Review Article

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ORTHODONTIC MANAGEMENT OF CLEFT LIP AND PALATE: AN OVERVIEW

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ABSTRACT:

Cleft of the lip and/or the palate is a congenital birth defect which is characterized by complete or partial clefting of the lip and/or the palate. The severity of clefting may vary from the trace of notching of the upper lip to complete non-fusion of the lip, primary palate and secondary palate.

Facial clefts are seen due to non-fusion of the facial process. The cleft of the lip, palate and face may be seen as an isolated birth defect, non-syndromic cleft or as a part of a syndrome with multiple congenital anomalies called as 'syndromic clefts'.

Patients with cleft lip and palate routinely require extensive and prolonged orthodontic treatment. Orthodontic treatment may be required at any or all of four separate stages: 1) in infancy before the initial surgical repair of the lip, 2) during the late primary and early mixed dentition, 3) during the late mixed and early permanent dentition, and 4) in the late teens after the completion of facial growth, in conjunction with orthognathic surgery.

This article discusses the various aspects of cleft lip and palate and its management from the orthodontic perspective.

Key words : Cleft lip, Cleft palate, Orthodontics.

INTRODUCTION:

Historically, evaluations and hospitalizations of cleft patients were done by independent caregivers. The American cleft palate-craniofacial association was established in 1943. The association defined the role of orthodontist in a cleft palate team.

In 1972 craniofacial teams became established as the extension of the cleft palate team. The treatment protocols for Cleft Lip and Palate management vary in cleft centres across the world with the underlying philosophy being the same. Early rehabilitation of the child allowing for normal development of intermaxillary relationship.

Integration of services

The care of cleft lip and palate patients require a number of specialists including psychologists and social workers to provide a comprehensive treatment from birth to adulthood. Treatment course of a cleft patient and approach is based on the consultation among the specialists involved with the cleft care. However, during different stages of the physical and social development of the cleft patient, role of one specialist may be more significant than the other.

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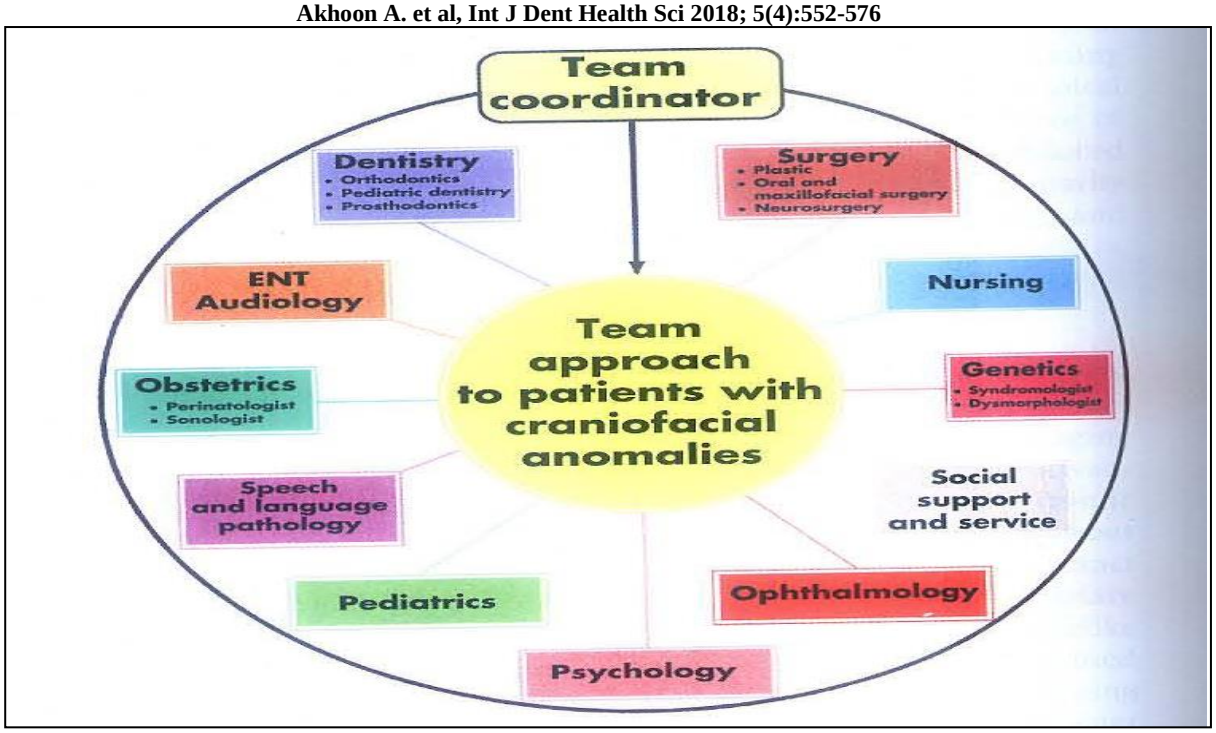


