



## Introduction to Orthopedic appliances

### Philosophy of extraoral forces

A disproportion in the size or position of the jaws result in a skeletal discrepancy in either sagittal, vertical or transvers planes. To manage and treat these skeletal discrepancies, three different approaches are available;

- I. Growth modification
- II. Dental camouflage
- III. Orthognathic surgey

Growth modification should be opted wherever applicable because this precludes the need for both tooth extraction and surgery. The goal of growth modification is to alter the unacceptable skeletal relationships by modifying the patient's remaining facial growth to favourably change the size or position of the jaws. Orthopaedic appliances are one of these appliances that are used to modify the growth of maxilla/ mandible.

### Basis for orthopaedic appliances

Orthopaedic appliances generally use teeth as “handles” to transmit forces to the underlying skeletal structures. These appliances produce intermittent forces of very high magnitude. Such heavy forces when directed to the basal bone via teeth tend to alter the magnitude & direction of the jaws by modifying the pattern of bone apposition at periosteal sutures and growth sites. The followings are the basic principles of using orthopaedic appliances effectively:

- a- **Amount of force:** The force magnitude should be high i.e, at least greater than 400 gm (400-600 gm) per side to make sure that only skeletal and no dental movement takes place.
- b- **Duration of force:** According to most authors, intermittent forces produce skeletal change whereas continuous forces produce dental movement. Extraoral appliances should be worn for about 12-14 hours/day to bring about the desired effect.
- c- **Direction of force:** The direction of force application should be such as to maximize the skeletal effect. A favourable skeletal effect is seen when a force is directed posteriorly and superiorly through the centre of resistance of the



## 4<sup>th</sup> Year Lec. No. 9

maxilla.

- d- Age of the patient:** Orthopaedic appliances are most effective during the mixed dentition period as it takes advantage of the prepubertal growth spurt.
- e- Timing of force application:** There is an evidence that there is an increase in the release of growth hormones more during the evening and night and is associated with the sleep onset. Therefore, it is advisable for the child to wear the headgear in the evening and throughout the night. Generally, the child is more likely to wear the appliance at night.

### Types of orthopaedic appliances

The followings are the commonly used orthopaedic appliances:

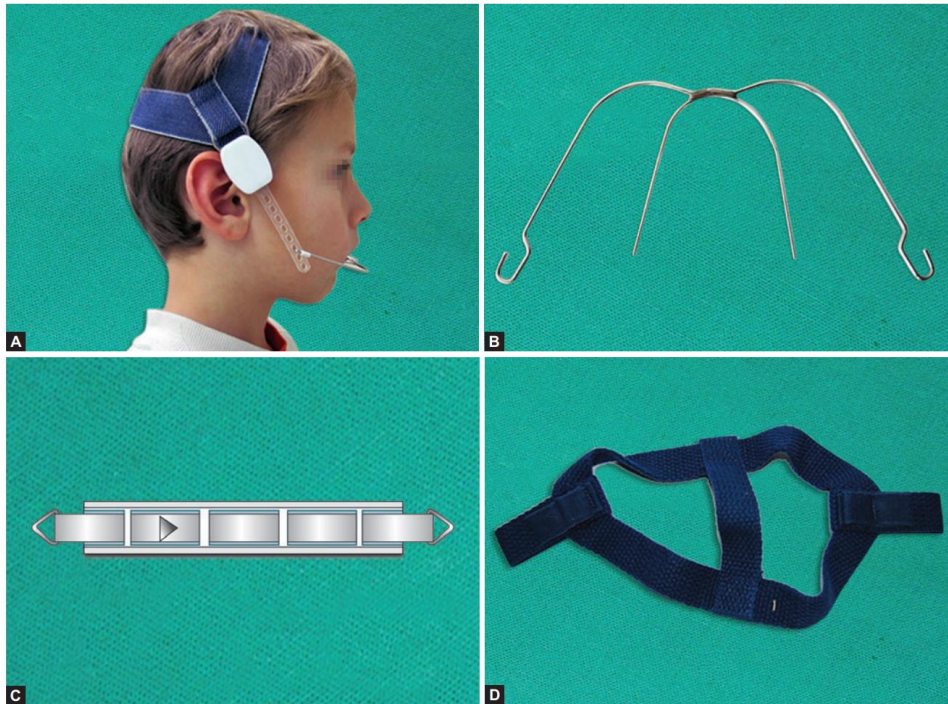
- a- Headgear**
- b- Facemask**
- c- Chin cup**

### Headgear

It is the most widely used extraoral orthopaedic appliances. It is ideally indicated in patients with excessive horizontal growth of the maxilla with or without vertical changes along with some protrusion of maxillary teeth, reasonably good mandibular dental and skeletal morphology. It is also used to distalize the maxillary dentitions along with the maxilla.



