Class II/2 malocclusion: Early treatment with removable appliances and stability after 20 years

Key words: Class II/2 – early treatment – long-term stability

Introduction

The Cl. II/2 malocclusion has been defined by Angle (1899) as having “the lower teeth occluding distal to normal, lingual inclination of the upper incisors and more or less bunching of the same” (Fig. 1). As early as the first decades of the last century, a particular resistance to therapy and a tendency to relapse of this type of malocclusion was observed, due to hereditary factors and muscle imbalance, upon which orthodontic treatment was thought to have little or no influence (Schwarz 1961; Hotz 1974a). Van der Linden (1983) showed the influence of the labial muscles as an important cause of this anomaly. Therefore, numerous authors have recommended early interceptive therapy, which allows for adequate dentoalveolar compensation with the help of the remaining available facial growth and the adaptation potential of the musculature (Litt & Nielsen 1984; Arvystas 1979).

Little has been written on the stability of this type of interceptive treatment, perhaps due to the fact that Cl. II/2 cases represent only 5–10% of all malocclusions (Sassouni 1971). The primary aim of this study was to examine long-term stability (at least 20 years out of retention) of early therapy with removable appliances.

Materials and methods

Subjects

In the author’s private practice, 1461 patients concluded orthodontic treatment from 1978 to 1985 with complete initial and final documentation (at least study models, panoramic

Summary

The Class II/2 malocclusion is a challenge in orthodontics, because of its resistance to therapy and its tendency to relapse. The aim of this study is to test effectiveness and long-term stability (at least 20 years out of retention) of early treatment with removable appliances. In the author’s practice, 44 Cl. II/2 patients were treated from 1978 to 1985 using an upper plate with an anterior bite plane and a protruding screw. Later a guide plane was added as well as an inferior splint acting as an activator. Thirty-seven patients were invited for a check-up visit in 2005 and 18 responded positively. The treatment was able to correct the malocclusion within 31–36 months, correcting the Cl. II intercuspation into a Cl. I, aligning and normalizing the inclination of upper and lower incisors and normalizing the deep bite. Little or no change was detected to ANB-angle, Wits appraisal and hypodivergency of the palatal plane-mandibular plane angle. These results were remarkably stable after 20 years, with the only exception of a minimal relapse of upper and lower anterior crowding.

Fig. 1 Typical Class II/2
radiographs and lateral headfilms). Of these, 75 (or 5.13%) were Cl. II/2 cases and 44 were treated with the method presented in this paper, while the other cases necessitated more complex therapy (e.g. severe lack of space and crowding of the lower anteriors, impacted canines, agenesis of permanent teeth, etc.). Seven patients were impossible to find. All 37 remaining patients were invited to contact the author in 2005 in order to verify the present status and to update their documentation. Eighteen agreed to participate in the study (almost 50%). This drop-out rate is in accordance with the literature (45% drop-outs after only 10 years reported by Al Yami et al. – 1999).

Therefore, a group of 18 patients (Group I) was available with initial documentation (before treatment, T0), final treatment documentation (removal of all ortho appliances – T1) and documentation taken at least 20 years later (T20) regarding the long-term stability of the final result. The remaining 26 treated patients (= 44–18; Group II), for whom we only had initial and final documentation (at T0 and T1), were evaluated for the immediate effectiveness of the treatment only.

**Treatment method**

The method of treatment was described many decades ago by European authors (Schwarz 1961b, Hotz 1974b) and is still in use (Demisch et al. 1992, Fields & Proffitt 2000). The method consists of three essential steps: 1) the protrusion of the upper incisors in order to make space for the advancement of the lower arch, 2) the opening of the bite in a vertical direction, and 3) the advancement of the lower dental arch and the protrusion of lower incisors. These changes can be obtained by using just one removable appliance, modified appropriately throughout the course of treatment.

