

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



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# Developing CI III Malocclusion

## Diagnosis and treatment

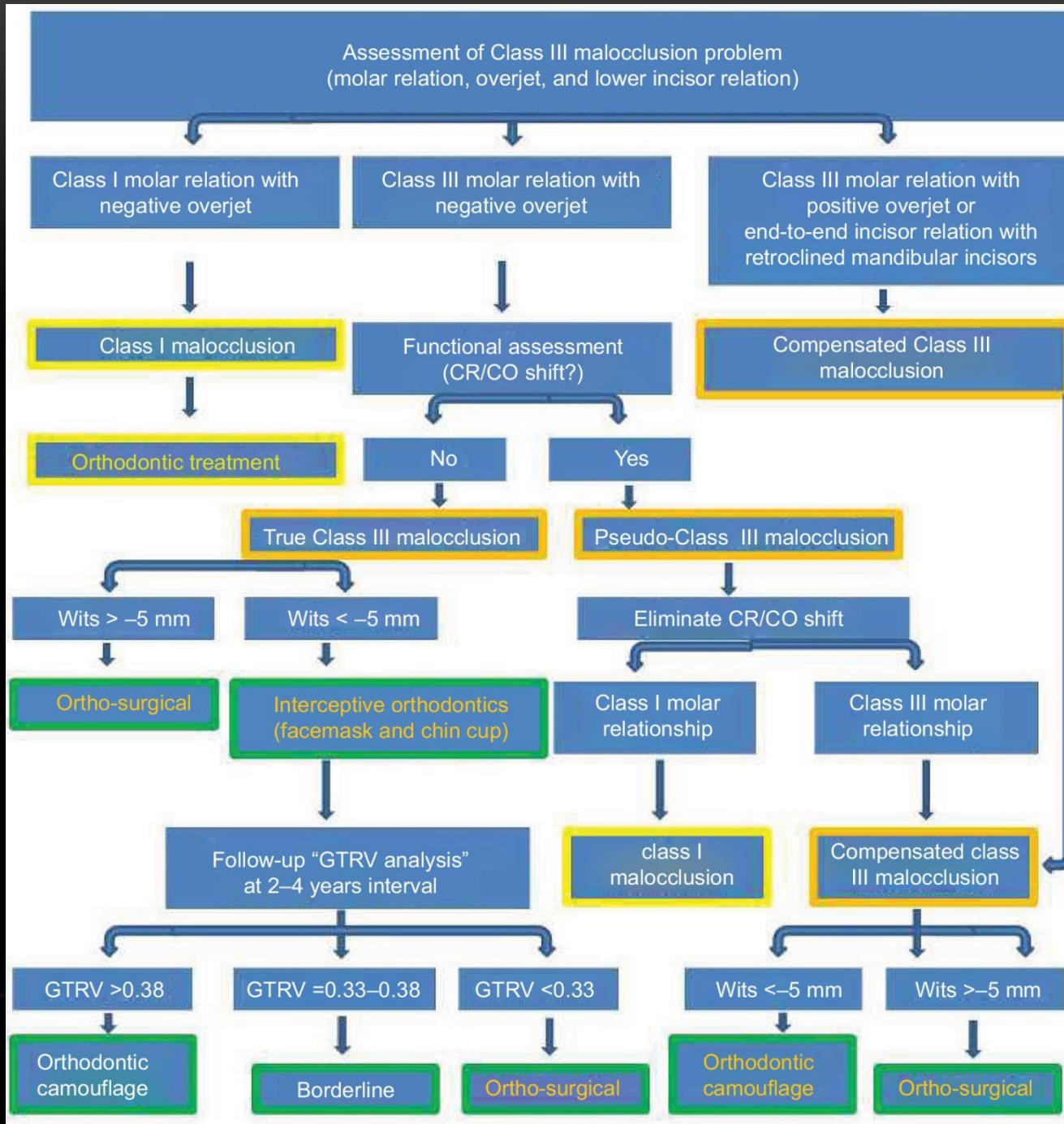
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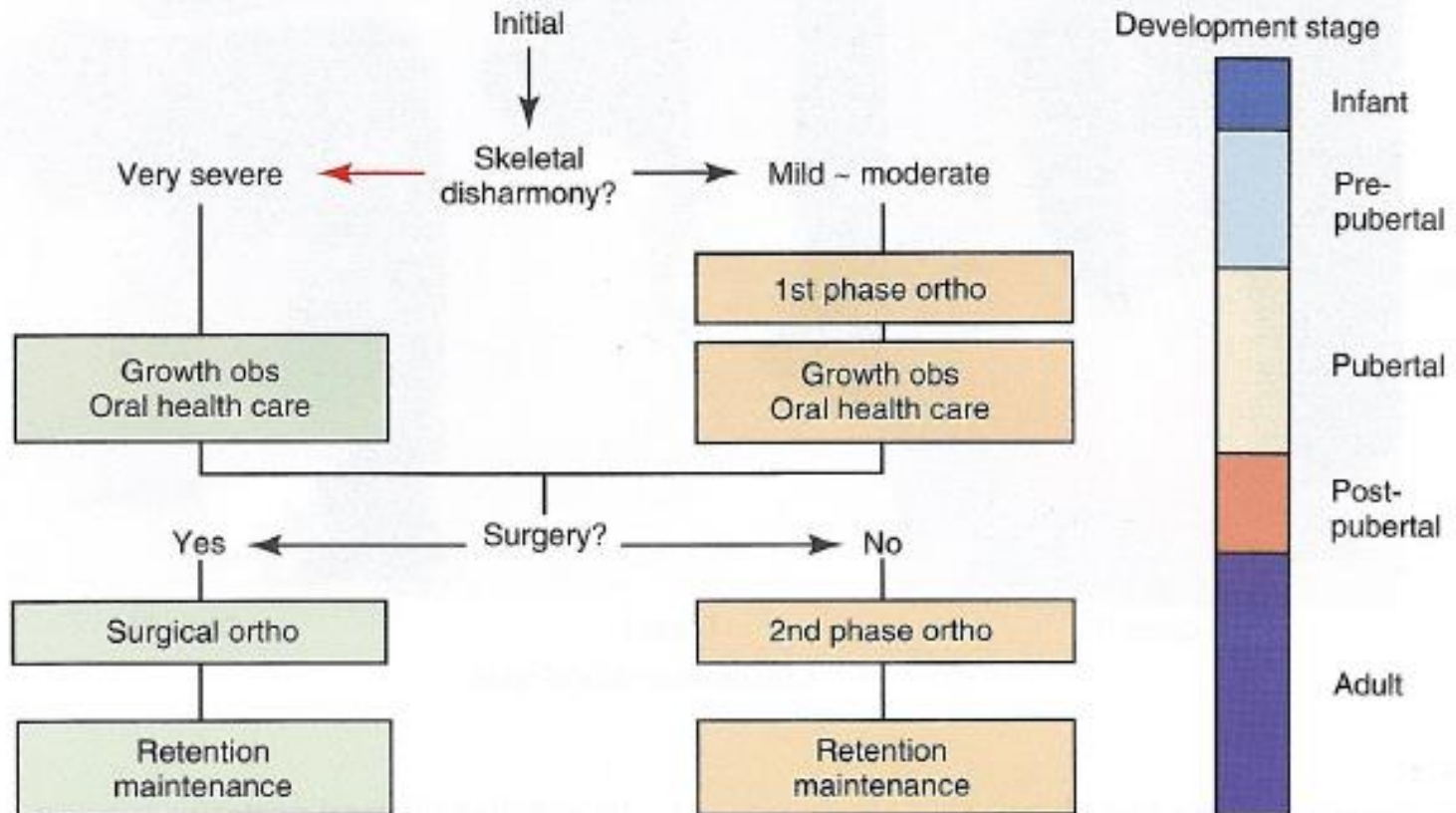
- Class III jaw discrepancies, due to some combination of deficient growth of the maxilla and excessive growth of the mandible.
- Almost any combination of deficient maxillary growth and excessive mandibular growth can be found in patients with Class III malocclusion, and in a broad view maxillary deficiency and mandibular excess are about equally likely.
- Extraoral force could pull the growing maxilla forward if done in the early mixed dentition period, led to a great increase in treatment aimed at promoting maxillary growth.
- In contrast, extraoral force via a chin cup anchored against the cranium has been shown to produce more downward and backward rotation of the mandible than true growth restraint. A large mandible cannot be rotated to decrease chin prominence without creating a long-face deformity except in patients who also have short anterior face height. That Class III phenotype is most prevalent in those of Asian descent, but is rarely seen in Europeans or Americans. Not surprisingly

