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## Review Article

# Headgear in orthodontics and dentofacial orthopedics

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### ABSTRACT

Extra oral appliances have been used since ages to bring about dental changes, skeletal changes and for anchorage reinforcement. Growth modifications can be done with help of these appliances. This can be done by inhibiting the growth or redirection of the growth. The biomechanics of the extraoral appliances needs to be understood well for using these appliances. The topic of headgear is vast and the following article tries to cover the details regarding the same in brief. The location of centre of resistance for application of force is important and plays a significant role in biomechanics and outcome of treatment results. Various types of headgears and their use depending on different criterias are discussed in detail.

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## 1. Introduction

Extraoral appliances play a crucial role in orthopedic management Extra-oral force are used for correcting interarch relationships as well as anchorage.<sup>1</sup>

Cellier in France (1802) reported utilization of extra-oral force to correct malocclusion.<sup>2</sup> Angle in 1888 has explained about extraoral attachments.<sup>3</sup> Dr. S.J. Kloehn soldered the two outer bow and inner bow in 1947.<sup>3</sup>

Skeletal changes as a result of using high pull head gear were described by Klein in 1957.<sup>2</sup> Headgears can also be used for dental corrections. For using these extraoral appliances it is important in the first place to understand the biomechanics which plays a crucial role in bring about the dental movements or skeletal movements. They can be used for treating malocclusions like Class II and Class III.

## 2. Definition

Headgear is the device which derives extra oral support and delivers forces intraorally.

## 3. Components of the Headgear

The components of headgear consist of a facebow, force elements and extraoral anchorage straps. A facebow is used to transfer forces to the tooth intraorally through buccal tubes. The force elements are used to generate force. This can be done using elastics or with the help of springs. The extraoral anchorage straps are used for anchorage purpose.

## 4. Classification of Headgear

Extra-oral appliances may be classified according to the –

### 4.1. Anchorage site

Depending on the anchorage site cervical pull headgear, straight pull headgear, occipital pull headgear.

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#### 4.2. Site of force application

Depending on the site of force application -dental arch, teeth, chin.

Indications for use of Headgear

1. Retraction of the anteriors.
2. Distalization of molars.
3. Distalization of the dental arch.
4. Anchorage reinforcement.
5. Distalization of the jaw.
6. Growth modification.
7. To treat vertical maxillary excess.
8. To treat open bite.

### 5. Biomechanics

In order to understand extra oral appliance biomechanics it is important to know about the following terms:

#### 5.1. Centre of resistance

It is a point on the body which offers maximum resistance and it is fixed point.<sup>3</sup> The centre of resistance of upper first molar is at middle third of root near junction of cervical third.<sup>4</sup>

Various authors have given different centre of resistance of maxilla. Some which are described below. Centre of resistance of upper jaw is in area of posterior superior ridge of pterygomaxillary fissure according to Tanne et al. According to Teuscher the centre of resistance of maxilla lies on the posterior superior aspect of the zygomaticomaxillary suture. According to Nanda and Hickory, the centre of resistance of maxilla lies around five to ten millimetres from the orbitale on the zygoma of the maxilla. According to Proffit, the centre of resistance of maxilla lies between the premolar roots in the upper arch. According to Braun et al., the centre of resistance is half of the distance between orbit and functional occlusal plane.

#### 5.2. Center of rotation

The body tends to rotate around this point and can be changed unlike centre of resistance.<sup>5</sup>

#### 5.3. Line of action or direction

Arrow is usually used to represent line of action. It is a direction in which the force acts. The direction of head gear force system can be adjusted for extrusion, intrusion or distal movement.<sup>5</sup>

#### 5.4. Force magnitude

For orthodontic correction 350 - 450 gms per side are used. Orthopedic corrections require heavy forces comparatively i.e. 500 gms and above.<sup>5</sup>

Teeth can be moved in only 3 planes of space i.e. sagittal, coronal and transverse.<sup>6</sup>

In the sagittal plane, the line of action and centre of resistance of the tooth determine the resulting force component. As centre of resistance remains constant, the line of action and the distance from the same are the factors that change.