## Components of headgear



Figs 33.1A to D: (A) Patient with headgear appliance; Components; (B) Face bow; (C) Force-generating unit; (D) Strap

## Types of headgears

Based on the site of anchorage, headgears can be divided into:

- 1- Cervical pull headgear:** This headgear obtains anchorage from the nape of the neck. It causes extrusion of the maxillary molars leading to an increase in the lower facial height. Therefore, this type of headgear is generally indicated in low mandibular angle and deep bite cases. In addition, it can also be used to move the maxillary dentition and the maxilla in a distal direction for patients with Class II molar relationship.



Cervical headgear

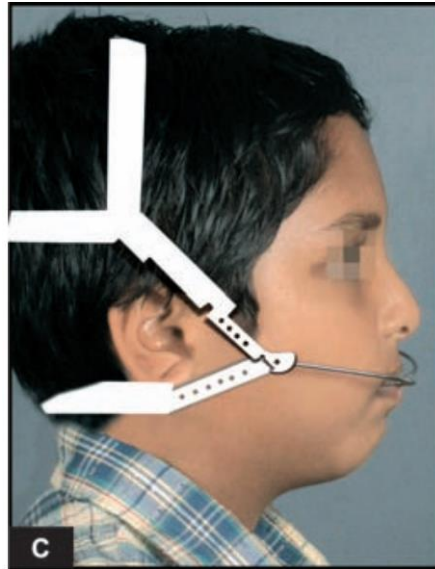


- 2- **Occipital pull headgear:** This type of headgear derives anchorage from the back of the head (occipital region). It produces a distal directed force on the maxillary teeth and the maxilla. A slight superior directed force may also be seen.



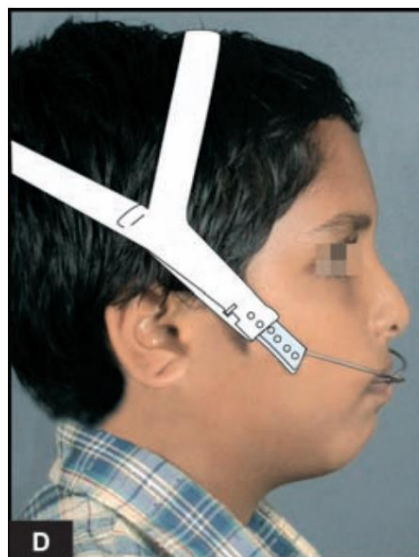
### Occipital headgear

- 3- **Combination headgear:** Both the occipital and cervical anchorage are combined in this type of headgear. When the forces exerted by both are equal, a distal and a slight superior directed force are exerted on the maxilla and maxillary dentition. Moreover, by varying the proportions of the total force derived from the head cap and the neck strap, the resultant force direction can be altered.



**Combination headgear**

- 4- **Vertical (high) pull headgear:** it derives anchorage from the front of the head (parietal region). Therefore, it produces a vertically directed force on maxilla and the maxillary dentition. As a result, it is used in individuals whom a decrease in the vertical development of maxilla is required such as long face classII patients and in patients with open bite tendencies. This headgear also exerts intrusive forces on the anterior region of the maxilla thereby producing a counter clockwise movement of maxilla. Therefore, it is useful in the treatment of vertical maxillary excess and gummy smiles. Intrusive forces on the posterior aspect of maxilla can be of benefit in anterior open bite patients as it intrudes the maxillary molars and therefore produces a clockwise movement of maxilla.



**High pull headgear**



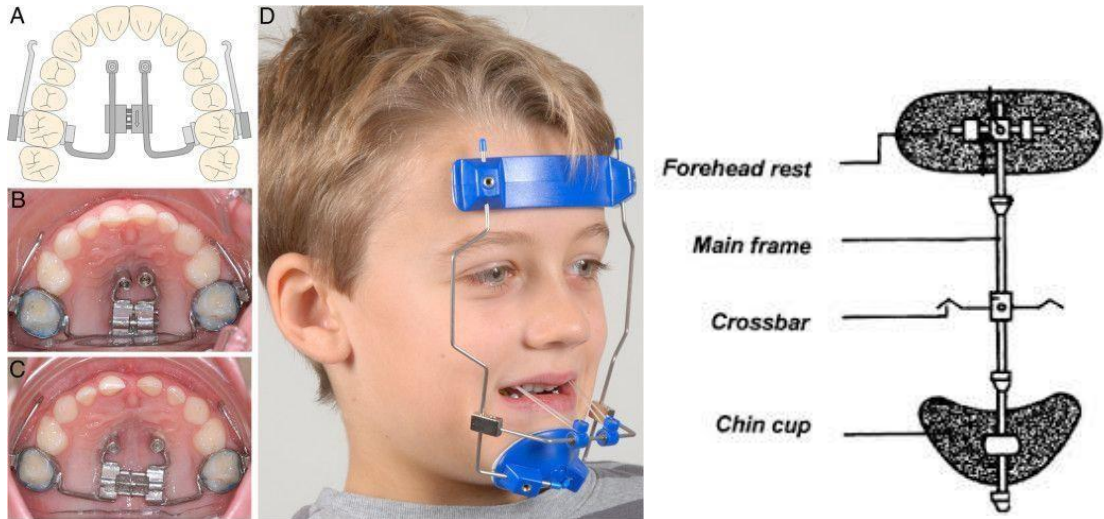
## Facemask

It is also called “protraction headgear” or “reverse pull head gear” or Delaire facemask. It is used to treat class III malocclusions that results from a combination of maxillary deficiency and mandibular excess in growing patients (around 8 years). This means it aids in pulling the maxillary structures forward and pushing the mandibular structures backward. It also be used for selective rearrangement of the palatal shelves in cleft patients.