# SKELETAL CLASS III MALOCCLUSIONS CAN BE A RESULT OF VARIOUS FACTORS

1. **Prognathic and/or macrognathic mandible** with a normal maxilla both in position and in size;
2. **Retrognathic and/or micrognathic maxilla** with a normal mandible both in position and in size;
3. Combination of **retrognathic and/or micrognathic maxilla with prognathic and/or macrognathic mandible**;
4. Normal skeletal jaw relationship with reverse overjet in the presence of centric relation **(CR)–centric occlusion (CO) discrepancy**, also known as a “**pseudo**” Class III relationship.



- $GTRV = \frac{\text{horizontal growth changes of the maxilla}}{\text{horizontal growth changes of the mandible}}$ .



# ANTEROPOSTERIOR AND VERTICAL MAXILLARY DEFICIENCY

- Both anteroposterior and vertical maxillary deficiency can contribute to Class III malocclusion. If the maxilla is small or positioned posteriorly, the effect is direct; if it does not grow vertically, there is an indirect effect on the mandible, which then rotates upward and forward as it grows, producing an appearance of mandibular prognathism that may be due more to the position of the mandible than its size.

# PSEUDO-CLASS III MALOCCLUSION

- Pseudo-Class III malocclusion is characterized by :
  1. the presence of an anterior crossbite due to a forward functional displacement of the mandible
  2. the maxillary incisors present retroclination,
  3. the mandibular incisors are proclined and spaced
- When patients are guided into a centric relationship, they usually show an end-to-end incisor relationship involving the performance of a forward functional mandibular shift due to a muscular reflex so that the posterior teeth are able to occlude . It is for this reason that this type of malocclusion has been described as a pseudo- or functional Class III malocclusion .

# SKELETAL FEATURES

- Short cranial base length.
- Decrease cranial base angle resulting in forwards position of mandible.
- Mainly skeletal class 3 base relationships but it could be Class I or even class II skeletal base.
- The maxillary skeletal base widths were (statistically) significantly smaller in the class 3 than in the class 1 group (Chen et al 2008)
- Skeletal asymmetries, esp. in conjunction with mandibular prognathism (Severt and Proffit, 1997).
- Reduced cranial base angle
- Increased saddle angle
- Obtuse gonial angle
- Reduced ANB
- Normal or increase MMP angle and lower face height
- Increased mand length
- Reduced maxillary length

# SOFT TISSUE FEATURES

- Orbital rim hypoplasia and Increased scleral show
- Reduced maxillary length
- Malar hypoplasia in midface deficiency
- Paranasal hallowing
- Obtuse NLA and LMA.
- Reduced incisor show at smile
- Increase buccal corridor dark space
- Upper lip looks thin with reduced vermilion border show while lower lip may be full and pendulous
- Prominent chin
- Concave or straight profile.

# DENTAL FEATURES

- Class III incisor relationship
- Mostly CI III molar relationship could be I or even II.
- Tendency to or full reverse OJ.
- Reduced OB, AOB may exist
- Max probably crowded, mandible is usually spaced.
- Incisors compensate for Skeletal base, i.e. Proclined maxillary, retroclined mandibular incisors
- Tendency to posterior cross bite. It could be unilateral with or without displacement or could be bilateral mainly without displacement.

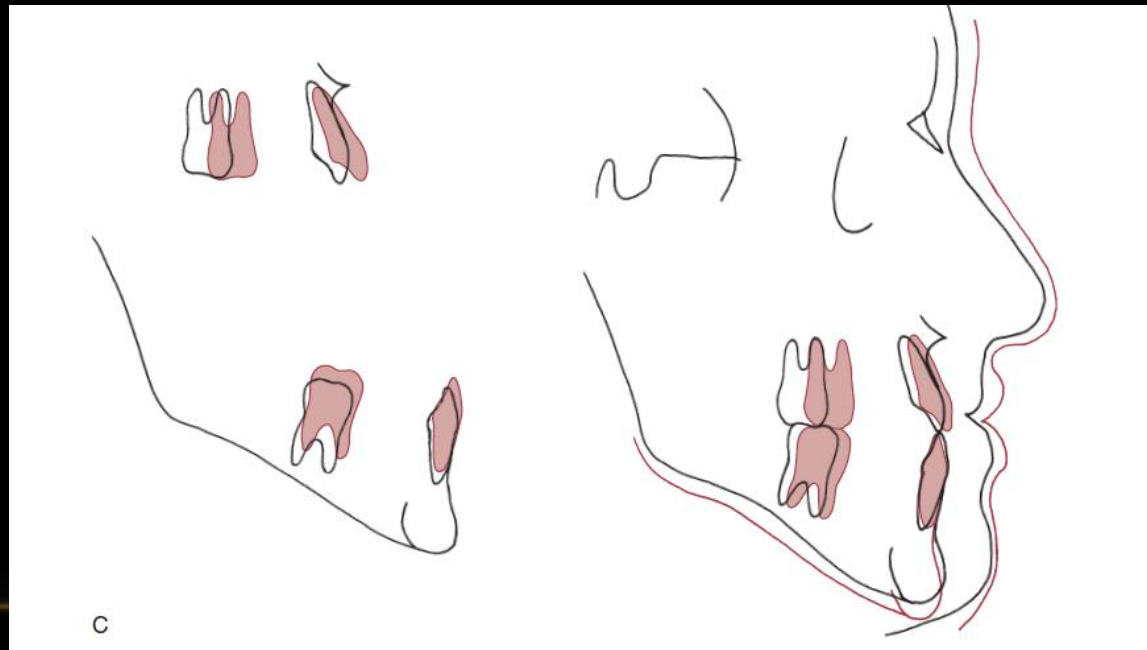
- In order of their effectiveness, there are three possible approaches to growth modification to correct maxillary deficiency:
  1. Frankel's FR-III functional appliance,
  2. reverse-pull headgear (facemask) to a maxillary splint or skeletal anchors,
  3. Class III elastics to skeletal anchors