Philosophy of Orthodontic Management

- Overview of the problem
- Interaction with other team specialists
- Evaluation of results
- Acquisition of new knowledge
- Diagnosis
- Management
- Overview of the problem

Knowledge of aspects like : incidence, etiology, embryogenesis, neonatal anatomy and physiology enhances the ability of the orthodontist to interact with the team. Also necessary is the discussions with plastic surgeons, normal and cleft speech mechanisms, maxillofacial prosthetic/Prosthodontic techniques, social service problems and anatomical deviations and the techniques of lip palate closure.

Incidence/Epidemology

Incidence of cleft lip/cleft palate : 1:800 – white Americans. 1:2000 – blacks. Cleft lip/cleft palate account for 50% of reported cases. Cleft lip or cleft palate alone account for 25% of reported cases.

In India :

- cleft lip + cleft palate : 1.25/1000
- cleft palate : 0.46/1000

Sex ratio :

Cleft lip + cleft palate : males > females

Cleft palate alone : females > males

Laterality of lesions :

In case of unilateral clefts, left side is more frequently involved than the right side.

Increase in frequency :

- with increase in parents age, especially father.
- consanguineous marriages.

Interaction with other team specialists

Prospective / Retrospective

Prospective :

- proper diagnosis
- treatment planning
- prognosis

Retrospective :

- leads to improvement in rehabilitary techniques.

•Acquisition of new knowledge
•To alter one's approach
•Determination of cost/benefit analysis
•Recognition of variability in cleft population
•Impractical to attempt to treat all cases alike
•Maintenance of good longitudinal records.

DIAGNOSIS:

Prenatal Diagnosis of Cleft Lip/Palate

Ultrasonography is a noninvasive diagnostic tool now widely used as a routine component of prenatal care. Ultrasonography serves to confirm fetal viability, determine gestational age, establish the number of fetuses and their growth, check placental location, and examine fetal anatomy to detect any malformations.

Advantages of Prenatal Cleft Diagnosis

There are several potential advantages for informing parents of a prenatal diagnosis of facial clefting:

1.Psychological preparation of parents and caregivers to allow for realistic expectations at the time of delivery.
2.Education of parents on the management of the cleft: presurgical neonatal orthopedics, plastic surgery for lip and palate closure, and alveolar bone grafting.
3. Preparation for neonatal care and feeding.
4. Opportunity to investigate for other structural or chromosomal abnormalities.
5. Possibility for fetal surgery.

An additional advantage of prenatal diagnosis of cleft lip and palate is the ability of the plastic surgeon to prepare a customized plan of management for surgical repair of the cleft once the sonologist characterizes the specific type of cleft and describes the extent of the anomaly.

With this information, the plastic surgeon may wish to educate the parents about the severity of the deformity, the need for any adjunctive intervention before surgery, and the predicted outcome of repair.

Disadvantages of Prenatal Cleft Diagnosis

Parents and professionals report an emotional disturbance and high maternal anxiety after prenatal diagnosis of cleft lip/palate is disclosed. However, parents of affected children strongly

favor being informed and involved in prenatal testing and counseling decisions and view this preparation as valuable despite acknowledging the increased anxiety and dysfunction during pregnancy. As the sensitivity of ultrasound screening in the detection of facial clefts increases, the potential exists for an increased number of families choosing to terminate the pregnancy even in the absence of other malformations. Factors such as perceived burden, expectation of recurrence, religious and cultural beliefs, professional advice, and gestational age at diagnosis are considered influential in the family's decision to terminate pregnancy.

A complex undertaking because of the various complicating factors.

Collection of records should begin at birth

- every six months till the age of 2 yrs.
- every year after that.

Data base

- patient history
- clinical / radiographic examination
- systemic description of the occlusion and analysis of the orthodontic records.

A. Patient history

1. Medical / Dental history :

Primary importance to the accurate description of the type and extent of cleft present at birth.

Record of the timing and type of surgery performed to correct the defect.

Well established differences in growth patterns and dimensions among various types of clefts.

Variations in frequency of dental anomalies depending on cleft type (10-25%).

