Treatment alternatives for patients with Class II division 1 malocclusion

Robert Bohlin, Andreas Bousios
Odontologiska institutionen
Karolinska Institutet

Abstract

The aims of this study were to describe and evaluate treatment alternatives for Class II: 1 malocclusions and to investigate which treatment alternatives being most often used by the orthodontists in the Stockholm and Uppsala area. Literature on available treatment methods was studied for scientific evidence, and a questionnaire was made concerning prevalence of Class II: 1 patients and treatment methods preferred by the orthodontists. The questionnaire was sent out to 50 orthodontists. 15 private orthodontists and 19 County Council orthodontists answered and returned the questionnaire. 33-37% of the orthodontists answered that 30% of their patients have a Class II: 1 malocclusion. 84-87% answered that the optimal treatment timing is 9-12 years of age. Upper proclined incisors and incompetent lips are considered the main reason for treating the malocclusion. Andresen activator is the most preferred functional appliance, but most orthodontists finalize the treatment with fixed appliances.

Aim

Class II malocclusions with an increased overjet is one of the most common malocclusions in a Caucasian population with a prevalence of 15-25%. There are several treatment options to treat Class II malocclusions. The aim of the present study was to describe and evaluate treatment alternatives for Class II: 1 malocclusions. We also wanted to investigate which treatment alternatives being most often used by orthodontists in the Stockholm and Uppsala area.

Introduction

The field of orthodontics comprises the development and growth of the face, the jaws and the development of the dentition. Diagnostics, interceptive treatment and treatment of congenital and acquired malocclusions is a part of orthodontics. The word orthodontics comes from the Greek words “ortho” which means straight and “odous” which means tooth. Orthodontic treatment is performed with fixed or removable appliances affecting the jaws and their growth in order to move the teeth into a more “ideal” position (1).

In order to describe the malocclusions, Edward Angle designed a model based on the occlusal relationship of the first molars. This was described as Angle Class I, normal relationship of the molars, Angle Class II division 1 (Class II: 1), lower molar distally positioned relative to the upper first molar with proclined upper incisors, Angle Class II division 2 (Class II: 2) with retroclined central incisors and Angle Class III, where the lower molar is mesially positioned relative to the upper first molar (2).
**Materials and Methods**

Information on different treatment possibilities for Class II: 1 malocclusions was collected from the database Pub Med, orthodontic literature from the Karolinska Institute University Library and from the Orthodontic Undergraduate course literature. In order to study the preferred treatment options a questionnaire was sent out to 50 orthodontists, asking about Class II: 1 treatment in the county of Stockholm and Uppsala. Private orthodontists as well as practitioners working for the County Councils were included in the survey. They were all telephoned in advance and informed about the project and asked to participate. All except one orthodontist accepted the questionnaire. 34 orthodontists answered and returned the questionnaire, 15 with private clinics and 19 working in the County Council clinics.

**Results from the literature search**

Class II division 1 malocclusion

**Dentoalveolar relation**

Class II: 1 is associated with proclined upper incisors or retroclined lower incisors. Different habits such as digit sucking proclines the upper incisors in a Class I and increases the overjet. The range of skeletal patterns varies and the management of increased or decreased vertical proportions is usually difficult and is referred to specialist.

Class II: 1 occurs in the presence of crowding or spacing. When the arches are crowded, the upper incisors may be crowded out of the arch labially thus worsening the overjet. On the other hand crowding in the lower arch may help to compensate the overjet in the same manner (3).

**Increased overjet**

When there is a large overjet and when the upper lips do not protect the upper incisors, this is called incompetent lip closure; the incidence of trauma to the upper central incisors is significantly increased. When the overjet exceeds 5 mm, the incidence of trauma has a prevalence of 10-30%. The greater the overjet, the greater risk of damage is to the incisors. According to the Swedish Council on Technology Assessment in Health Care 2005, it was shown that most of the traumas occur between the age of 8 and 14. The results indicate that early treatment of large overjet is beneficial in order to reduce the occurrence of incisor traumas. However, studies analyzing the outcome of possible reduction of trauma, prevalence with orthodontic means are lacking (1).

**Vertical relations**

The maxillary-mandibular plane angle in Class II: 1 could be increased or reduced. When it is reduced there is often an anterior pattern of growth rotation. In these cases the overbite is frequently deep and incomplete because of an adaptive pattern of swallowing behaviour or a
digit-sucking habit. In some cases, the maxillary-mandibular plane angle is increased which might lead to a posterior pattern of growth rotation. These patients will probably have a trend towards a vertical growth pattern. Cases with an anterior pattern of growth rotation are generally favourable because the skeletal relationship will tend to improve as well as the soft tissue pattern. Cases with signs of vertical growth and a posterior mandibular rotation have a poorer prognosis and sometimes worsen with growth (4).

Aetiology

Skeletal pattern
Class II: 1 is associated with a postnormal skeletal pattern, due to a retrognathic mandible or a prognathic maxilla.
The genetic influence is more or less pronounced and is dependent on the soft tissues.

Soft tissues
In a Class II: 1 malocclusion, the lips are often incompetent owing to the prominence of the upper incisors or/and the skeletal pattern. Soft tissues interact with the skeletal pattern, both sagittally and vertically. The resting position of the patient’s soft tissues and their functional activity plays a big part. In case of incompetent lips the patient often tries to achieve an anterior oral seal. When the patient can achieve a lip-to-lip contact by circumoral muscle activity the mandible is postured forward, and the influence of the soft tissues is to moderate or camouflage the underlying skeletal pattern.