# FR-III FUNCTIONAL APPLIANCE

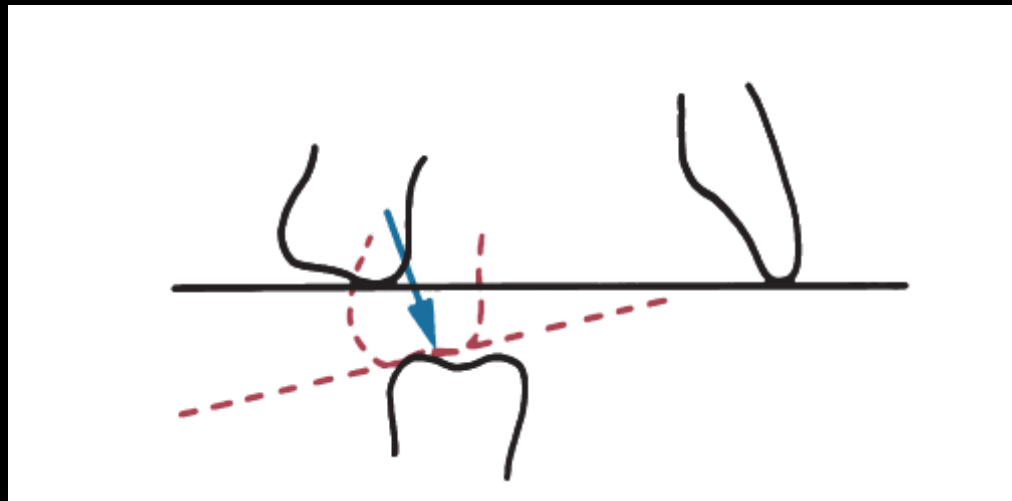
- The FR-III appliance is made with the mandible positioned posteriorly and rotated open and with pads to stretch the upper lip forward. In theory, the lip pads stretch the periosteum in a way that stimulates forward growth of the maxilla .



- little true forward movement of the upper jaw, Instead, most of the improvement is from dental changes. The appliance allows the maxillary molars to erupt and move mesially while holding the lower molars in place vertically and anteroposteriorly. The appliance tips the maxillary anterior teeth facially and retracts the mandibular anterior teeth .



- Rotation of the occlusal plane as the **upper molars erupt more than the lowers** also contributes to a change from a Class III to a Class I molar relationship.
- In addition, if a functional appliance of any type **rotates the chin down and back**, the Class III relationship will improve, because of the **mandibular rotation, not an effect on the maxilla.**

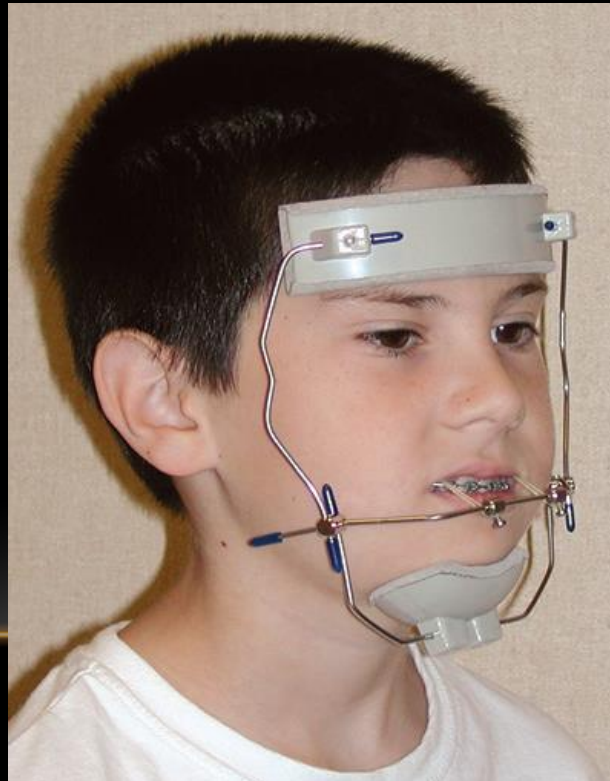


- In short, functional appliance treatment, even with the use of upper lip pads, **has little or no effect on maxillary deficiency** and, if considered, should be used only in **mild cases**. If this appliance is used, there are **long treatment and retention periods** that require **excellent compliance** to maintain limited changes.

# REVERSE-PULL HEADGEAR (FACEMASK)

- Dental Anchorage
- Delaire's demonstration that at an early age, a facemask attached to a maxillary splint could move the maxilla forward by inducing growth at the maxillary sutures.
- The **age** of the patient is a critical variable. It is easier and more effective to move the maxilla forward at younger ages. Although some recent reports indicate that anteroposterior changes can be produced up to the **beginning of adolescence**, the chance of true skeletal change appears to decline **beyond age 8**, and the chance of clinical success begins to decline at **age 10 to 11**.

- This Delaire-type facemask (sometimes called reverse headgear) offers good stability when used for maxillary protraction. It is rather bulky and can cause problems with sleeping and wearing eyeglasses. With even modest facial asymmetry, it can appear to be ill-fitted on the face.



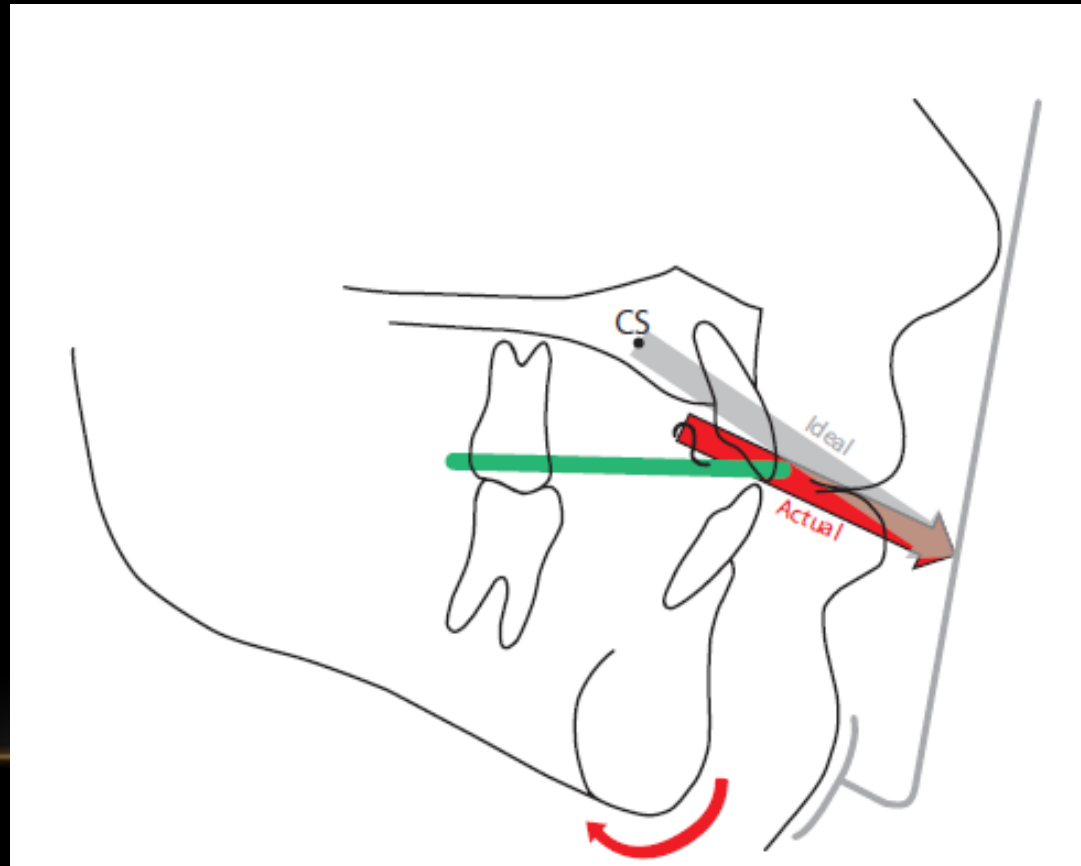
- This rail-style facemask provides more comfort during sleeping and is less difficult to adjust. It also can be adjusted to accommodate some vertical mandibular movement. Both types can lead to skin irritation caused by the plastic forehead and chin pads. These occasionally require relining with an adhesive-backed fabric lining for an ideal fit or to reduce soft tissue irritation. Clinical experience indicates that some children will prefer one type over the other, and changing to the other type of facemask can improve cooperation if the child complains.