The point of force application can be anywhere anterior or posterior to the centre of resistance. It can be above or below the centre of resistance. Depending on this position of the point of force of application the moments are generated resulting in the tooth movement or movement of the jaw or dental arch.<sup>6</sup>

When the line of action passes through the centre of resistance, there is translation of the teeth or jaw or dental arch. If it passes above the centre of resistance it results in counter clockwise moment, which further results in flattening of occlusal plane. If the line of action passes below the centre of resistance, it results clockwise moment further resulting in steepening the occlusal plane.<sup>7</sup> It results in extrusion of anteriors. If the line of action passes anterior to the centre of resistance in case of short outerbow it will result in cervical headgear will result in steepening of the occlusal plane but with parietal pull will result in intrusion of anterior segment. If the line of action passes posterior to the centre of resistance in case of long outerbow will result in flattening of occlusal plane in case of cervical pull headgear but with parietal headgear it will result in steepening of the occlusal plane.<sup>7</sup>

The outerbow can be expanded and contracted and hence bring about lateral or medial movements of the molars.<sup>7</sup>

### 6. Types of Headgears

#### 6.1. Cervical pull headgear (Kloehn headgear, cervical strap, neckstrap)<sup>6</sup>

It is given by Kloehn and is used in patients who are growing and who have decreased vertical dimension. It can also be used to restrain the growth of maxilla. The line of force application passes below the occlusal plane and hence has distalising effect as well as extrusive effect can be seen. Depending on the point of force application whether anterior or posterior or above or below, the tooth movement produced varies.<sup>8</sup>

#### 6.2. Straight pull headgear

This headgear is responsible for distal movement as well as intrusive force on molars.<sup>8</sup> In growth modification this appliance can be used in vertical maxillary excess cases. It can be used in patients with steep mandibular plane as it can cause autorotation of the mandible due to correction in maxilla.<sup>8</sup>

### 6.3. High pull headgear

It derives its anchorage from the parietal region and the force is applied in the upward direction perpendicular to the occlusal plane. This appliance is used in vertical maxillary excess cases for growth modification. It can be used for intrusion of the entire dental arch.<sup>8</sup>

### 6.4. Vertical pull headgear

This is a type of high pull headgear in which the outer bow is hooked to the head cap in such a way that the line of action is parallel to occlusal plane and passes through centre of resistance, hence pure intrusion takes place. It is not commonly used but mostly used in cases of Class I open bite cases.<sup>8</sup>

### 6.5. 'J' hook headgear to the arch wires

This type of head gear can be used for retraction of anterior segment. It consists of hooks attached to the wire.<sup>8</sup>

## 7. Selection of Headgear

The selection of headgear can be done depending on the following:

1. If the patient is normodivergent, no change in vertical proportion is required then the force must be horizontal to the maxillary molars or maxilla for restricting the growth of the maxilla. In such a case straight pull headgear can be used. If the patient is hyperdivergent, change in the vertical proportions is desired that is we have to prevent the growth of the alveolus and further bring about intrusion of molars. In such a case high pull headgear can be used. If suppose the patient is hypodivergent and growth of alveolus is desired and extrusion of molar is desired. In such a case cervical pull headgear can be used.<sup>9</sup>
2. Depending on the case whether we have to distalize the molar or hold it in place, we have to decide the timing and the amount of force application. If the molars are supposed to be held in position, force of less magnitude can be used for a more shorter duration. If the distalization of molar is planned then, relatively heavy force is applied and for a longer duration.<sup>9</sup>
3. In case of molar distalization if the movement desired is translation then the force should pass through the centre of resistance and the position of the outer bow has to be directed accordingly.<sup>9</sup>

## 8. Headgears in Combination with Other Appliances

### 8.1. Headgears with fixed appliance

In the edgewise appliance, different types of headgears can be used. This depends on the stage of the treatment and the

type of malocclusion. In cases where extrusion of teeth has to be controlled or the anterior retraction has to be carried out, a straight pull headgear is used. In cases of openbite where intrusion of molars is required, high pull headgear is used. In cases where extrusion of molars is required, Kloehe type of headgear can be used. This type of headgear can however be used for reinforcing the anchorage and in cases where growth is present, it can be used for bringing about skeletal changes.<sup>10</sup>

In straight wire appliance, modified Ascher's bow can be used for retraction of anterior teeth when the anchorage is critical. The force used for retraction is 12-15oz of force.<sup>10</sup>

In Beggs appliance extraoral appliances are not required but can be used for distalization of the teeth or when growth is present can be used for modification of growth. It can be used for distalization of maxilla or teeth.<sup>10</sup>

### 8.2. Headgears with Functional Appliance

Headgears can be used with activator. It was Levin et al who reported that the cervical headgear can be used with activator. He used a long outerbow. Normal mandibular occlusal development can be obtained with activator cervical headgear therapy. Considerable results were obtained when used in patients with Mesofacial or Brachyfacial pattern. A study was performed by Cura et al.<sup>11</sup> In which the effects of activator was compared with activator with headgear. It was concluded in the study that greater changes in the sagittal relations were seen with headgear along with activator rather than activator alone. The combination of headgear and cervical headgear was used by Pfeiffer. The reason for choosing cervical headgear was to extrude the maxillary molars and activator was used to bring about orthopedic changes. The headgear - activator combination was used by Teusher and Stockli and concluded control in all three planes of space was possible.<sup>11</sup>

