

Review Article

Orthopedic Appliances- A Review Article

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ABSTRACT:

Dentofacial orthopedics is directed primarily toward the correction of facial skeletal deviations influencing or associated with malocclusions. The primary objective is to correct the skeletal imbalance; correction of the malocclusion is relatively secondary in importance. Numerous commercially available appliances are used by orthodontist to assist in effecting orthopedic jaw correction and/or orthodontic tooth movement, but selection of appliance can be confusing. Some commonly used appliances include headgear, facemask and chin cup.

Keywords: Orthopedic appliances, Headgear, Facemask, Chincup.

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INTRODUCTION

The word Orthopedic originates from two Greek words *orthos* meaning straight or correct and *paideia* meaning the rising of children. Dentofacial orthopedics is directed primarily toward the correction of facial skeletal deviations influencing or associated with malocclusions.

Orthopedic appliances are designed to transfer forces to facial skeletal appliance as directly as possible. These appliances effectively influences bone growth and sutural changes which when given in growing age favourably alters the continuing facial growth pattern². Some commonly used Appliances include headgear, facemask and chin cup.

Now-a-days the awareness of the patients about dental treatment in general and orthodontic treatment specialty has increased. With orthopedic appliance therapy, the effort is not just to treat the dental discrepancies but to improve the facial profile taking advantage of the growth potential of the children regardless of the kind of orthopedic appliances to be used. This depends on

the understanding of every appliance, its working mechanism, the skeletal and dental condition of the patients to be treated and their compliance.¹¹ Therefore, Dentofacial orthopedics represents a positive approach to treatment of craniofacial imbalance as they address the underlying cause of malocclusion by maximizing the natural potential of growth and improving the facial profile.

HEADGEAR

HISTORY OF HEADGEAR

The use of extraoral forces began in the early 1800's, when Celleir developed cervical and occipital traction to prevent luxation of the mandible.³ In the year 1802 Joseph Fox used a chincup attached to a skullcap. But it was in 1822 that Gunnell wrote on the use of headgear for occipital anchorage¹⁴. The first reported use of headgear anchorage for correction of protrusion of the upper anterior teeth was made by Kingsley in 1866¹⁰.



Fig. 1 Kingsley headgear

COMPONENTS OF HEADGEAR

- i. Force Delivering Unit:** It consists of:
- I. Outer Bow
 - II. Inner Bow
 - III. The Junction

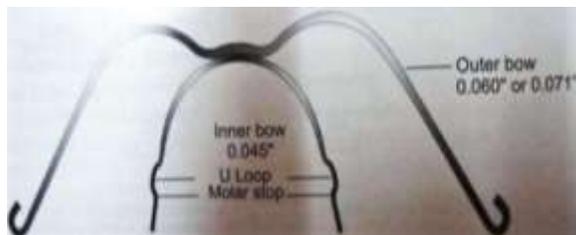


Fig. 2 – Components

- ii. Force element:** comprises of springs, elastics or stretchable material
- iii. Anchor Unit:** consists of the head cap or cervical strap

SELECTION OF HEADGEAR TYPE

1. **Anchorage location** The initial choice of headgear configuration is usually based on original facial pattern: the more the signs of a vertical excessive growth pattern are present, the higher the direction of pull and vice-versa¹⁰.
2. **Attachment to the Dentition** The usual arrangement is a facebow to tubes on permanent first molars
3. **The type of tooth movement required i.e. bodily movement or tipping**
4. **Mandibular plane angle** It is based on sella-nasion and mandibular plane.

1- If the SN–MP angle is 35° or less; class II skeletal patterns can be treated with a cervical facebow

2- If the SN-MP angle is 36°-41°; vertical dimension is best treated with the use of combination head gear (occipital and cervical straps)

3- If the SN-MP angle is 42° or greater; we need to prevent further vertical growth of the maxilla .A high pull face bow is described for the patient with high angle skeletal class II¹²

5. Occlusal Plane

Action desired: Head gear type

- i. Extrusion and steepening: Cervical headgear: outer bow even/low
- ii. Extrusion and flattening: Cervical headgear: outer bow very high
- iii. Intrusion and steepening: High pull headgear: outer bow posterior to Cres
- iv. Intrusion and flattening: High pull headgear: outer bow anterior to Cres
- v. Distal force and flattening: Combination headgear: outer bow above Cres
- vi. Distal force and steepening: Combination headgear: outer bow below Cres
- vii. Distal force and no moment: Combination headgear: outer bow at Cres⁸

CLINICAL PROCEDURE IN HEADGEAR USE

The instructions should include the following details:

- i. Patients should be advised never to wear their headgear during playful activity
- ii. Should another individual grab their facebow, the patient should also take hold of it until the other person has released their hold. They should then dismantle the headcap and/or neckstrap, and facebow to check that nothing has been broken.
- iii. Always fit the locking facebow first. Once the facebow is in position then the self-releasing headcap/ neckstrap may be fitted, whilst holding on to the facebow, to the prescribed tension as shown by the orthodontist.
- iv. If the head cap/neck strap ever comes off at night or there are any other problems, the patient should stop wearing the appliance, and return to see the clinician as soon as possible.
- v. If the patient experiences a problem unlocking or removing the face bow, excessive force should not be used to remove it.
- vi. Before removing the facebow the patient must first remove the head cap/neck strap¹.
- vii. The patient and parent should also be advised that, if in the rare and unlikely event, they suspect that part of the head cap/neck strap/face bow might have caused injury to the eye then the eye should be examined without delay. A warning should be given that failure to comply with the instructions may result in injury¹.

