6 (20%)</td>
<td>18 (60%)</td>
<td>6 (20%)</td>
</tr>
<tr>
<td>Bodily</td>
<td>5 (17%)</td>
<td>4 (13%)</td>
<td>-</td>
</tr>
</tbody>
</table>

D. Changes in the position of crowns and roots of the mandibular molars

The different movement of the crowns and the roots of the mandibular molars which are presented in Table IV showed that the crowns of fifty percent of the mandibular molars had a distal tipping from their original position whereas root apices of more than fifty percent of the cases acquired a position mesial to their original. Six teeth out of thirty exhibited a bodily mesial movement whereas three had a bodily distal movement.

Table IV: Linear movements of crowns and roots of the mandibular molars

<table>
<thead>
<tr>
<th>Type</th>
<th>Distal Movement</th>
<th>Mesial Movement</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown</td>
<td>15 (50%)</td>
<td>8 (27%)</td>
<td>7 (23%)</td>
</tr>
<tr>
<td>Root</td>
<td>4 (13%)</td>
<td>18 (60%)</td>
<td>8 (27%)</td>
</tr>
<tr>
<td>Bodily</td>
<td>3 (10%)</td>
<td>6 (20%)</td>
<td>-</td>
</tr>
</tbody>
</table>

E. Pre-treatment and Post-treatment overjet and overbite parameters

The mean pre-treatment and post-treatment values of overjet and overbite which are depicted in Table V showed a decrease reflecting retraction of upper and lower incisors with simultaneous bite opening.

Table V: Mean standard deviation and Level of Significance

<table>
<thead>
<tr>
<th>Cast Variables</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear (mm)</td>
<td>Mean SD SE</td>
<td>Range</td>
</tr>
<tr>
<td>Overjet</td>
<td>8.13 1.70 0.310 5-11</td>
<td>2.33 1.37 0.25 06</td>
</tr>
<tr>
<td>Overbite</td>
<td>5.73 1.80 0.33 3-9</td>
<td>1.62 1.22 0.22 06</td>
</tr>
</tbody>
</table>

F. Mean Standard Deviation and Level of Significance

The values of the mean standard deviation and level of significance of overjet and overbite which are presented in Table IV were found to be statistically highly significant, indicating that intrusion and retraction of upper and lower incisors, and extrusion of lower posteriors had taken place during the therapy.

Table VI: Mean, Standard Deviation and Level of Significance

<table>
<thead>
<tr>
<th>Cast Variables</th>
<th>Mean</th>
<th>SD</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear (mm)</td>
<td>Overjet -5.80</td>
<td>2.04</td>
<td>-15.59*</td>
</tr>
<tr>
<td></td>
<td>Overbite -4.12</td>
<td>1.62</td>
<td>-13.94*</td>
</tr>
</tbody>
</table>

G. Total Treatment Time

The mean treatment time taken to complete the treatment was 24 months. The range evaluated was from 14 months to 35 months when the cases were treated by modified Tweeds Mechanotherapy.

Discussion

Angular Measurements

Considerable improvement in the treatment results was seen when the cases were treated by modified Tweeds mechanotherapy. The results of the present study were quite comparable to the findings of Tweeds. Tweed' considered a normal value of 90° (90°-5°) in the axial
inclusion of lower incisor to its basal bone. Findings of the present study showed the mean value of IMPA after treatment of 95° with a mean difference of (-3.53°) reflecting that retraction of lower incisors has led to decrease in the value of IMPA. The findings are close to Tweed's norm of 90° and within the limit established by Kharbanda on normal North Indian adults with a mean of 102°. Marginal increase in the value of FMA angle had no significance. This could be attributed to the controlled movements of teeth with the mechanics used in the treatment. The mean value of FMA after treatment was found to be 27°. The mean difference of 0.93° in the value of FMA suggested stability of occlusal plane. These findings were comparable to the findings reported by Tweed's norms of 25°. A significant amount of increase 3.67 (p<0.05) in the value of FMIA was seen. The mean value of FMIA found to be 57° in the present study was quite low compared to Tweeds norms of 65° but in accord with the range given by Kharbanda (53°) confirming that North Indian have more proclined mandibular incisors compared to Caucasians.