Weislander was the one who reported the use of headgear with Herbst appliance. This can be done in cases with severe Class II cases.<sup>12</sup> This increases the orthopedic effect of the appliance with proper anchorage control. Weislander performed a study to evaluate the retention and the outcome of the treatment. It was found that there was 2mm increase in the length of the mandible body when the cases were reviewed after three to five years.<sup>12</sup>

Another study was performed to evaluate the changes post treatment in patients with Herbst appliance alone and Herbst Appliance with headgear by Rabie and Hagg. It was found in this study that restriction of maxillary arch was seen in patients with headgear along with Herbst appliance. It was seen in patients with Herbst appliance alone showed rotation of palatal plane. The result obtained was found to be retained well with the patients using headgear during retention period.<sup>13</sup>

A study conducted by Dahan et al in which he used the bionator with high pull headgear. It was found that rapid changes were observed in the correction of malocclusion. In contrast no change was seen in patients with openbite when open bite bionator was used with headgear in a study conducted by Weinbach and Smith. He compared the difference in the effect of use of open bite bionator with headgear and headgear alone and concluded no difference in both.<sup>14</sup>

A randomized clinical trial was performed by Camilla Tullock to compare the effects of modified bionator and headgear. This was done in three phases. Phases 1 - early treatment in mixed dentition, Phase 2-permanent dentition and Phase 3-retention after treatment. The severity of Class II malocclusion was decreased in both head gear and bionator cases. It was seen that there was restriction of maxillary growth in patients using headgear whereas patients wearing myofunctional appliance showed forward positioning of the mandible. It was seen that both the approaches showed improvement of the interjaw relationship.<sup>15</sup>

The effects of modification of Twin block was studied by Parkin and Sandler. It was found that the vertical eruption of maxillary molars was controlled and anticlockwise rotation of maxilla was seen. The vertical growth as well as sagittal growth was in control with use of modified Twin Block.<sup>16</sup>

The Frankel appliance could be modified by adding a headgear and a bite block. This was done by Owen et al. and concluded that vertical dimension were in control or even showed decreases in height with this modification. Condylar growth was not seen.<sup>17</sup>

### 8.3. Headgear with removable appliances

Graber appliance was used for treating Class II div 1.<sup>18</sup> The appliance acts as an active retainer and can bring about expansion if needed in the premolar region. Margolis used extraoral appliance in combination with removable intraoral appliance. This appliance was called Margolis acrylic cervico occipital anchorage (ACCO).<sup>19</sup> It can be used in active phase as well as retentive phase. It is a modified version of Hawleys appliance with extraoral forces. This appliance consists of ball end clasps so as to prevent dislodging due to extraoral forces. Occlusal coverage with acrylic also helps in retention. Jacobsons splint is similar to Margoli's ACCO and it helps in controlling the eruption of maxillary molars and promotes forward eruption of mandibular molars.<sup>20</sup>

### 9. Molar Distalisation with Headgear

Nanda states that the forces must pass through the centre of resistance of the maxillary molars for translation of molars. The force required for this translation was 500gms

as suggested. For a patient with compliance, a significant improvement can be observed in time period as less as 6 months.<sup>21</sup>

### 10. Injuries from Headgear

Playing with headgear on can result in accidental disengagement of the headgear.

Improper handling by child during wearing the headgear.

Another child forcefully disengaging the headgear.

Detachment of the headgear unintentionally during sleep.

### 11. Patient Compliance Assessment of Patients Wearing Headgear

Following has to be observed to check the compliance of the patient:

The patient wearing the headgear regularly will show mobility of molars.<sup>9</sup>

The headgear straps and tubes of the patients should be assessed for cleanliness.

The position of the molars must be assessed and anchorage has to be checked

The spaces between the teeth have to be assessed.

The ease with which the patient wears the headgear must be assessed.

### 12. Instructions that are to be given to the Patient Wearing Headgear

The patient should stop wearing the headgear and visit the clinic in case of any problems with respect to headgear and if the appliance gets detached while sleeping.<sup>12</sup>

The patient should not wear the appliance while playing.

The patient should make sure to first remove the anchorage straps and then remove the facebow.

In case of any injury to eyes from the headgear, the patient must visit an ophthalmologist.

### 13. Conclusion

Extraoral appliances can be used for various purposes as discussed above. Depending on the purpose, the type of headgear has to be selected. The biomechanics of headgear must also be kept in mind before selecting an appropriate headgear. The compliance of the patient also plays an important role when it comes to treatment with headgear and desired treatment outcomes.

### 14. Source of Funding

None.

### 15. Conflict of Interest

None.


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