- When force is applied to the teeth for transmission to the sutures, **tooth movement in addition to skeletal change is inevitable**. Whatever the method of attachment to the teeth, the appliance must have hooks for attachment to the facemask that are located in the **canine–primary molar area above the occlusal plane**.



- The force vector nearer the purported center of resistance of the maxilla and limits maxillary rotation.

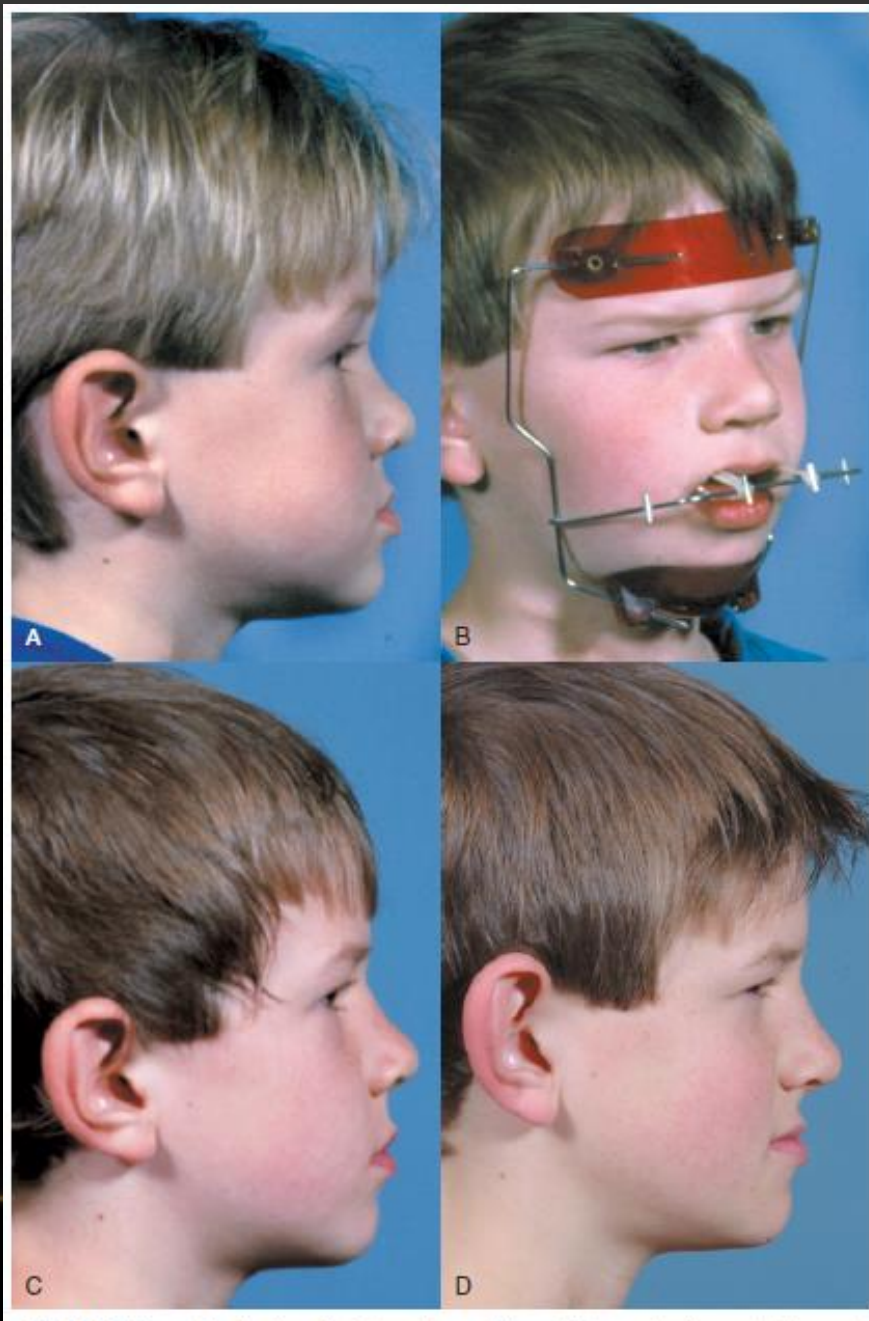


- Facemask treatment is most suited for children with **minor to moderate skeletal problems**, so that the teeth are within several millimeters of one another when they have the correct axial inclination. This type of treatment also is best used in children who have **true maxillary problems**, but some evidence indicates that the effects on mandibular growth during treatment go beyond changes caused by clockwise rotation of the mandible.
- In general, it is better to defer maxillary **protraction until the permanent first molars and incisors have erupted**. **The molars can be included in the anchorage unit and the inclination of the incisors can be controlled to affect the overjet.**

- Many clinicians use protraction with a facemask following or simultaneously with palatal expansion, on the theory that this increases the responsiveness of the sutures above and behind the maxilla to the protraction force but that is not correct.
- If the maxilla is narrow, palatal expansion is quite compatible with maxillary protraction and the expansion device is an effective splint; there is no benefit, however, from expanding the maxilla just to improve the protraction.