Treatment initiates with an upper removable plate provided with a protruding screw for the incisors (Fig. 2). The thickness of the acrylic in the retroincisal area causes a rise of the occlusion (Fig. 3), often followed by spontaneous anterior repositioning of the mandible, since it is no longer distally forced by the upper incisors, as some authors assert (e.g. Thompson 1986). The screw is activated by the patient, ¼ of a turn (= 0.2 mm) every five days, until the alignment of the upper incisors and the necessary overjet are reached (Fig. 4). At this point, a guide plane (Hotz 1974b) is added using self-curing acrylic (Fig. 5), which forces the mandible into a more forward position. At the same time retention of the upper incisors causes them to protrude. If this step is not required, one can proceed directly to the “activator phase”. The guide plane is an excellent way to open the bite, as long as the appliance is worn full time, even during meals. It is important to obtain an overcorrection of the deep bite, almost to the point of achieving an open bite in order to reduce the amount of the expected vertical relapse (Fig. 6).

When the lower incisors are sufficiently protruded and when the bite is opened, the superior plate is complemented by an additional custom-made lower plate. This is trimmed bilaterally in order to obtain the correct thickness (approx. 1–2 mm above rest position) after which a layer of self-curing acrylic is applied. The two plates are placed in the mouth and the patient closes in an end-to-end position (Fig. 7). By doing so, the two united appliances become an activator (Fig. 8). The advantage of this procedure as opposed to making a new activator, in addition to reduce laboratory costs, is that the patient gets used to more easily, since the upper half of the appliance remains the same.

From this moment on, the appliance is worn only at night, in order to complete the correction of the Class II, or for retention. When a Class I occlusion is reached, the appliance is progressively reduced until complete eruption of all permanent teeth (every other night for several months, then two nights a week) and eventually discarded. Therefore there is no distinct separation between the active and the retention phase, but all periods flow into each other. In some cases the appliance was actually removed months before the final documentation, having been withheld until the eruption of the last permanent teeth. For this reason there is a difference between the duration of the treatment with appliances and the T0–T1 interval in the table. In all these cases (Groups I and II), the
results were satisfactory with no need for a second phase of treatment.

Fig. 9 demonstrates the final result. Figs. 10 and 11 depict a typical case after 23 years out of retention. Cephalometric tracings of the different treatment phases are shown in Figs. 12 to 15.

Cephalometric radiographs were all taken with the same machine and with a focus-film distance of 2 meters. The cephalometric norm values and standard deviations used were those of the “Analysis of Zürich” (Wick 1970). The ANB angle and the “Wits appraisal” (Jacobson 1975) were measured to determine the antero-posterior relationship of maxilla and man-
dible; the basal angle between palatal plane and mandibular plane expressed their vertical relationship. Upper and lower incisor inclination was related to palatal and mandibular plane. The PAR-index (RICHMOND ET AL. 1992) was used to quantify the irregularity of the dentition measured on plaster models. Since it doesn’t differentiate between the classes, but attributes 0 points in cases with excellent intercuspation in cl.I, II or III, in order to verify the effect on the Class II intercuspation, we added another measurement, called “Cl.II-mm”, which expresses the distance in mm between the mesio buccal cusp of the first maxillary molar and the buccal groove of the first mandibular molar, parallel to the occlusal plane. In a perfect Class I this measurement is 0. It becomes positive in a Class II and negative in a Class III. The mean value of the right and left side was used.

The statistical significance (P) of the difference between $T_{1} - T_{0}$ and $T_{20} - T_{1}$ values was assessed with a paired $t$ test.

The patient’s subjective perception of any given treatment is very important in orthodontics. Therefore the 18 patients in Group I were asked to answer a questionnaire with simple questions regarding the inconvenience caused by the treatment and the achieved result.

**Results**

The results are presented in Tables I–IV and Figs. 9 to 11. In both groups the treatment corrected typical features of Cl.II/2, normalizing the ANB angle, the Wits, the inclination of the upper incisors and the intercuspidation. The PAR-index, which includes also deep bite and crowding, was reduced to a nearly ideal value. Only the palatal-mandibular plane angle worsened slightly, whereas the inclination of the lower incisors was practically unchanged. 20 years later only minor changes had occurred, except for a nearly 5° relapse of the upper incisor inclination.

**Discussion**

The first interesting observation which can be derived from data is that a morphological Class II/2 is not necessarily a skeletal Class II. The average initial ANB angle for both groups was 4.08°, respectively 5.0°, showing a tendency to Class II. However, the values vary for both groups from 0.5° to 7°, ranging from cases tending towards Class III to cases of very pronounced Class II. This is confirmed by the initial Wits value, which in both groups is 0.56 resp. 1.10, with a range from –3 to + 4. All cases, by definition, had a dental Class II to start with, and the measurements on the models (Cl.II-mm) varied from 3 to 10.5 mm, that is from half to one and a half premolar widths.