CLASSIFICATION of HEADGEAR

- a. Based on anchor units headgears are of following types:
 - ✓ Cervical headgear or low pull headgear
 - ✓ Occipital headgear or high pull headgear
 - ✓ Parietal headgear or vertical pull headgear
 - ✓ Combination (of cervical and occipital headgear) or straight pull Interland headgear
- b. According to Root (1975)
 - ✓ Attached to teeth
 - ✓ Attached to archwire
- c. According to the mode of attachment intraorally
 - ✓ J hook headgear
 - ✓ Headgear with conventional facebow inserted into tubes
- d. According to attachment to the jaws
 - ✓ Headgear to upper jaw
 - ✓ Headgear to lower jaw
- e. According to symmetry of the facebow
 - ✓ Symmetric headgear
 - ✓ Asymmetric headgear

Types of Headgear

1. Cervical Headgear (Low Pull Headgear)

This type of headgear is frequently referred to as cervical traction and is the most commonly used headgear appliance.



Fig 3 Cervical Headgear

➤ Effects of cervical headgear:

- To erupt the entire upper jaw
- Tends to move the upper jaw distally
- To Steepen the occlusal plane
- Expansion of the upper arch
- First order moment tending to rotate each segment mesial out and distal in⁶

2. High pull Headgear

High-pull headgear produces forces that pass apically through the centre of resistance of the maxillary teeth producing intrusive forces to the molars, which can therefore help correction of an anterior open bite.



Fig. 4 High pull Headgear

3. Protraction headgear

This is also called a facemask or reverse headgear. Facemask therapy is an effective orthopaedic appliance for growing children in order to correct a Class III malocclusion through forward movement of the maxilla.



Fig.5 Protraction headgear

4. Unilateral headgear

There are many clinical situations which require a greater force delivery on one side of the arch. In these instances, face-bows of the asymmetric or unilateral type are used. Face-bows which successfully and predictably provide an asymmetrical delivery of distal force to their inner-bow terminals are termed "unilateral face-bows".

5. Parietal Headgear (Vertical pull headgear)

They derive anchorage from parietal regions of the cranium. The main purpose of this headgear is to produce an intrusive direction of force. It is very useful when pure intrusion of buccal segments is required.



Fig. 6 Parietal Headgear

6. J Hook Headgear

This headgear consists of two separate curved hooks which are attached directly onto the maxillary archwire in the anterior region. This HG is mainly used to retract and intrude the maxillary incisor teeth and to prevent or correct 'gummy smiles'



Fig. 7 J Hook Headgear

FACEMASK HISTORY

The treatment of patients with maxillary retrusion and mandibular protrusion can be one of the more challenging aspects of clinical orthodontics. If the skeletal malrelationship is left untreated, beyond the patient's pubertal growth spurt, orthopaedic correction becomes more difficult and may require surgery to establish a functioning occlusion. The facial mask which was first described more than 100 year ago is one of the most important appliance to achieve above principles. Cellier and Fox were the first to report the use of a chin cap. They used this appliance only to immobilize jaw fractures and treat luxation.

COMPONENTS OF FACE MASK

The standard components are:

- i. Extra-oral components
- ii. Connecting force device
- iii. Intra-oral component

i. Extra-oral components

Facial mask

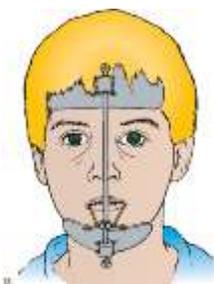


Fig. 8 The orthopedic facial mask Petit

ii. Connecting component

This is a crossbar made from 0.075" stainless steel that is secured to the main framework by a setscrew.

iii. Intra-oral component

- Banded expansion appliance



Fig. 9 Banded expansion appliance

- Bonded expansion appliance



Fig. 10 Bonded expansion appliance

- Force Device

Elastic Traction: The facial mask is secured to the face by stretching elastics from the hooks on the maxillary splint to the crossbow of the facial mask.



Fig.11 Elastic traction

TYPES

Protraction headgear:

In the early 1960's, Hickham developed the protraction headgear for forward maxillary traction. It is made up of 2 long and 2 short arms all of which originate from the chin cup.

Delaire facemask:

Delaire's facemask is made up of a rigid, square-shaped metal framework, which connects a chin up to the forehead pad and has a wire for elastic attachment¹⁰.

Tubinger model of facemask

It is a modified version of facemask in which the forehead cap and chin cup are connected with the help of two midline metal rods. An adjustable crossbar is attached in front of the mouth to engage elastics.

