Abstract:
Functional appliances intended to alter mandibular growth play a major role in growth modification treatment. Various factors like timing of treatment, case selection, patient compliance and appliance selection contribute in determining the success of treatment. Dentists have varied thoughts on the selection and timing of treatment in functional appliance therapy. This article highlights all these factors for a successful functional appliance therapy. The special indicators for early treatment will undoubtedly be clarified as further data become available and as conclusions based on data replace clinical opinions can be the basis for determining treatment.

Key words: Class II malocclusion, growth modulation, functional appliance, patient compliance, timing of treatment.

INTRODUCTION
Functional appliances form the main stay for treatment of mandibular deficiency in growing children. In the early years of the 20th century, it was all but taken for granted that pressure against the growing face could change the way it grows. Extra oral force to the maxilla (Head gear) was utilized by the pioneering American orthodontists of the late 1800s, who found it reasonably effective. Later Angle and his contemporaries thought that Class II elastics would cause the mandible to grow forward and that this would produce an easier and better correction.

At a later stage in the United States, guide planes consisting of a wire framework were used to force patients to advance the mandible upon closure also with idea of stimulating mandibular growth. Growth stimulation can be defined in two ways viz.,

1. The growth attainment of a final size larger than would have occurred without treatment
2. The occurrence of more growth during a given period than would have been expected without treatment.2

The requirement for treatment success can be summarized into four areas of focus.
1. The timing of treatment
2. Case selection
3. Patient compliance
4. Appliance selection

Dentists in general practice have wide ranging thoughts on the selection and timing of treatment in functional appliance therapy. The objective of this
article is to highlight the factors to obtain consistent good results from functional appliance in treating Class II div I malocclusion.

**TIMING OF TREATMENT**

It is not logical to favor early treatment at age 8 – 10 years only for growth reasons because there is plenty of mandibular growth still available at age 11-13 years. Growth studies give only average values for the amount, direction and timing of growth but there is wide variation among individuals. It is recommended to start treatment in the late mixed dentition at dental age 11-12 years with entire correction being accomplished in one treatment.

Von Bremen and Pancherz investigated the efficiency of early versus late Class II div I treatment in a group of 204 patients. They concluded that the treatment of Class II div malocclusion is more efficient in permanent dentition than it is in the mixed dentition.

Bondevik reported greater treatment success with increasing age of the patient. The mean age in the group with satisfactory treatment result was 11.95 years, while the mean age in the unsatisfactory group was 10.87 years. This suggests that the treatment results were better with late treated cases.

In 2004, Tulloch and coworkers published the outcomes from an important 10 year study on 137 patients in a prospective randomized controlled trial. Their findings suggested that early and late treatment started before adolescence in the mixed dentition might be no more clinically effective than the treatment started during adolescence in the early permanent dentition. They also noted that early treatment appeared to be less efficient because it produced no reduction in the average time with fixed appliance.

In 2005, Hsich and coworkers investigated 512 consecutive patients and found that it was inefficient to start treatment in the mixed dentition with early treatment objectives or to start treatment before the age of 10 years in males and 10.5 years in females.

The disadvantages of early treatment included prolonged treatment time, increased patient/parent burn out and a worse incidence of compromised treatment outcomes. In spite of these disadvantages, in few individuals an early start of treatment can be considered such as social or psychological reason or risk of enamel damage.

**CASE SELECTION**

The literature and clinical experience suggest that there are five main considerations when selecting an ideal case for functional appliance treatment.

1. Class II malocclusion with an overjet up to about 11 mm and a deep overbite.
   The functional appliance is essentially a method of reducing the overjet and overbite in Class II div I malocclusions to resume in the growing individual. If the overjet is more than 11 mm, it may not be possible to bring the upper incisor into lip control, unless an unusual amount of mandibular forward growth occurs or the upper incisors are allowed to become unacceptably retroclined. Clinical experience suggests that low angle deep bite cases respond well to treatment, producing notably favorable facial change especially among boys.