From the values shown in Table II and Table III it can be concluded that the treatment corrected the dental Class II by more than 7 mm, whereas the ANB angle and Wits appraisal were only slightly modified, since they were already less deviated to start with. 20 years later, only minor changes had taken place.

In both groups, the maxillary incisors were protruded by 6°, resp. 5°, until reaching normal values, and relapsed by nearly 5° after 20 years, maintaining a gain of only 1.5°. In contrast, De Vreese et al. (2007) found a relapse of only 2.2° in 61 patients, but 3.4 years out of retention. The difference from our results could be due to our longer follow-up. The mandibular incisors, even with the action of the guide plane, migrated labially less than 1° and after the 20 year period went back to their original position.

The therapy did not have any positive influence on the hypodivergence: the palatal-mandibular plane angle worsened

<table>
<thead>
<tr>
<th>Tab.1 Age and treatment duration</th>
</tr>
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<tbody>
<tr>
<td>$T_{0}$</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Group I</td>
</tr>
<tr>
<td>Group II</td>
</tr>
</tbody>
</table>
Normal T₀ T₁ T₂₀ T₁–T₀ T₂₀–T₁ P mean SD mean SD mean SD mean SD mean SD P
ANB [°] 4 3.6 4.8 1.9 2.67 2.00 3.11 2.25 –1.41 1.51 ** 0.44 1.19 NS
Wits [mm] 0/+1 0.56 2.06 –0.83 1.79 0.94 2.65 –1.39 1.61 ** 1.77 1.76 **
Cl. II-mm [mm] 0 7.31 2.58 –0.50 1.68 1.00 1.95 –7.81 2.70 ** 1.50 2.09 *
Mx 1 [°] 109 5.64 103.44 7.69 109.72 6.16 105.00 8.51 –6.28 6.94 ** –4.72 8.14 *
Md 1 [°] 92 5.08 94.17 6.16 95.44 5.67 94.00 5.52 1.05 4.67 NS –1.44 3.80 NS
Bases [°] 28 4.03 20.39 4.84 19.50 5.80 16.78 6.21 –8.88 2.44 NS –2.72 2.88 **
PAR [–] 0/5 11.94 5.03 3.44 1.92 6.72 3.58 –8.50 4.57 ** 3.33 4.67 **

Tab. III Group II (n = 26): measurements, standard deviations and comparison of differences (t test) of cephalometric and dental variables at T₀ and T₁

<table>
<thead>
<tr>
<th>Normal</th>
<th>T₀</th>
<th>T₁</th>
<th>T₂₀</th>
<th>T₀–T₁</th>
<th>T₂₀–T₁</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANB [°]</td>
<td>4 3.6</td>
<td>5.50</td>
<td>1.29</td>
<td>3.33</td>
<td>1.71</td>
<td>–1.96</td>
</tr>
<tr>
<td>Wits [mm]</td>
<td>0/+1</td>
<td>1.22</td>
<td>1.70</td>
<td>–0.58</td>
<td>2.23</td>
<td>–1.80</td>
</tr>
<tr>
<td>Cl. II-mm [mm]</td>
<td>0</td>
<td>7.17</td>
<td>2.15</td>
<td>0.30</td>
<td>2.35</td>
<td>–6.88</td>
</tr>
<tr>
<td>Mx 1 [°]</td>
<td>104.76</td>
<td>5.92</td>
<td>109.68</td>
<td>6.16</td>
<td>4.92</td>
<td>8.63 **</td>
</tr>
<tr>
<td>Md 1 [°]</td>
<td>95.34</td>
<td>6.27</td>
<td>96.26</td>
<td>7.15</td>
<td>0.92</td>
<td>3.68</td>
</tr>
<tr>
<td>Bases [°]</td>
<td>19.69</td>
<td>4.57</td>
<td>17.89</td>
<td>4.72</td>
<td>–1.80</td>
<td>3.27</td>
</tr>
<tr>
<td>PAR [–]</td>
<td>0/5</td>
<td>14.38</td>
<td>3.71</td>
<td>3.65</td>
<td>1.14</td>
<td>–10.30</td>
</tr>
</tbody>
</table>