- It is claimed by some clinicians that **aggressive maxillary expansion (Alt-RAMEC)** to create greater maxillary mobility significantly facilitates forward movement with traction from a facemask. This procedure consists of rapid expansion for a **week at 1 mm per day, followed by turning the screw in the opposite direction to constrict for another week, and continuing this over a 7- or 9-week period.** It certainly creates maxillary mobility, sometimes extreme mobility, and there seems to have been little consideration of possible **adverse effects and risks.** A recent clinical trial showed a statistically significant further forward movement with facemask therapy after Alt-RAMEC, but the investigators noted that the greater change was so small (**1 mm**) that it probably was **not clinically significant.**
- Given the **minimal if any benefit and the possibility of injury to multiple sutures** (which, given the excessive mobility that sometimes occurs, may not be trivial), Alt-RAMEC **cannot be recommended.**

- Approximately 350 to 450 gm of force per side is applied for 12 to 14 hours per day. Most children with maxillary deficiency are deficient vertically, as well as anteroposteriorly, which means that a slight downward direction of elastic traction between the intraoral attachment and the facemask frame often is desirable, and some downward and backward mandibular rotation improves the jaw relationship. A downward pull would be contraindicated if lower face height is already large.
- A maxillary-deficient child who cooperates with facemask treatment usually shows a noticeable improvement in facial esthetics as the maxilla moves forward more than the mandible.



- Cephalometric superimposition tracings show that backward displacement of the mandibular incisors and forward displacement of the maxillary teeth also typically occur in response to this type of treatment, and afterward the maxilla may change minimally while the mandible appears to show catch-up growth. Usually some of the Class III correction is lost as the mandible outgrows the maxilla. As children come closer to adolescence, mandibular rotation and displacement of maxillary teeth—not forward movement of the maxilla—are the major components of the treatment result.

## A KEY QUESTION IS HOW MUCH OF THE EFFECT IS RETAINED AFTER THE ADOLESCENT GROWTH SPURT?

- If the mandible grows forward during adolescence and the maxilla doesn't keep pace, orthognathic surgery might still be necessary although the jaw discrepancy was largely corrected before adolescence.
- 25% to 33% chance 8 years later of recurrence of anterior crossbite because of excessive mandibular growth, not because the maxilla relapsed, and most of the patients who experienced this needed orthognathic surgery.

## HOW DO YOU DEAL WITH INFORMED CONSENT FOR PREADOLESCENT FACEMASK THERAPY?

- “If we do this treatment, your child is very likely to have a short-term improvement, and there is about a 75% chance of long-term success; but that also means there is about one chance in four that surgery still will be needed later.”
- The parents need to understand that, and if you are the doctor, you want a signed and witnessed copy in your records.

# FACEMASK TRACTION TO SKELETAL ANCHORAGE.

- Clearly, a major negative side effect of conventional maxillary protraction is tooth movement that detracts from the skeletal change. With bone screws and miniplates now readily available as temporary implants, skeletal anchorage for maxillary protraction is straightforward. Single alveolar bone screws are not adequate, but a facemask can be attached to miniplates on the anterior maxilla .
- Although varying results have been reported, three acceptable randomized clinical trials show that greater skeletal change can be obtained with facemasks to skeletal rather than dental anchorage, with 4 to 5 mm of advancement about the limit. The greatest difficulty with this approach is that miniplate placement on the anterior surface of the maxilla is invasive and bone maturity is not adequate until around age 11, well after the preferred time window for facemask therapy (age 8 to 10).