2. A horizontal skeletal pattern
   The Class II pattern may be assessed by the following methods
   - Measurement of ANB angle (cephalometrically)
   - The Wits appraisal (cephalometrically)
   - Incisor torque correction (cephalometrically)
   - Mandibular protrusion (clinically – VTO)

3. A vertical skeletal pattern
   More favorable treatment result can be seen if the mandibular plane angle is 28° or less.

4. Generally well aligned dental arches with little or no crowding case will have favorable result.

5. A growing patient with a cooperative attitude.
**PATIENT COMPLIANCE AND MOTIVATION**

Compliance with wearing the appliance is essential to get early overjet reduction and it is achieved in three ways.

  - By carefully explaining the treatment details to the child and parents to motivate them
  - By ensuring the advantages of the appliance
  - By scheduling at least 15 minutes in each visit and not squeezing in appointments because it is a removable appliance.

**APPLIANCE SELECTION**

The various functional appliances being used in the treatment of Class II malocclusion are broadly classified into removable and fixed functional appliances.

*Removable functional appliances*  

The removable functional appliances being used till date are enumerated in the following table.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Pioneered by</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bite plate</td>
<td>Norman Kingsley</td>
<td>1879</td>
</tr>
<tr>
<td>Mono bloc</td>
<td>Pierre Robin</td>
<td>1902</td>
</tr>
<tr>
<td>Activator</td>
<td>Viggo Anderson</td>
<td>1908</td>
</tr>
<tr>
<td>Bionator</td>
<td>Balters</td>
<td>1956</td>
</tr>
<tr>
<td>Functional regulator</td>
<td>Frankel</td>
<td>1966</td>
</tr>
<tr>
<td>Palatal free activator</td>
<td>Metzelder</td>
<td>1968</td>
</tr>
<tr>
<td>Propulsor</td>
<td>Muhlemann</td>
<td>1974</td>
</tr>
<tr>
<td>Twin Block</td>
<td>William Clark</td>
<td>1977</td>
</tr>
<tr>
<td>Functional magnetsystem</td>
<td>Vardimon</td>
<td>1989</td>
</tr>
<tr>
<td>Mandibular growth advance</td>
<td>Yakota</td>
<td>1993</td>
</tr>
</tbody>
</table>

*Fixed functional appliances*

The fixed functional appliances being used till date are enumerated in the following table.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Pioneered by</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbst appliance</td>
<td>Emil Herbst (popularized by Pancherz)</td>
<td>1979</td>
</tr>
<tr>
<td>Mandibular anterior repositioning appliance (MARA)</td>
<td>Ralph M Clements and Alex Jacobson</td>
<td>1982</td>
</tr>
<tr>
<td>Jasper Jumper</td>
<td>J J Jasper</td>
<td>1987</td>
</tr>
<tr>
<td>Saif Spring</td>
<td>Armstrong</td>
<td>1989</td>
</tr>
<tr>
<td>Herbst with high pull head gear</td>
<td>Schiavoni</td>
<td>1992</td>
</tr>
<tr>
<td>The adjustable bite corrector</td>
<td>Richard P Wert</td>
<td>1995</td>
</tr>
<tr>
<td>Mandibular protraction appliance (MPA)</td>
<td>Coelho Filho</td>
<td>1997</td>
</tr>
<tr>
<td>Eureka spring</td>
<td>John Devincenzo</td>
<td>1997</td>
</tr>
<tr>
<td>Universal bite jumper</td>
<td>Xevier Calvez</td>
<td>1998</td>
</tr>
<tr>
<td>Churro Jumper</td>
<td>Ricardo Castanon</td>
<td>1998</td>
</tr>
</tbody>
</table>
CONCLUSION

A favorable reduction in Class II skeletal problems can occur for patients in a broad range of skeletal severity and growth patterns. The likelihood of patient cooperation is one of the most important factors influencing the choice of orthodontic treatment.

The special indicators for early treatment will undoubtedly be clarified as further data become available and as conclusions based on data replace clinical opinions as the basis for determining treatment.

REFERENCES

18. Graber TM, Vanarsdall RL, Vig KWL. Orthodontics - Current principles and technique. 4th ed; St. Louis; Elsevier publishers; 2005: pp 500-530.