More commonly the lower lip is drawn behind the upper incisors, which leads to a retroclination of the lower incisors and a proclination of the upper which results in worsening the incisor relationship. In cases where the tongue is habitually being pressed forward, the result is often proclined upper incisors. This soft tissue behaviour is associated with increased vertical skeletal proportions, and results in an increased overjet and anterior open bite. Class II: 1 also occurs owing to retroclination of the lower incisors by a very active lower lip.

Habits
As mentioned above, a digit-sucking habit will act as a true orthodontic force upon the teeth if it’s indulged more than a few hours a day. The severity of the habit depends on its duration and intensity (3).

Treatment options

Early treatment
There is an ongoing discussion whether to treat Class II: 1 with two-phase or one-phase therapy. Two-phase therapy begins early, in the mixed dentition with some kind of functional appliance to correct the jaw-relationship and finish with fixed appliances. One-phase therapy means that you wait until the permanent dentition is erupting and treatment of the jaw relationship and the dental malocclusion happens simultaneously or consecutively with fixed appliances. Recent studies have however shown that one-phase therapies have advantages compared to two-phase. They are as effective as two-phase treatment and requires less time.
and less costs. This must be considered by the general dentist before referring patients with Class II: 1 malocclusion to orthodontists (5).

Due to the proclined upper incisors it is thought that early treatment should prevent any kind of trauma. However, children who undergoes early treatment with some kind of functional appliances and later on completes the therapy with fixed appliances shows little difference in gaining better results compared to children who undergoes therapy with only fixed appliances during adolescence. The disadvantage is that treatment time is prolonged. Many clinicians feel that treatment is best deferred until the permanent dentition and soft tissue maturity increases the likelihood of lip competence (3).

The age is of real importance concerning facial growth. It is of great interest if facial growth is expected or anticipated, whether this is likely to be favourable or unfavourable. In an average child, forward growth of the mandible occurs during the pubertal growth spurt and in the early teens. This is an advantage in management in Class II malocclusions. However, to correct the incisor relationship in a child with vertical skeletal growth and a backward opening has a poorer prognosis for stability. This is because the anterior-posterior discrepancy will worsen with growth. In addition, an increase in lower face height will probably reduce the likelihood of lip competence at the end of treatment (3).

Functional appliances
Class II: 1 is the malocclusion that is most commonly treated with functional appliance. If the dental arches are well aligned, and the only problem is an anterioposterior discrepancy between the arches, then the functional appliance alone may be sufficient. Functional appliances are also used as the first phase in a two-phase treatment, followed by a second phase of fixed appliances. By correcting the anterioposterior problems with the functional appliance, the amount of anchorage required during the fixed appliance stage is reduced.

The idea of functional appliances is to utilize, eliminate, or guide the forces of muscle function, tooth eruption and growth to correct a malocclusion. Most of the functional appliances work by the principle of posturing the mandible forward in growing patients. They are most effective at changing the anteroposterior occlusion between the upper and lower arches, usually in patients with a mild-to-moderate Class II skeletal discrepancy. Functional appliances should be used on growing patients and, if possible, coincide with the pubertal growth spurt (6).

Removable functional appliances
There are many types of functional appliances, but most share the common feature of holding the mandible in a forward position. Every appliance should be individually tailored to the patient and their malocclusion (6).

Functional appliances can be combined with other types of appliances. In a study made on a group of patients treated with a combined headgear-activator appliance one found that overjet, molar relationship, and jaw-base relationship improved, and the mandibular incisors became less proclined. These changes were statistically significant over a 2-year period (7).
Andresen activator
Dr Viggo Andresen (1870-1950) is said to be the father of functional therapy. Based on the concept that “the function determines how the skeletal development will be” he developed the Andresen appliance, also known as an activator or monobloc. It is made of a loose fitting appliance, with no retention mechanism, which is held in place by the musculature and it forces the mandible into a forward position. In Class II: 1 cases it achieves good overjet reduction if worn 10-12 hours each day (8).

Activator and high-pull headgear combination therapy is effective in treating Class II malocclusions and improving the soft tissue facial profile. Functional therapy is of clinical benefit in actively growing patients and should be initiated during the middle to late mixed dentition period. This was seen in one study with patients with Class II malocclusions caused by maxillary prognathism and mandibular retrognathism. One patient group was treated with activator and high-pull headgear combination and a control group had no treatment. Activator and high-pull headgear combination treatment in these growing patients resulted in a correction of the skeletal Class II relationship, a restriction of maxillary growth, an advancement of the mandibular structure, an increase in lower face height, a correction of the overjet, an improvement in overbite, up-righting of the maxillary incisors and protrusion of the mandibular incisors. The study showed that dento-alveolar effects played an important role in correcting the malocclusion, but also a mandibular advancement was apparent, relative to the maxilla (9).

Another study evaluated the skeletal and dental effects of Andresen activator and activator with high-pull headgear on Class II: 1- patients. The study was made on pre- and post-treatment cephalograms and considered radiographic angles. The results showed that in both groups the maxillary prognathism was reduced. An increase of the anterior facial height and clockwise rotation of the occlusal plane was observed in the patients treated with only activator appliance. On the other hand, if using the high-pull headgear the normal forward displacement of the upper first molars was reduced significantly and the axial inclination of the lower incisors was controlled much better (10).