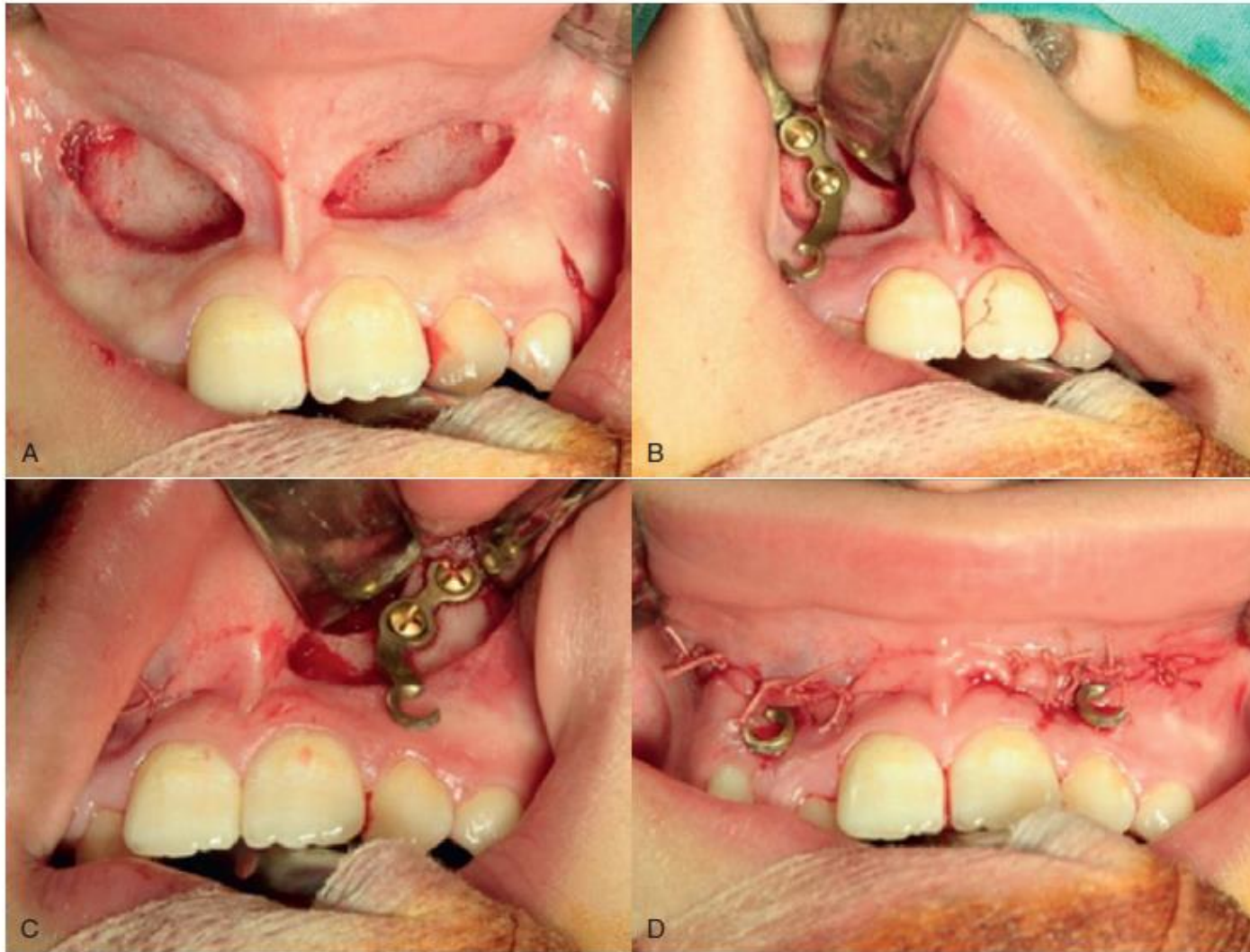


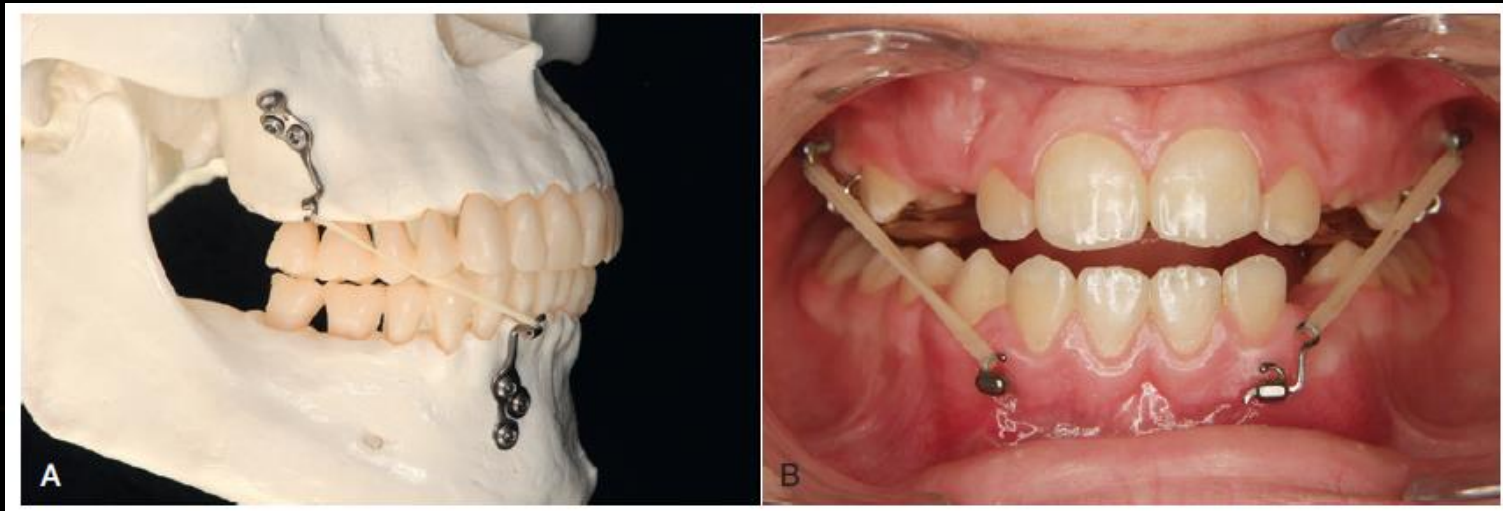
Fig. 12.22 Clinical management of the hard palate from a firm “M” shaped “M” E. (A) Initial cleft. (B) Placement of metal arch bar. (C) Placement of metal arch bar. (D) Final closure with sutures.

# CLASS III ELASTICS TO MAXILLARY AND MANDIBULAR MINIPLATES

- The **most effective approach** to protraction of the maxilla is Class III elastics between bone-supported miniplates at the base of the zygoma above the maxillary molars and the anterolateral surface of the mandible, so that light force is delivered to the jaws rather than the teeth.

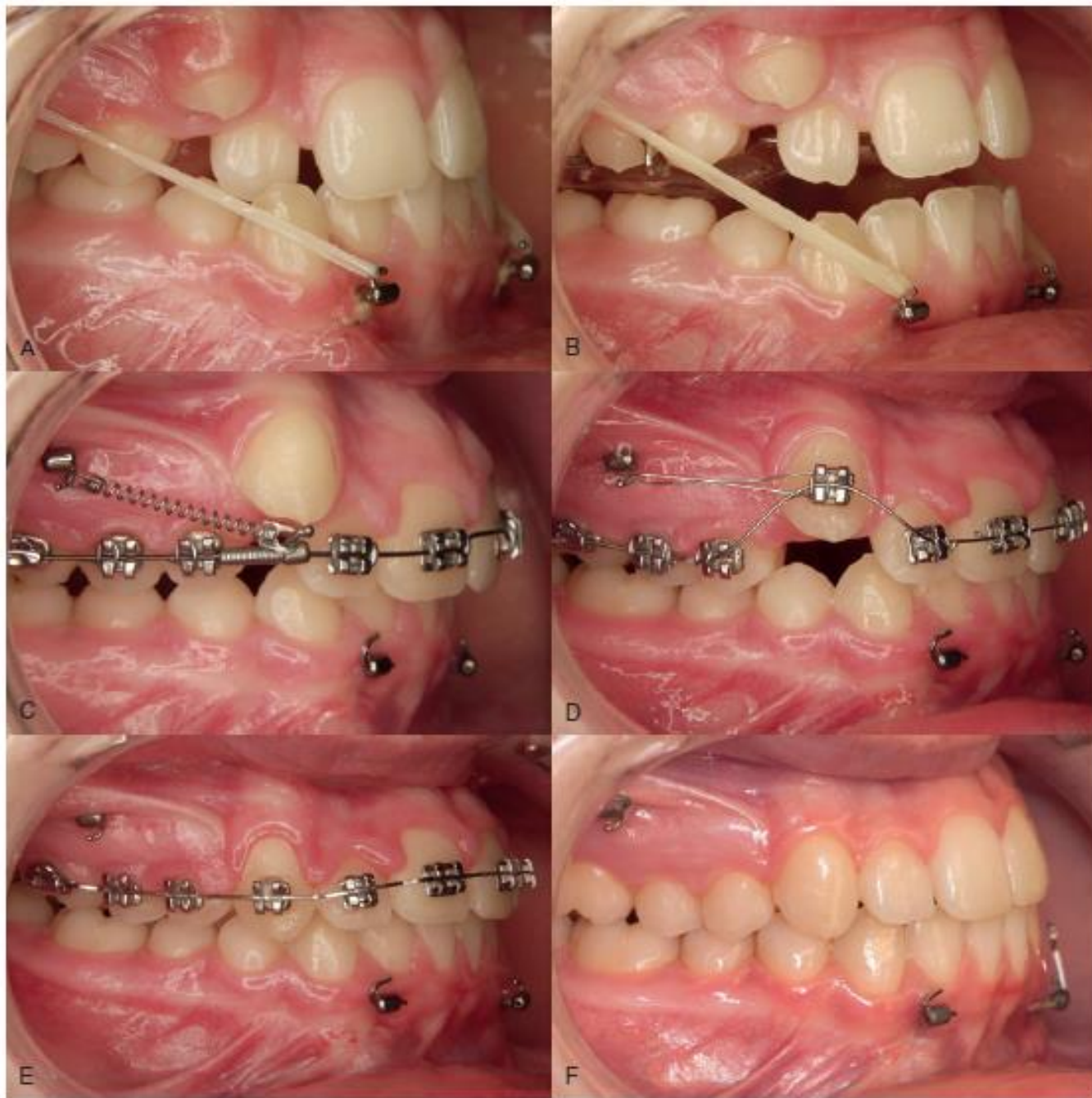
# SEQUENCE AND TIMING OF TREATMENT

- The first step is placement of the bone anchors, with a three-screw plate at the base of the zygomatic arch and a two-screw plate on the anterolateral surface of the mandible.
- It is **technique sensitive**.
- To reduce the risk of infection at the implant site, it is important to bring the intraoral connector into the mouth just below **the upper extent of attached gingiva rather than through mucosa**, and the connector should be both smooth and round to minimize soft tissue irritation.