A mean decrease in the value of SNA of -1.33 degree found to be statistically highly significant (p<0.05). Reduction in SNA has been achieved by closer of extraction spaces by retraction of maxillary anterior with the use of high pull headgear and Class II elastics thereby inhibiting growth of maxilla. The mean difference for angle SNB showed a marginal increase of 0.13 degree which was insignificant. These findings are in consonance with the findings reported by Gianelly indicating residual growth of the mandible in the anteroposterior direction. ANB showed a mean decrease of -2.27° and this decrease was found purely due to the reduction in the angle SNA. Similar decrease in the ANB angle was found by Carlson. These findings however could not be related with range given by Tweed (-3 to 0°) because of the racial difference, variation in skeletal pattern, growth which was almost completed in the present study, poor patient cooperation in wearing the handgear and differences in the basal jaw discrepancies of the two samples. The value of ArNa6 was found to be statistically insignificant with a mean difference of -0.17 degree. Marginal decrease in the value of ArNa6 showed that the distal tipping movement of the crown of lower mandibular molars has occurred.

Linear Measurements

An increase in the linear measurement value of 1-AP crown reflected lingual movement of the crown of the lower incisors and decrease in its axial inclination value, indicating retraction of lower anterior with a mean difference of -1.58. The root apex of the lower mandibular incisors showed a labial shift as related to its original position. These findings are in accord with the study done by FOGEL. Tweed however did not find any such change because of the torque given in the edgewise wire. An increase in the linear measurement value of 6-Ap crown after treatment was found to be statistically insignificant (p<0.05). There was distal tipping of the crown of the lower molars with shift of its root apex in the mesial direction. The present study findings showed that in fifteen out of thirty cases, crown has tipped distally confirming that sufficient anchorage preparation and bite opening was done during the treatment procedure. The root apex of the mandibular molars had a mesial shift in most of the cases indicating forward movement of teeth when subjected to Class II therapy at the time of maxillary anterior retraction. It was seen that lower molars showed strong tendency to come forward as treatment progresses in Class II cases. This is in accord with the cephalometric survey reported by Brodie. Significant improvement in the overall soft tissue profile was observed due to the reduction in the procumbency of the lips with a straightening of the total profile. The mean retraction of the upper lip found to be -1.97 and lower lip found to be -2.53 respectively with reference of the Rickett's esthetic plane following orthodontic treatment indicating patient treated by extraction of four first premolars had sufficient reduction in the procumbency of the lips, leading to an improvement in the overall facial profile of the patient.

Case Records

Overbite and overjet reduction was found to a significant level of <0.05 with mean reduction of -4.12 and -5.80 respectively. The reduction in overjet was mainly due to retraction of upper and lower incisors into the extraction spaces. High pull headgear was used for a longer period in treating these cases for retraction of incisors leading to the correction of the overjet to a significant level. Similar findings have been reported by Stoner et al. on evaluating fifty seven cases treated by Tweed. The present study findings showed the range of time taken to complete the Class II Div. 1 cases to be from fourteen months to thirty five months with a mean of twenty four months indicating sufficient decrease in treatment time when the cases were treated by modified Tweed's mecanotherapy.
The ultimate results of Class II division 1 malocclusion cases when treated with certain modifications were quite encouraging as overall malocclusion conditions including important cephalometric and dental measurements obtained were suggestive of good results and were quite comparable to the Tweed’s ideals. Some shortcomings which could be observed can be well attributed to the higher age group of children treated, limited facilities and availabilities of material, frequent change of operators in the department. In many cases the patient cooperation was poor and the appointments were not strictly maintained by them. It is claimed that even better results are possible with the given modification if more emphasis is given to the value of patient cooperation and better working conditions. A stage to stage dental and cephalometric evaluation may further reveal the important phases of treatment which may be responsible for the end results.

Conclusion

From the present study the following conclusions have been drawn:

1. An appreciable uprighting of lower mandibular incisors was achieved with lingual and labial tipping movement of the crowns and roots of the mandibular incisors reflected by a decreased in incisor mandibular plane angle. 
2. Reduction in the value of ANB angle was mainly brought about by the retraction of the maxillary incisors.
3. Sufficient decrease in overjet and overbite with marked improvement in the facial profile was seen following orthodontic treatment. 
4. Total treatment time was substantially shortened without compromising on the treatment results.

Marked improvement in the treatment results were observed. It is apparent therefore, that the compelling element in redesigning and simplifying the treatment mechanisms from the Tweeds edgewise appliance is the determined effort to uncover a useful formula which will retain the desirable qualities of edgewise appliance, decrease the total duration of the treatment without compromising on the treatment results.

Communications

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