Twin-block appliance
The Twin Block appliance is constructed in two parts and therefore it is well-tolerated by patients. The upper and lower parts fit together using posterior bite blocks with interlocking bite planes, which posture the mandible forwards. Rapid correction is possible since the appliance can be worn full-time. It is also possible to modify the appliance to allow expansion of the upper arch. If further advancement of the mandible is required during treatment, it is easy to reactivate the twin-block appliance. One of the effects of the Twin Block appliance is posterior lateral open bites seen at the end of the functional phase. Acrylic can be trimmed away from the occlusal surfaces of the upper block to allow the lower molars to erupt. Remaining lateral open bites are closed down spontaneously or in the fixed appliance phase of treatment (6).

Twin Block is an effective appliance in Class II: 1 malocclusion subjects. It accelerates mandibular growth, helps in molar correction and overjet reduction (11).

Mills et al compared patients with Class II malocclusion treated with Twin Block appliance and untreated Class II-patients. It was shown that mandibular growth is significantly increased in the Twin Block-group in comparison with the untreated group. This increase has shown to still be present at a 3 year follow-up (12).
With the Twin Block treatment about 40% overjet correction is achieved by skeletal and about 60% by dentoalveolar changes. Correction of postnormal buccal segment is achieved by the combination of distal movement of the upper molars and forward migration of lower molars (13).

Optimal timing for Twin Block therapy of Class II disharmony, according to a short-term cephalometric study, is during or slightly after the onset of the pubertal peak. When compared to treatment performed before the peak, late Twin Block treatment produces more favourable effects that include: (1) greater skeletal contribution to molar correction, (2) larger increments in total mandibular length and in ramus height, and (3) more posterior direction of condylar growth, leading to enhanced mandibular lengthening and to reduced forward displacement of the condyle in favour of effective skeletal changes (14).

Using cephalometric reference points gives a stable baseline when assessing treatment changes. This was done in one study on 30 Class II: 1 patients treated with Twin Block and a control group generated from standard Bolton outlines. Both a statistically and clinically significant improvement in the dental base relationship due to a forward mandibular skeletal response and maxillary dentoalveolar retraction of the maxillary incisors was observed (15).

Medium opening activator
The Medium opening activator (MOA) is a one-piece functional appliance, with minimal acrylic to improve patient comfort. The lower acrylic extends lingual to the lower labial segment only, and the upper and lower parts are joined by two rigid acrylic posts, leaving a breathing hole anteriorly. There is no molar capping, so the lower posterior teeth are free to erupt. The MOA is therefore useful when trying to reduce a deep overbite (6).

Teuscher activator
In some cases it has been seen that the activator treatment increases posterior maxillary vertical height, which results in a backward rotation of the mandible. It has also been seen that the activator inhibits the horizontal anterior growth of the maxilla by as much as 2 mm. The unwanted vertical effect of the activator caused Ulrich Teuscher to advocate the use of high pull headgear together with the activator to counteract the undesired maxillary side effect. Teuscher claimed some success using the headgear-activator (Teuscher appliance). There are, however, very few scientific reports in the literature of the effects of this type of appliance (16).

A study was performed to evaluate skeletal, dentoalveolar, and soft tissue profile changes with activator and high-pull headgear combination therapy in patients with Class II malocclusions caused by maxillary prognathism and mandibular retrognathism. Activator and high-pull headgear combination treatment in these growing patients resulted in a correction of the skeletal Class II relationship, a restriction of maxillary growth, an advancement of the mandibular structures, an increase in lower face height, a correction of the overjet, an improvement in overbite, up righting of the maxillary incisors, protrusion of the mandibular incisors, and a correction of the dental Class II malocclusion. The soft tissue profile changes were a correction of facial convexity, and an increase in lower anterioposterior, and lower vertical soft tissue dimensions. The mentolabial fold depth was also significantly decreased. The activator and high-pull headgear combination appliance was effective in treating growing patients with maxillary prognathism, mandibular deficiency, and facial convexity by a
combination of skeletal and dentoalveolar changes and improvement in the soft tissue facial profile (9).

Bionator
Originally, the Bionator was designed to modify tongue behaviour, using a heavy wire loop in the palate. The lack of acrylic in the palate makes the Bionator easy to wear. The cheeks are held out of contact with the posterior teeth with a buccal extension of the labial bow, which allows some arch expansion (6).

When comparing the Twin Block and Bionator appliances, it has been shown that they are both effective in correcting molar relationships and reducing overjets in Class II: 1 malocclusion subjects. However, the Twin Block was more efficient than the Bionator in the treatment of Class II: 1 (17).

Bass Activator
Bass Activator has an acrylic pelott that causes the proprioceptors of the anterior lingual surface of the alveolar process to hold the mandible in a forward position.

Fixed functional appliances

Herbst appliance
The Herbst appliance is a fixed functional appliance often used in combination with fixed appliances. One section is attached to the upper posterior segment teeth and the other section is attached to the lower anterior segment teeth. These sections are joined together by a rigid arm that postures the mandible forwards. It removes most compliance factors since it is a fixed appliance. The Herbst appliance is as efficient as the Twin Block appliance. However, it is slightly better tolerated since most patients find it easier to eat and talk with the Herbst appliance in place than with the Twin Block. The two main disadvantages with the Herbst appliance are the frequent breakages and higher cost (6).