- ❖ In the timing of treatment, two related factors are important:
  - First, adequate bone density to retain the screws does not develop until approximately age 11;
  - Second, the mandibular bone plates should not be inserted until the permanent mandibular canines have erupted, which should not be a problem because they usually erupt at approximately 9 years of age.
  - Treatment for about 1 year between the ages 12 and 14 is the best plan.

- Only light force is needed to obtain the desired growth modification (not more than 250 gm per side; often 150 gm is adequate). With the miniplate anchorage, stability is better if elastic wear begins the day after placement of miniplates. Steady force against the anchors is tolerated better than heavier discontinuous force, so patients should avoid intermittent finger or tongue pressure against the miniplates.
- In typical treatment with this method, intermaxillary traction is maintained for about 12 months, which is almost always enough time to correct the jaw discrepancy, and then a second phase of treatment with a fixed orthodontic appliance follows.
- Opening space for the canines.
- It is possible that after debonding, even if this is toward the end of adolescence, some additional growth in the Class III pattern can occur. For that reason, it is wise not to remove the miniplates for another 6 to 12 months (or longer if mandibular growth continues) so that additional elastic wear can be used if needed.



# COULD ORTHOPEDIC FORWARD MOVEMENT OF THE MAXILLA FACILITATE AIR FLOW THROUGH THE PHARYNGEAL AIRWAY?

- The answer seems to be no.
- Maxillary protraction does no harm to the airway, but sleep apnea is not an indication for it.

# SUMMARY OF MAXILLARY PROTRACTION EXPERIENCE

- The only Class III functional appliance that attempts to overcome maxillary deficiency is the Frankel FR-III, and its ability to do that is limited.
- Maxillary protraction with a facemask at an early age (8 to 10, after first molars and incisors have erupted but before adolescence) usually produces clinical improvement in a patient with Class III malocclusion—but the more the growth pattern is excessive mandibular growth, the greater the chance of long-term recurrence of the problem. After age 10 to 11, facemask therapy largely produces tooth movement and down-back mandibular rotation.. When current selection criteria are used, follow-up after adolescent growth indicates about a 25% chance of recurrence of anterior crossbite, and many of these patients require orthognathic surgery.
- Class III elastics between bone anchors at the base of the zygoma and the anterior surface of the mandible are clearly more effective in protracting the maxilla than facemask therapy, even when the facemask traction is to bone anchors on the maxilla. The miniplates and Class III treatment cannot be done as early as conventional facemask therapy but is effective during adolescent growth. That is a disadvantage if preadolescent treatment is desired, but an advantage if treatment was not sought until early adolescence.

# MANDIBULAR EXCESS

- Children who have Class III malocclusion because of excessive growth of the mandible are extremely difficult to treat.
- There are three possible treatment approaches:
  1. Class III functional appliances,
  2. Extraoral force to a chin cup,
  3. Class III elastics to skeletal anchors.

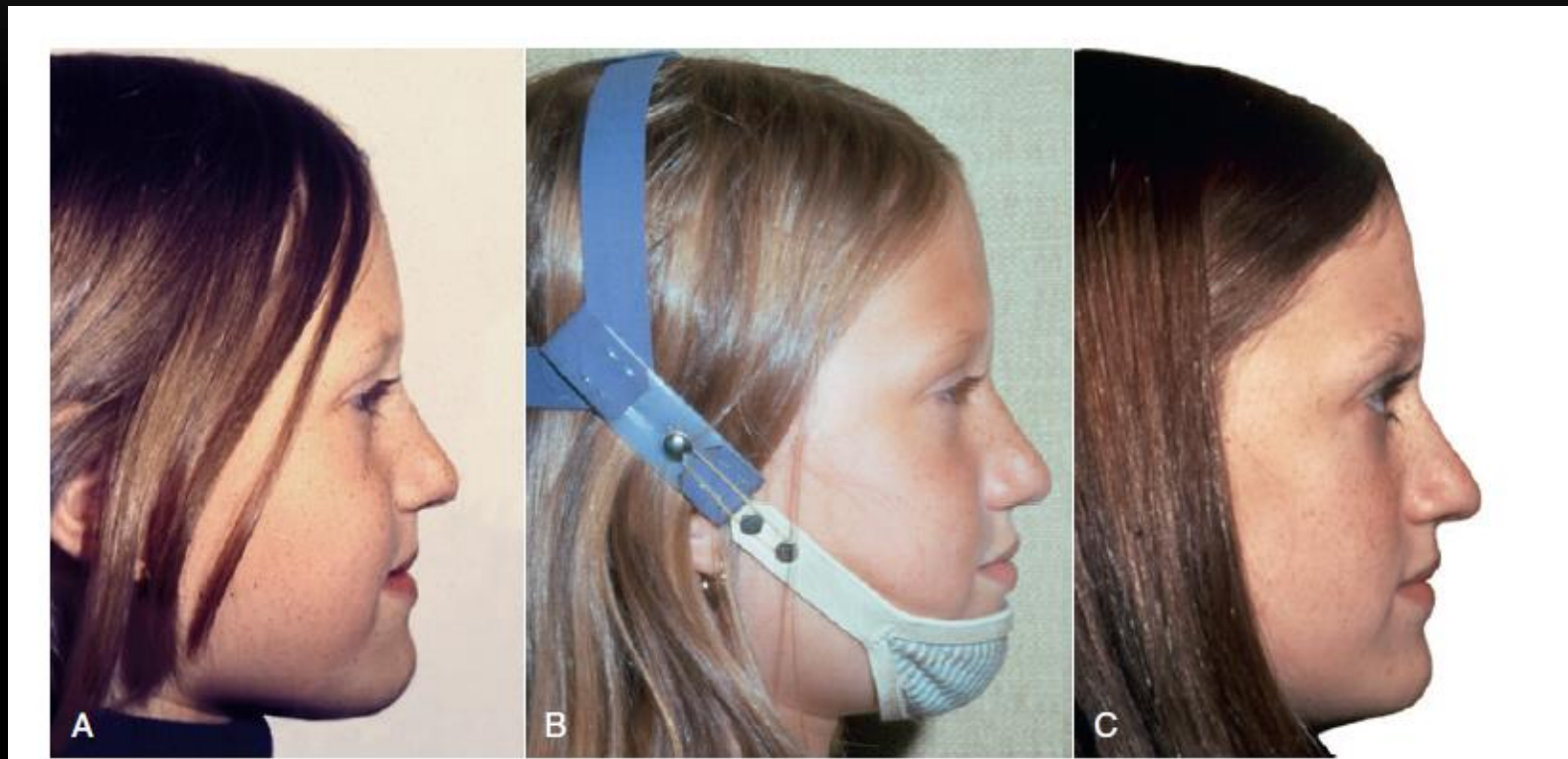
# FUNCTIONAL APPLIANCES IN TREATMENT OF EXCESSIVE MANDIBULAR GROWTH

- Functional appliances for patients with excessive mandibular growth **make no pretense of restraining mandibular growth**. They are designed to **rotate the mandible down and back** and guide the eruption of the teeth so that the upper posterior teeth erupt down and forward while eruption of lower teeth is restrained. This rotates the occlusal plane in the direction that favors correction of a Class III molar relationship. These appliances **also tip the mandibular incisors lingually and the maxillary incisors facially**, introducing an element of dental camouflage for the skeletal discrepancy.