TREATMENT EFFECTS

1. Correction of the anterior crossbite and Class III molar relationship can be achieved with 6 to 9 months of treatment with maxillary expansion and a protraction facemask.
2. Maxillary expansion in conjunction with protraction was found to produce greater forward movement of the maxilla.
3. Significant soft tissue profile change can be expected with maxillary protraction including straightening of the facial profile and better lip competence and posture. However, one should anticipate individual variations in treatment response and subsequent growth changes.
4. Treatment with a facemask is most effective in Class III patients who have a retrusive maxilla and a hypodivergent growth pattern.
5. The effects of maxillary protraction that are seen on the lateral cephalogram include forward and downward movement of the maxillary bone and dentition, lingual inclination of mandibular teeth, and downward and backward rotation of the mandible. These effects tend to turn Class III malocclusion into Class I occlusion and produce an orthognathic profile in a short period of time.⁵

CHIN CUP HISTORY

The first historical reference of importance is the correction of jaw dislocations with the chin cup i.e restraining devices to reduce mandibular prognathism by Cellier in 1802. It was applied in an attempt to correct a mandibular protrusion by Joseph Fox one year later and throughout the last century it was a popular and widely used appliance.

COMPONENTS

The chin cup is an extraoral appliance that utilizes a head cap, which is firmly fitted/seated on the posterosuperior aspects of the cranium as anchorage and has attachments for the placement and activation of the chin cup.



Fig. 12 Components of chincup

It consists of the following:

- Force module: It is an Elastic/metal spring that provides the desired tension levels on the chin cup.

- Chin cup: It is Custom made or preformed and can be either hard or soft. A hard chin cup can be custom made from plastic using a chin impression. A soft cup can be made from a football helmet chins trap.

TYPES OF CHIN CUP

1. Occipital pull chin cup

It derives anchorage from the occiput region. This is used in Class III cases with mild to moderate mandibular prognathism, which can bring their incisors in an edge-to-edge position at centric relation. This is the more commonly used chin cup¹⁰.

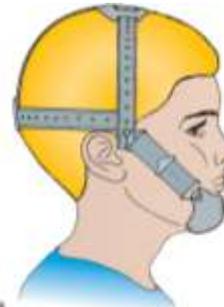


Fig. 13 The occipital-pull chin cup

2. Vertical pull chin cup

If no increase in lower anterior facial height is desired, the vertical-pull chin cup can be used¹⁵. It derives anchorage from the parietal region.

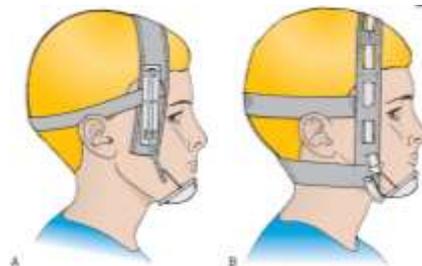


Fig. 14 The vertical-pull chin cup

TREATMENT EFFECTS

Short Term Effects:

A number of clinical and experimental studies have reported that chin cup force has several short term orthopedic effects:

- i. Redirection of mandibular growth
- ii. Backward repositioning of mandible
- iii. Retardation of mandibular growth
- iv. Remodeling of mandibular morphology at the gonial angle, symphysis and temporo-mandibular joint¹³.

The short-term or initial effects of chincup orthopedic force vary greatly with different ages and treatment timings. The skeletal profiles of patients who began treatment at age 7 changed more than those who began

treatment at a later age. In addition, patients that began treatment at age 7 showed a more posterior positioning of the mandible than those who entered treatment at age 11. These results indicated that chin cup treatment is more effective before the pubertal growth spurt¹³.

Long term effects:

The following significant craniofacial alterations were noted in patients who underwent orthopedic chin cup therapy:

1. A retardation of vertical ramus growth.
2. A retardation of vertical development in the posterior aspect of the mandibular body.
3. A retardation of vertical development in the posterior maxilla.
4. A closure of the gonial angle.
5. A distal rotation of the mandibular complex.
6. A decreased amount of anteroposterior anterior cranial base growth.
7. A redirection of the predominantly horizontal mandibular growth pattern to a more vertical direction.
8. A reduction of the maxillomandibular malrelationship toward normative values.
9. A production of an Angle Class I dental relationship following the establishment of normal maxillomandibular relations.
10. A lack of detectable localized effect on the symphyseal region or incisor position as a direct result of chin cup placement and pressure.
11. Development of soft-tissue profile changes in harmony with underlying skeletal changes⁷.

CONCLUSION

Nowadays the awareness of the patients of dental treatment in general and orthodontic treatment specially has increased. Orthopedic appliances aim to improve the facial profile taking advantage of the growth potential of the children. The choice of appliance should be based on the proper diagnosis of different aspects of the malocclusion and not because a particular appliance is thought to have a greater influence on modifying growth. Clinicians should be thoroughly familiar with the appliances they are using, including their potential benefits and limitations.

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