The correction of Class II dental relationships can be achieved through dentoalveolar changes, orthopaedic forces to inhibit maxillary growth and orthopaedic forces to stimulate mandibular growth. The Herbst appliance is reported to combine these effects in order to achieve Class I dental relationships. Its bilateral telescopic arms work as an artificial joint to force the mandible into continuous protrusion. The Herbst’s increasing popularity stems, most likely, from the high degree of control it provides the clinician, as patient cooperation is not required.

Herbst treatment in the mixed dentition, in combination with retention, produces significant long-term improvements in dental and skeletal relationships as a result of dentoalveolar changes and orthopaedic effects in both jaws (18).

In one study treatment outcome was compared on 18 pairs of boys that were matched for growth period at the time of therapy, with similar pre-treatment sagittal and vertical jaw base relationship. They were treated with Herbst or Bass respectively. After 6 months of treatment the Bass appliance seemed to have a greater effect on mandibular jaw base position. In the Herbst patients the correction of overjet and sagittal molar relationship was more complete.
The patients showed a great individual variation of growth. This seems to be a likely explanation to why at long-term follow-up at the end of growth it was hard to show any pronounced differences in the treatment effect of Herbst and Bass. However, the restraining effect on the position of the maxilla was somewhat more pronounced in the Bass sample (19).

**Forsus**
The Forsus is essentially a Eureka Spring, which is an interarch compressive spring. It consists of an internal spring that transmits a distalizing force to the maxillary dentition and an equal and opposite mesializing force to the mandibular teeth. Compared to Herbst and Jasper Jumper the risk of breakage with this appliance is significantly reduced (20).

**Jasper Jumper**
The Jasper Jumper is a modification of the Herbst appliance. It has a flexible force module which allows the patient greater freedom of movement. As with the Herbst appliance, the Jasper Jumper resorts to pushing forces and the key element is repetitive forward posturing. The treatment response is divided almost equally between basal and dental effect. On average, a 2-mm increase in mandibular length occurs while only little maxillary skeletal change has been noted. The most pronounced dentoalveolar change with the Jasper Jumper is a relative posterior movement of the maxillary buccal segments of about 2.5 mm and a proclination of the lower incisors (21).

**Molar distalizer**

**Pendulum**
The Pendulum appliance is a fixed intra-arch appliance which consists of a large acrylic Nance button resting on the anterior palate. This button is used for anchorage and serves as an attachment for two posteriorly extending arms. Activation by attaching the free ends into lingual sheaths on the molars creates a distalizing component force. Movement is rapid, so it is not uncommon to observe a 1 to 2 mm space mesial to the first molar within 6 weeks of insertion. Once the molars are distalized, the orthodontist constructs a new Nance button attached to the molars and retracts the premolars and anterior teeth using the newly positioned molars and Nance button as anchorage. The Pendulum is most effective before the maxillary second molars have erupted and it is readily adapted to a phase I treatment plan (20).

**The Carrière Distalizer**
The Carrière Distalizer is a new treatment method for Class II malocclusions. The main purpose of the Carrière Distalizer is to provide a rotation movement of the maxillary first molars around their palatal root and at the same time receive a distalization impulse resulting in bodily distal movement with full time Class II elastics. The Carrière Distalizer is a metallic arch that is bonded to the first maxillary molar and the maxillary canine. The ClassOne Platform is of strategic importance in simplifying the orthodontic treatment and is the reference position to be achieved as the first priority at the first stage of a treatment. From this point on, every malocclusion is much easier to treat and can be finished with any orthodontic technique preferred. Since there are no competing forces in the mouth with this appliance, average Class II correction can be achieved in only 4 months according to the manufacturer. Patients usually accept the Carrière well with its simple design, and the compliance rate is
quite high. The purpose is to use it during the first 3 to 6 months of the treatment period. Another benefit for the patient is that the upper incisors are left without any appliance in the maxilla and an invisible lower lingual arch or Essix is placed in the mandible for anchorage, making the acceptance of the appliance very good. After distalization fixed appliance is placed and the use of Class II elastics continues (22).

**Late treatment**

Ideally, treatment of Class II: 1 should start in the late mixed dentition or early permanent dentition before growth peak and with erupting premolars. At that age there is still plenty of growth left, it is not possible to complete a full course of orthodontic treatment before the premolars and second permanent molars have erupted at dental age 12 or 13 years. There are evidence that treatment at this stage is more efficient, with a shorter treatment time, compared to early treatment at age 8-10 (23).

**Fixed appliances**

**Class II elastics**

Most often, in the contemporary comprehensive orthodontic therapy, the main therapy for Class II: 1 is fixed appliances. The overbite correction is a prerequisite for the decrease of the overjet. Initial alignment is usually obtained by the use of light, round arch wires attached to brackets that have been bonded to the teeth. Initially nickel/titanium alloys are used for the arch wires. The use of flexible wires provide light and continuous forces followed by progressively stiffer in a sequential way until continuous steel wires can be placed, without generating excessive forces. The mandibular teeth need to slide forward and the maxillary teeth need to slide backwards in response to the horizontal force from the Class II elastics. (24)

Class II elastics is the term used to describe intraoral traction between points of attachment at the anterior part of the maxillary arch to the mandibular posterior teeth. This method is intended to deliver an anterior force to the mandibular teeth and a posterior force on the maxillary teeth. Indication for the use of Class II elastics is when anterior movement of the mandibular teeth is desired and rotation of the occlusal plane, with extrusion of the mandibular molars and maxillary incisors can be accepted. It is more favourable to use Class II elastics when the skeletal jaw discrepancy is moderate and the lower incisors are not too proclined due to dental compensation. In a Class II: 1 malocclusion it is more favourable to use Class II elastics when the incisors initially are retrusive (24)