* = P < 0.01  ** = P < 0.001  NS = non significant

Tab. IV Group I (n = 18): number of answers to a questionnaire with subjective judgment of the received treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Actual teeth position</th>
<th>After treatment my teeth had</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very annoying</td>
<td>1</td>
<td>Excellent</td>
</tr>
<tr>
<td>Moderately annoying</td>
<td>7</td>
<td>Good</td>
</tr>
<tr>
<td>Little annoying</td>
<td>9</td>
<td>Mediocre</td>
</tr>
<tr>
<td>Not annoying</td>
<td>1</td>
<td>Bad</td>
</tr>
</tbody>
</table>

Data are also in accordance with the literature: LITTLE ET AL. (1988) found that lower anterior crowding continued to increase in an unpredictable manner even 10 to 20 years postretention, and SHAH (2003) stated that lower incisors crowding is almost inevitable, but might possibly be reduced with prolonged retention. On the other hand the upper anterior crowding showed a greater improvement and only a moderate relapse after the 20 year period (T₀ = 2.55, T₁ = 0.16, T₂₀ = 1.55) and the overbite remained surprisingly stable. In contrast, KIM & LITTLE (1999) reported a relapse of 1.4 mm 15 years postretention. Since their group had a mean age of 12.7 years at the onset of treatment, the difference could be explained by our earlier treatment.

The mean treatment time including the retention period was of 31 resp. 36 months, with 24 resp. 26 appointments. These data are in accordance with those reported in the literature for the most efficient treatments (VON BREMEN & PANCHERZ 2002). It should be noted that, according to these authors, “treatment efficiency was defined as a shorter treatment duration with a better outcome”. This definition is incomplete. It does not take into consideration the type of appliance used. It is a com-

sufficiently during the treatment time and after 20 years was further reduced by approximately 3°. Therefore, it can be argued that opening of the bite is not due to molar extrusion with mandibular rotation, but to tilting of the upper incisors and intrusion of the lower incisors (Figs. 13 and 14).

The PAR index, which exhibited a value of 11.94 resp. 14.3, was reduced by the treatment to 3.44 resp. 3.65, that is by about 71%–76%, indicating a good alignment of the arches. According to Richmond ET AL. (1992) a high treatment standard is characterized by a PAR score reduction of at least 70%, and a final score below 10 is an acceptable result; a score of less than 5 is close to perfect occlusion and alignment. Twenty years later this value moved to 6.72, which is equivalent to an improvement of 43.7%. Our data are in accordance with other studies. Al YAMI ET AL. (1999) achieved an immediate reduction of 67.1%, and 45.2% after 10 years; Von Bremen & Pancherz (2002) reported a reduction of 73%.

A separate examination of the different components of the PAR index showed that 1/3 of the regression after 20 years was due to lower anterior crowding, which became even worse than at the beginning (T₀ = 1.33, T₁ = 0.88, T₂₀ = 2.05). These data are also in accordance with the literature: LITTLE ET AL. (1988) found that lower anterior crowding continued to increase in an unpredictable manner even 10 to 20 years postretention, and SHAH (2003) stated that lower incisors crowding is almost inevitable, but might possibly be reduced with prolonged retention. On the other hand the upper anterior crowding showed a greater improvement and only a moderate relapse after the 20 year period (T₀ = 2.55, T₁ = 0.16, T₂₀ = 1.55) and the overbite remained surprisingly stable. In contrast, KIM & LITTLE (1999) reported a relapse of 1.4 mm 15 years postretention. Since their group had a mean age of 12.7 years at the onset of treatment, the difference could be explained by our earlier treatment.

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**Overall quoting of the treatment (from 1 = bad to 6 = excellent): mean value 5.44**
The one-stage early treatment with removable appliances of the uncomplicated Cl. II/2 malocclusion analyzed in this study has been shown to be simple, efficient and less a burden to the patients, with good stability for over 20 years. The stability could certainly be further improved with a long-term fixed retention in the lower anterior arch.

Résumé


Conclusion

The one-stage early treatment with removable appliances of the uncomplicated Cl. II/2 malocclusion analyzed in this study has been shown to be simple, efficient and less a burden to the patients, with good stability for over 20 years. The stability could certainly be further improved with a long-term fixed retention in the lower anterior arch.

Zusammenfassung


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