## Components of Facemask

Basically, facemask consists of the following:

- 1- rigid metal extraoral framework:** It is the main component of a facemask assembly. It connects the various components such as the chin cup and the forehead cap. It also has provision to receive elastics from the intraoral appliance. The design of the metal frame differs based on the type of facemask.
- 2- Chin cup or pad:** It takes anchorage from the chin area. It is usually connected to the rest of the facemask assembly by means of metal rods.
- 3- Forehead support or cap or strap:** It is used to derive anchorage from the forehead area.
- 4- Heavy elastics:** These elastics are used to apply a forward traction on the upper arch. The vertical posts of chin cup are used to attach the elastics onto the upper molars or hooks soldered on the upper arch wire.
- 5- Intraoral appliance;** it is the most common type of protraction device is a multi-banded appliance with a ridge wire. Traction hooks are placed either in the molar or premolar region. McNamara advocates a banded rapid maxillary expansion along with the protraction device that resembles the banded Herbst appliance.



**Facemask appliance**

## Philosophy of facemask therapy

The principle of using this device is by applying a pulling force on the maxillary suture with reciprocation pushing force on the forehead and/or chin through facial anchorage. A forward maxillary pull is applied with the help of heavy elastics that are attached to hooks on the rigid framework.

## Indications

1. Mild to moderate Class III skeletal malocclusion due to maxillary retrusion, reverse pull headgear works best in young, growing children (around 8 years).
2. Ideal patients for facemask should have:
  - Normal or retrusive but not protrusive maxillary teeth as facemask causes forward movement of the maxillary teeth relative to the maxilla.
  - Short or normal, but not long, anterior vertical facial dimensions, i.e. a hypodivergent growth pattern.
3. Correction of postsurgical relapse after osteotomies.
4. Selective rearrangement of palatal shelves in cleft patients.

## Chin cup

It is an extraoral orthopaedic device that covers the chin and is connected to headgear. It is used to retard or redirect the growth of mandible. Therefore, it is indicated to treat class III malocclusion due to a protrusive mandible but a relatively normal maxilla.



## 4<sup>th</sup> Year Lec. No. 9

### Components of chin cup

Chin cup consists of the following:

- 1- **Force module:** ex. Elastics/metal springs that provide the desired tension levels on the chin cup.
- 2- **Chin cup**
- 3- **Head cup**

### Types of Chin cup

Generally, chin cups are of two types:

- 1- **Occipital -pull chin cup:** This is the most commonly used type of chin cup that derives anchorage from the occipital region of the head. It can be used to treat the following:
  - Class III malocclusions associated with mild to moderate mandibular prognathism in patients who can bring their close to an edge to edge at centric relation.
  - Patients with slightly protrusive lower incisors as it produces lingual tipping of lower incisors.
  - Patients who begin treatment with a short lower anterior facial height as this appliance can lead to an increase in this dimension.



**Occipital chin cup**





## 4<sup>th</sup> Year Lec. No. 9

- 2- **Vertical-pull chin cup:** This derives anchorage from the parietal region of the head. It is indicated patients with high mandibular plane angle and excessive lower anterior facial height as it helps to close the angle of mandible and increase posterior facial height. These patients usually exhibit anterior open bite.



**Vertical chin cup**

### **Philosophy of Chin cup therapy**

Mandible grows by apposition of bone at the condyle and along its free posterior border. Condyle is not a growth centre and condylar growth is largely a response to translation of surrounding tissues. This contemporary view offers a more optimistic view of the possibilities for growth restraint of the mandible.

### **Effects of Chin cup therapy**

Although most human studies have failed to conclusively prove that chin cup inhibits mandibular growth. The following effects are seen:

- 1- Redirection of mandibular growth in a downward and backward direction.
- 2- Remodelling of the mandible and a decrease in mandibular plane angle and gonial angle.
- 3- Lingual tipping of lower incisors.
- 4- Improvement in skeletal and soft tissue profile. Therefore, chin cup works well in patients with reduced or normal lower anterior facial height but is contradicted in long face patients.



## 4<sup>th</sup> Year Lec. No. 9

According to TM Graber, ideal patients for chin cup therapy are those suffering from:

- A mild skeletal problem with the ability to bring the incisors end-to-end or nearly so.
- Short vertical face height
- Normally positioned or protrusive, but not retrusive lower incisors.