One way to achieve movement of a single tooth or a group of teeth is through the use of Begg appliance, which is a round wire that fits loosely at the top of the bracket. Apical and rotational movement is achieved by means of auxiliary springs or by loops placed in the arch wire (25).
Anchorage – Mini Screws

When using appliances, fixed as well as removable, it is important to have anchorage, in order to avoid unwanted tooth movement. This unwanted tooth movement occurs as a result of Newton’s Third Law – every action has an equal and opposite reaction. Anchorage can be created through the use of a head gear, transpalatal arches, intermaxillary elastics, or skeletal anchorage. The principle of osseointegration as described in 1977 by Brånemark is what skeletal anchorage is based on. A way to create skeletal anchorage is the use of miniscrews. These are small screws that are inserted into the jaw (upper or lower). However most of the mini screws now used is not osseointegrated. Mini screws can be loaded immediately after insertion. Most of them feature a special head to accommodate orthodontic force systems or wires. The advantages of miniscrews are for example: simple insertion technique, relative affordability, application in various anatomical areas. Potential disadvantages are: rotational instability, screw migration, screw fracture upon removal, mucosa irritation or overgrowth, and the danger of injury to the root of the tooth when inserted interdentally. One recent study established a cumulative success rate of 86%. It is assumed that application of skeletal anchorage devices such as miniscrews is associated with a learning curve, and that the success rate will increase as the user gains experience. (26)

Surgery

In adult patients a severe Class II: 1 relation can not be solved with only orthodontics. Also, a stable aesthetic orthodontic correction may not be possible in patients with an unfavourable skeletal pattern anteroposteriorly and/or vertically. In these cases surgery may be necessary. A phase of pre-surgical orthodontics is required to align the teeth and remove dental compensation like proclined lower incisors and retroclined upper incisors. However, arch levelling is usually not completed as extrusion of the molars is much more easily accomplished after surgery. Where the overbite is particularly marked, the lower labial segment may have to be set down surgically, in which case space will have to be created distal to the lower canines for the surgical cuts to be made.

A combination of surgery and orthodontics is required in adults with a markedly increased overbite and those patients where the underlying skeletal pattern is more markedly Class II (27).

Retention and stability

Soft tissues play a major role of stability following an overjet reduction. If the upper incisors are being retroclined and a lip-trap is avoided the lips will be competent and it’s less likely for the incisors to relapse.

No treatment

In cases where the over jet is slightly increased, the arches are not significantly crowded and the aesthetics acceptable, it may be prudent to accept the malocclusion.
The incisor relationship is to be accepted
In cases there the lower incisors occlude onto tooth tissue it may be possible to accept the increased overbite, limiting treatment to alignment, particularly of the upper lateral incisors (3).

Studies evaluating and comparing different types of treatment of Class II malocclusions with increased overjet
In one study a special headgear-Herbst appliance was designed and used for a 5 month intensive treatment in a group of patients in the very early mixed dentition. The findings from this treatment period was compared to a control group and showed dramatic effects of treatment. After a 10-month post treatment period a new comparison was made, where a tendency to relapse was observed. In conclusion it is claimed that a short period of interceptive orthopaedic treatment in the very early mixed dentition may be indicated to correct skeletal deviations to establish competent lip closure and a normal relationship between the maxilla and the mandible. Treatment can then be followed by a period without appliance wear until final dentoalveolar adjustments, if necessary, are made in the permanent dentition (28).

In one study dentofacial morphology was compared and long-term follow-up changes in growing males with skeletal Class II malocclusions treated without extractions and with either Begg or Herbst appliances. Treatment effects differed between the groups, with usually more favourable effects in the Herbst group. However, during the follow-up period, many of the changes were reversed. During the total observation period, maxillary prognathism and lower anterior facial height increased more in the Begg group than in the Herbst group. Although there were initial marked differences in the treatment outcomes, most of these differences were not sustained over the longer term (29).

Mossaz et al compared two types of treatment for Class II molar relation, cervical head gear and pendulum appliance. Both of the treatments were followed by fixed edgewise appliance. Although the patients with head gear experienced better maxillary restriction, the pendulum is a good alternative for non-compliant patients with moderate skeletal discrepancy and more predictable in an early stage. Meanwhile treatment time was longer with pendulum compared with head gear after the fixed appliances (30).

One study compared treatment outcomes on 18 pairs of subjects that had been treated with Bass appliance or Herbst appliance respectively. After six months of treatment the Bass appliance seemed to have a greater influence on mandibular jaw base position than the Herbst appliance, although no statistical significant differences existed between the treatment groups. The correction of overjet and sagittal molar relationships was more complete in the Herbst than in the Bass patients. This was due to greater dental changes (distal movement of the maxillary molars, proclination of the mandibular incisors) taking place in the Herbst subjects (31).

In most cases early treatment means two-phase treatment. Tulloch et al carried out a study where they first compared treatment outcomes of early (preadolescent) versus later (adolescent) treatment outcomes in children with severe (>7mm overjet) Class II malocclusions. Both groups received treatment with either a headgear or a functional appliance. Favourable growth changes were observed in about 75% of those receiving early treatment. After a second phase of fixed appliance treatment for both previously treated
children and untreated controls, early treatment had little effect on the subsequent treatment outcomes measured as skeletal change, alignment, and occlusion of the teeth, or length and complexity of the second treatment. The differences that appeared by phase 1 treatment before adolescence, between the treated children and untreated control group, disappeared when both groups received comprehensive fixed appliance treatment during adolescence (32).