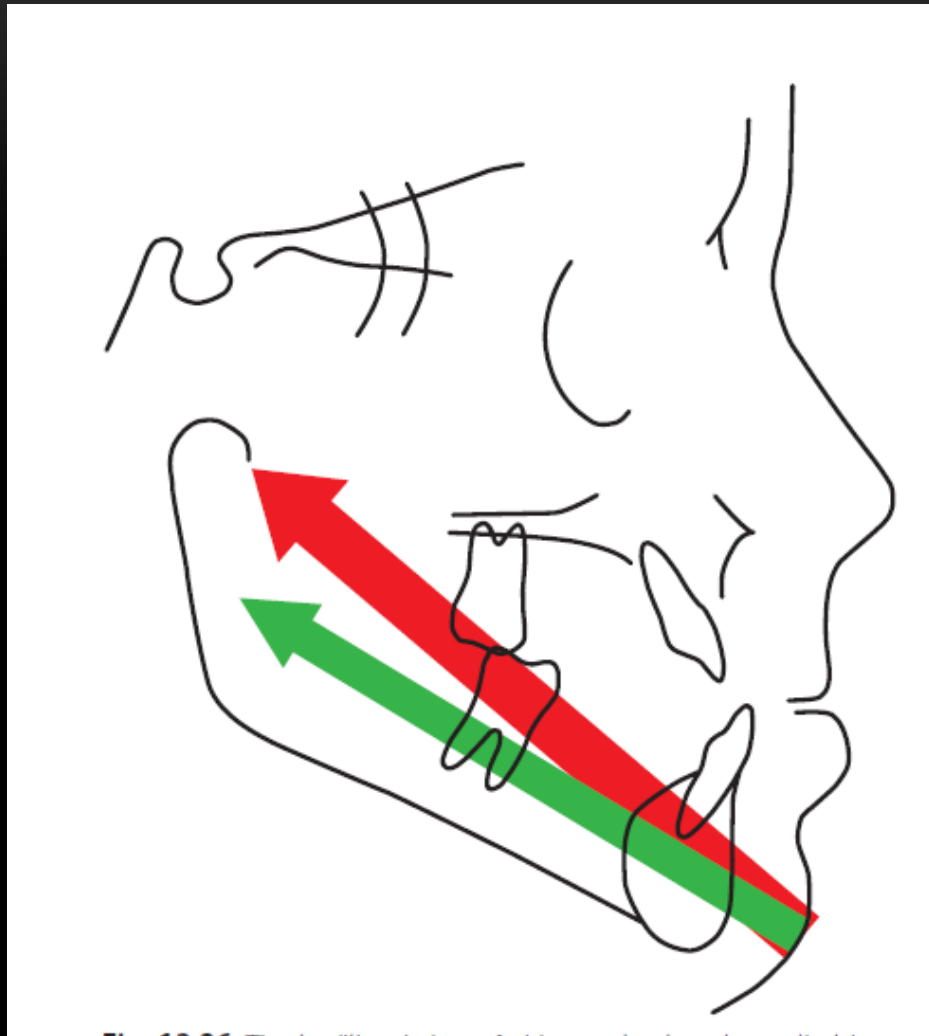
- To produce the **working bite** for a Class III functional appliance, the steps in preparation of the wax bite, practice for the patient, and use of a guide to determine the correct vertical position are **identical** to the procedure for patients with **Class II problems** .
- However, the working bite itself is significantly different: **The mandible is rotated open on its hinge axis but is not advanced. This type of bite is easy to obtain because light force can be placed on each side of the mandible to guide the mandible and retrude it.**
- How far the mandible is rotated open depends **on the type of appliance and the need to interpose bite blocks and occlusal stops between the teeth to limit eruption.**
- The general guideline is that the mandible should be **rotated at least 3 and not more than 5 to 6 mm beyond its postural rest position**. If this is not enough or would produce excessive anterior face height, the problem is too severe for functional appliance treatment.

# CHIN-CUP APPLIANCES: RESTRAINT OF MANDIBULAR GROWTH?

- In theory, extraoral force directed against the mandibular condyle would restrain growth at that location, but there is little evidence that this occurs in humans . What chin-cup therapy does accomplish is a change in the direction of mandibular growth, rotating the chin down and back, which makes it less prominent but increases anterior face height. The data seem to indicate a transitory restraint of growth that is likely to be overwhelmed by subsequent growth. In essence, the treatment becomes a trade-off between decreasing the anteroposterior prominence of the chin and increasing face height. In addition, lingual tipping of the lower incisors often occurs because the appliance presses on the lower lip and dentition , which often is undesirable.



- For chin-cup treatment, a hard plastic cup fitted to a cast of the patient's chin or a soft cup made from an athletic helmet chinstrap can be used. The more the chin cup or strap migrates up toward the lower lip during appliance wear, the more lingual movement of the lower incisors will be produced, so soft cups produce more incisor uprighting than hard ones. The headcap that includes the spring mechanism can be the same one used for high-pull headgear. It is adjusted in the same manner as the headgear. A persistent recommendation through the years has been a force of approximately 16 ounces per side aimed directly at the head of the condyle, on the theory that this would reduce growth. Once it is accepted that mandibular rotation, not growth inhibition, is the major treatment effect, lighter force oriented to produce greater rotation makes more sense



- One concern about chin cup treatment always has been the possibility that it could create temporomandibular dysfunction problems. this is not a problem, especially if very heavy force is avoided.
- In essence, chin cup therapy does the same thing as a Class III functional appliance, but offers at least a slim chance of some growth inhibition. For children with a large mandible, chin-cup treatment is essentially transient camouflage. For that reason, it has limited application.

# CLASS III ELASTICS TO SKELETAL ANCHORS

- The use of Class III elastics to skeletal anchors as an effective way of producing maxillary protraction was discussed earlier—but this force system also affects the mandible and may eventually provide a way to restrain mandibular growth.

# SUMMARY

- ❖ Controlling excessive mandibular growth remains the greatest challenge in orthodontics. Of the three possibilities:
  - Mandibular functional appliances offer **no possibility of inhibiting the excessive growth. They are capable only of downward– backward rotation of the mandible, which risks creating a long-face problem.**
  - Backward force against the mandible via chin cups attached to high-pull headgear also offers little beyond downward– backward mandibular rotation.
  - **Why is this so ineffective?** Probably because successful growth modification requires light force with a long duration, and chin cups deliver heavy force for short durations.
  - Class III elastics from miniplates at the base of the zygoma to the anterior surface of the mandible now have been shown to significantly change the pattern of mandibular growth. **This includes a lack of forward growth, the possibility of backward movement of the chin, and a reshaping of the mandible with an increase in the gonial angle—that is, an uprighting of the ramus relative to the body of the mandible.** Because most skeletal Class III patients have a component of both maxillary deficiency and mandibular excess, the effect on both jaws is an improvement over changing the growth of just one.