When records taken before and after treatment and a mean of 14.0 years post retention of adolescent patients treated for a significant Class II: 1, in a study, a relapse of 0.5mm for overjet and overbite was observed. The mode response for molar, premolar, and canine relationships was no change. The patients in the study were treated with active appliance therapy with and without tooth extraction. Conclusively, successful correction of Class II: 1 through differential growth adaptation and tooth movement appears to be very stable (33).

Priority index

In orthodontics as in other divisions of the health care system treatment cannot be given to meet with the total demand for treatment due to limited resources. In order to manage the demand of treatment, the Swedish Dental Law (Tandvårdslagen) prescribes that only “malocclusions with functional disturbance, risk for damages to teeth and surrounding tissues or that causes serious psychological stress to the individual, should be treated without charge by the Public Dental Services.” The agreement is that about 25% of an age group receives free orthodontic care up to the age of 20 years. In an attempt to limit the necessary orthodontic care the County Councils use different kinds of priority index. The purpose is to select the individuals with the greatest need. The morphological priority index is based on the conception that some malocclusions have some risks. The indexes can be both morphological and aesthetical (1).

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<th>Domain</th>
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<td>HLD, Handicapping Labio-Lingual Deviation Index, USA</td>
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Results

Here are the results from the survey. The results from most of the questions are presented in tables and graphs, but in some cases a table only was considered illustrative enough. For the last question, a wide variety of answers were given, hence a summary of the answers was made.

1. Do you work as a private practitioner or at a county council?

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<td>County Council</td>
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2. How long have you been working as an orthodontic specialist?

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<td>a. 0-5 years</td>
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<td>31% (6)</td>
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<td>b. 6-10 years</td>
<td>6% (1)</td>
<td>10% (2)</td>
</tr>
<tr>
<td>c. 11-15 years</td>
<td>20% (3)</td>
<td>5% (1)</td>
</tr>
<tr>
<td>d. 16-20 years</td>
<td>27% (4)</td>
<td>10% (2)</td>
</tr>
<tr>
<td>e. More than 20 years</td>
<td>20% (3)</td>
<td>31% (6)</td>
</tr>
</tbody>
</table>
3. How large amount of your patients are treated for postnormal malocclusions Angle Class II: 1?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 5 %</td>
<td>0 % (0)</td>
<td>0 % (0)</td>
</tr>
<tr>
<td>b. 10 %</td>
<td>7 % (1)</td>
<td>16 % (3)</td>
</tr>
<tr>
<td>c. 15 %</td>
<td>27 % (4)</td>
<td>21 % (4)</td>
</tr>
<tr>
<td>d. 20 %</td>
<td>33 % (5)</td>
<td>26 % (5)</td>
</tr>
<tr>
<td>e. 30 %</td>
<td>33 % (5)</td>
<td>37 % (7)</td>
</tr>
</tbody>
</table>

4. When do you think a postnormal malocclusion, with a large overjet >6 mm and incompetent lip closure, should be treated?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 0-6 yrs of Age</td>
<td>0 % (0)</td>
<td>0 % (0)</td>
</tr>
<tr>
<td>b. 6-9 yrs of age</td>
<td>13 % (2)</td>
<td>0 % (0)</td>
</tr>
<tr>
<td>c. 9-12 yrs of age</td>
<td>87 % (13)</td>
<td>84 % (16)</td>
</tr>
<tr>
<td>d. Older than 12 yrs of age</td>
<td>20 % (3)</td>
<td>26 % (5)</td>
</tr>
</tbody>
</table>
5. What should determine the treatment need for postnormal malocclusions? (multiple answers can be given)

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Proclined upper inc.</td>
<td>80% (13)</td>
<td>84% (16)</td>
</tr>
<tr>
<td>b. Great overjet</td>
<td>40% (7)</td>
<td>16% (3)</td>
</tr>
<tr>
<td>c. Incomp. lip closure</td>
<td>93% (15)</td>
<td>95% (18)</td>
</tr>
<tr>
<td>d. Aesthetical unsatisfaction</td>
<td>60% (9)</td>
<td>63% (12)</td>
</tr>
<tr>
<td>e. Other</td>
<td>27% (4)</td>
<td>5% (1)</td>
</tr>
</tbody>
</table>
6. Which priority index do you use?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. IOTN</td>
<td>7 % (1)</td>
<td>16 % (3)</td>
</tr>
<tr>
<td>b. Socialstyrelsen</td>
<td>53 % (8)</td>
<td>84 % (16)</td>
</tr>
<tr>
<td>c. Other</td>
<td>0 % (0)</td>
<td>0 % (0)</td>
</tr>
<tr>
<td>d. None</td>
<td>40 % (6)</td>
<td>0 % (0)</td>
</tr>
</tbody>
</table>

7. Do you find that priority indexes are in agreement with the actual treatment need in patients with postnormal malocclusions?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Yes</td>
<td>40% (6)</td>
<td>63% (12)</td>
</tr>
<tr>
<td>b. No</td>
<td>53% (8)</td>
<td>37% (7)</td>
</tr>
<tr>
<td>c. Other</td>
<td>7% (1)</td>
<td>0% (0)</td>
</tr>
</tbody>
</table>
8. Do you use any type of functional appliance to treat a postnormal malocclusion or do you only use fixed appliances?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Yes I use functional appl.</td>
<td>100% (15)</td>
<td>84% (16)</td>
</tr>
<tr>
<td>b. No I do not use functional appl.</td>
<td>0% (0)</td>
<td>16% (3)</td>
</tr>
</tbody>
</table>

9. If affirmative question 8, what type of functional appliance do you use?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Andresen activator</td>
<td>80% (12)</td>
<td>37% (7)</td>
</tr>
<tr>
<td>b. Twin Block</td>
<td>40% (6)</td>
<td>16% (3)</td>
</tr>
<tr>
<td>c. Herbst</td>
<td>40% (6)</td>
<td>42% (8)</td>
</tr>
<tr>
<td>d. Bionator</td>
<td>13% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>e. EOD</td>
<td>20% (3)</td>
<td>21% (4)</td>
</tr>
<tr>
<td>f. EOD+something above</td>
<td>40% (6)</td>
<td>53% (10)</td>
</tr>
<tr>
<td>g. Other</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
</tbody>
</table>

10. What is the main reason for your choice of treatment with functional appliances?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Well supported by studies</td>
<td>20% (3)</td>
<td>10% (2)</td>
</tr>
<tr>
<td>b. Economy</td>
<td>0% (0)</td>
<td>5% (1)</td>
</tr>
<tr>
<td>c. Clinical experience</td>
<td>80% (12)</td>
<td>79% (15)</td>
</tr>
<tr>
<td>d. Compliance</td>
<td>20% (3)</td>
<td>5% (1)</td>
</tr>
</tbody>
</table>
11. If answered negative on question 8, why not?

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>County council</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Compliance</td>
<td>0% (0)</td>
<td>16% (3)</td>
</tr>
<tr>
<td>b. Time effort</td>
<td>0% (0)</td>
<td>5% (1)</td>
</tr>
<tr>
<td>c. Fixed appliances better</td>
<td>0% (0)</td>
<td>16% (3)</td>
</tr>
<tr>
<td>d. Other</td>
<td>0% (0)</td>
<td>37% (12)</td>
</tr>
</tbody>
</table>

a. Well supported by studies: 20% Private, 0% County
b. Economy: 10% Private, 0% County
c. Clinical experience: 80% Private, 76% County
d. Compliance: 20% Private, 5% County
e. Recommendations: 0% Private, 5% County
12. What type of fixed appliances do you use to correct postnormal malocclusions?

Most of the orthodontists answered that they only used Class II traction, 53% of the private and 47% of the County Council orthodontists did so. Others used a combination of Class II traction and other orthodontic appliances such as the Herbst appliance, Forsus, Carrière Distalizer, high-pull headgear and by use of Damon appliance.

Discussion

Treatment of postnormal malocclusion division 1 can be accomplished in many ways; one-phase or two-phase treatment, with functional appliances, fixed appliances or a combination of the two. There is an ongoing discussion whether to treat a Class II: 1 early or late. An early treatment demands a great deal of cooperation from the patient and their parents, since they always have to have in mind wearing removable orthodontic appliances. The early treatment will in most of the cases be followed by a period with fixed appliances, where the malocclusion will ultimately be treated. A late one-phase treatment will only involve fixed appliances with less or even no need of patient cooperation. The treatment time will be noticeably shorter compared to two-phase treatment and the treatment results will be more or less the same. Fixed orthodontic appliances are also necessary when bodily movement of the teeth is indicated. (34)

Concerning the questionnaire that we handed out to the orthodontists, it showed some interesting answers. Most of the orthodontists in the County Council have been working less than 5 years or more than 20 years. The trend of how long private orthodontists have been working is more even spread over 0-20 years.

The answers concerning the amount of patients treated with Class II: 1 malocclusion is indicating that 33% of the County Council orthodontists have patient groups with Class II: 1 consisting of both 20% and 30% of the total amount of patients. Private practitioners have Class II: 1 patients taking 30% of their patient amount.

Whether Class II: 1 should be treated early or late, the questionnaire showed that most orthodontists preferred early treatment starts. 87% of the private and 84% of the County Council orthodontists agree that the most suitable age of treatment is from 9-12 years of age, i.e. in the mixed dentition, which means that the majority of the orthodontists treat Class II: 1 with two-phase therapy (5). Treatment timing has been debated for a long time. According to SBU 2005, most traumas to the upper incisors occur between age 8 and 14, which speaks in favour of early treatment. Another factor that often speaks in favour of early treatment is the child’s parents. They are often concerned and want early treatment (3). So what are the advantages of early treatment? From what we found in the literature, the main indications for early treatment are: risk of trauma and aesthetical (psychosocial) (1). Early treatment produces no reduction in the average time for the second phase with fixed appliances during a two-phase treatment (32). The mean time for treatment is much shorter if only one-phase treatment is used, with fixed appliances. (3)

It seems, however as though most factors are in favour of one-phase treatment of Class II: 1, i.e. the treatment is deferred until the eruption of the secondary dentition, because this is most convenient for the patient, takes less time and costs less money than two-phase treatment, and the end result is as good as with two-phase treatment (23, 5, 3, 32). According to Wieslander
Robert Bohlin, Andreas Bousios

one can make a first phase of the treatment in the early mixed dentition, short and intensive to
correct skeletal deviations, and then let the patient have a period of time without appliance
wear. If necessary, one can then make dentoalveolar adjustments in the permanent dentition
(28). Researches have shown similar results.

20% respectively 26% of the private and county council orthodontists have answered that
most treatment should be awaited after the age of 12. This is favourable because then all
permanent teeth have erupted and the patient is older and can express their own views on
whether they want to undergo orthodontic treatment or not.

The most important reasons for treating a Class II: 1 malocclusion according to the answers is
obviously proclined upper incisors and incompetent lip closure. Over 80% of the
orthodontists chose this answer and over 93% respectively 95% incompetent lip closure. This
is also mentioned in SBU 2005. The other answers showed that great overjet and aesthetic
unsatisfaction also is of great importance in treating the malocclusion. Some orthodontists
mentioned other reasons for treating Class II: 1 malocclusion, such as deep overbite.

Concerning the matter of priority index, a great majority is working with index given by the
Socialstyrelsen (The National Board of Health and Welfare). Only 16% of the county council
orthodontists worked with the index of IOTN, whereas 40% of the private practitioners did
not use any kind of index. This might be because the decisions whether or not a patient should
receive treatment free of charge or not is usually taken by an orthodontist from the County
Council, hence private orthodontists do not for economical reasons need to use any kind of
priority index. In the index given by Socialstyrelsen incompetent lips is not even mentioned
as a reason for treatment and proclined incisors is mentioned as a treatment need of 2 out of 4.
On the matter if the orthodontists considered the priority index to be in agreement with the
actual treatment need in patients with postnormal malocclusions, we could not see any trend.
Two thirds of the county council orthodontists’ states that they do, while only 39% of the
private orthodontists say it does.

It was interesting to see that all of the private practitioners stated that they use functional
appliances for their treatment of Class II: 1, while 84% of the County Council used functional
appliances. The other remaining 16% who did not use functional appliances indicated reasons
as patient compliance in 16%, time effort in 5% and a consideration that fixed appliances is
better in 16%. The degree to which functional appliances are tolerated by the patients varies
as does the degree to which the patient cooperates in the treatment. Most functional
appliances are dependent on the patients’ cooperation. Twin-block might be easier for the
patient to tolerate than, for example the Andresen activator, since it is in two-parts (3), and
although it has not been around for as long as the Andresen, several studies have shown good
results in outcome of treatment with Twin-block (11, 12, 25). The Herbst appliance was quite
commonly used both in the County councils as well as by private practitioners. It is as
efficient as Twin-block, and it removes most compliance factors since it is a fixed appliance.
One might wonder if it is mainly economical factors or the risk of breakage that explains why
Herbst is not more commonly used (6). Twin-block works through both skeletal (40%) and
dentoalveolar (60%) changes (13). Herbst is also said to work through both of these types of
changes and so is Andresen and high pull headgear (9, 18). Can one assume that the other
functional appliances work in the same way? Most of the functional appliances demand a
great deal of compliance and that is one of the main reasons why many of the orthodontists do
not use functional appliances, as they answered in the questionnaire.
Concerning the matter of what kind of functional appliance the orthodontist used, a majority (80%) of the private practitioners used Andresen activator. This is not surprising since Dr Viggo Andresen from Norway was the one who introduced the concept of functional appliance into the field of orthodontics and hence the Andresen activator is the type of functional appliance which has most studies to support its effect (8). In the County Councils EOD together with another functional appliance was most commonly used. According to literature, there are several advantages of combining EOD with another type of functional appliance i.e. forward displacement of the upper first molars is reduced and the axial inclination of the lower incisors is better controlled (10). Activator treatment alone has the side effects that it increases posterior maxillary vertical height, resulting in a backward rotation of the mandible. Using a high pull headgear together with an activator counteract these side effects (16). Bionator wasn’t used at all in the County Councils, and barely by private practitioners (13%). Both Bionator and Twin-block are fairly easily accepted by patients, but it has been seen that Twin-block is more efficient than Bionator in treating Class II: 1 (17). When choosing Twin-Block as a therapy the dentist should keep in mind that optimal time is during or slightly after pubertal peak (14). Most of the orthodontists, both private practitioners and those working for the County Councils claimed that they base their choice of functional appliance mainly on clinical experience. A good treatment outcome can apparently be achieved in several ways. It seems as though the choice of functional appliance is more a matter of the orthodontist’s preferences and experience than it is a matter of large differences in the effect of the different types of functional appliances. If used correctly most types of functional appliances seem to be able to produce just about the same result (6, 29, 31, 19). Functional appliances practice its function when optimal treatment timing is chosen.

The reasons why orthodontists mentioned they did not use functional appliances are mainly that functional appliances require compliance and that they consider fixed appliances to be better. Only one answered time effort as a reason for not using functional appliance.

All of the orthodontists used Class II traction when treating the malocclusion with fixed appliances. 53% of the private and 47% of the County Council used only fixed appliances with Class II traction, whereas the rest used fixed appliances in conjunction with other appliances such as Herbst, Carrière Distalizer, Forsus, high-pull headgear.

Treatment options for Class II: 1 malocclusions are multiple and a good and stable result seems to be achievable in most cases. There is no such thing as a standard treatment for a Class II: 1 malocclusion. Several factors have to be taken into consideration, such as the patient’s age, level of compliance and presence of other malocclusions. Preferences by the orthodontist also play a role in the choice of treatment.

Acknowledgement

We wish to express our gratitude to our supervisor Lena Berglund-Stevenberg for all her help and support. We would also like to thank the personnel from the department of Orthodontics who helped us with different matters.
References

1. SBU 2005 - Bettavviksel och tandreglering i ett hälsoperspektiv.