Potential complicating factors

- Mental retardation.
- Neuromuscular anomalies.
- Skeletal tissue anomalies.
- Frequent upper respiratory infections
- Enlarged tonsils or adenoids
- Other forms of nasal obstruction.

2. Social / Behavioral :

Behavioral characteristics lead to extremely poor oral hygiene.

Poor prognosis for co-operation.

Patient "burn-out".

Orthodontist should be willing to adjust.

3. Somatic growth, development and maturation

Includes : - Clinical evaluation
- Serial ht/wt data
- Dental age
- Skeletal age

Infancy / "catch-up" growth

Exhibit lower skeletal ages than normals, indicating delayed maturation. Aspects like delayed dental development and

retarded eruption to be considered in terms of possible :

- Serial extractions
- Initiation of active treatment

4. Genetic / Family history :

Family history is significant as cleft superimposed upon an underlying skeletal growth pattern may vary from Class I, Class II, Class III.

i.e. In class III cases : immediate attention

In class II cases : favourable

5. Habits : - Tongue thrust
- Finger/Thumb sucking
- Prolonged use of pacifiers

B. Clinical and Radiographic examination

1. Facial esthetics :

In defects of palate only- facial esthetics are usually close to normal.

In case of an extensively scarred palate, there is a slight maxillary underdevelopment leading to a straight or mildly concave mid-face profile.

Also continued growth of the mandible and nose may worsen the profile.

Clinical findings:

- Forward rotation/position of pre-maxillary segment
- Tethered nasal tip
- Thin upper lip, protrusive lower lip
- Retrusive soft tissue profile
- Increased lower face height
- Lowered positioning of the tongue due to a constricted, scarred, obliterated palatal vault
-Mouth breathing
-Enlarged tonsils.

2. Intra-oral soft tissue :

Estimate of the extent , location and severity of palatal and alveolar scarring provides a clue to :

1. Response of a palate to expansion
2. Degree of retention required.
3. Impediments to tooth movement.

4. Possible cause of altered tongue posture.

Soft tissues potentially leading to altered mandibular posture or function.

Abnormal, scarred frenal attachments may affect the configuration of any appliance. Monitoring gingival signs of developing periodontal disease related to poor oral hygiene.

3. Muscle balance and function :

The diagnosis and interception of developing functional problems, from early childhood through stabilization of the adult dentition is the most important aspect of clinical evaluation. Functional alterations due to frequent occurrence of severely malposed teeth, dental anomalies and skeletal dysplasia's.

Functional alterations :

1. Mandibular closure
2. Tongue function + posture
3. Respiratory patterns.

Effects :

1. Unilateral crossbite in centric occlusion
2. Pseudoprognathism (mixed dentition)
3. Problems of lip tonus + function.

4. Dental problems

The presence of the cleft is associated with division, displacement and deficiency of oral tissue. Cleft lip and palate patients can have one or more of the following features:

•Congenitally missing teeth (most commonly the upper laterals)
•Presence of natal or neonatal teeth
•Presence of supernumerary teeth
•Ectopically erupting teeth
•Anomalies of tooth morphology
•Enamel hypoplasia
•Microdontia
•Fused teeth
•Poor oral hygiene leading to caries + pdl disease
•Mobile and early shedding of teeth due to poor periodontal support
•Posterior and anterior cross bite
•Protruding premaxilla
•Deep bite / open bite
•Spacing and crowding
•Careful monitoring required as premature loss may lead to decrease in arch length.
•Soft palate muscles insert on posterior

margin of remaining hard palate rather than midline raphe.
•Associated Dental Abnormalities
•Supernumery Teeth- 20%
•Dystrophic Teeth- 30%
•Missing Teeth- 50%
•Malocclusion- 100%

C. Description of the occlusion and analysis of the diagnostic records

Need to understand the basic D-A and craniofacial development potential in the cleft population.

According to Graber (1949)

- All children with clefts, if left untreated are capable of achieving reasonably normal skeletal/dental relationships.
- Many of the present day orthodontic problems are the result of the treatment rather than the defect itself.

Various problems encountered :

1. Intra arch alignment and symmetry.
2. Profile / esthetics.
3. Transverse problems.
4. Sagittal problems.
5. Vertical problems.

Intra arch alignment and symmetry :

Process of lip repair results in a generalized reduction in cleft width and max. arch width dimensions. Intra-arch malalignments appear with the eruption of the deciduous dentition. Severe rotations/lingual inclination of permanent incisors in clefts involving the alveolar ridge.

Transverse problems :

Infants : excessive max. width dimensions

(BCLP > UCLP > CP > NORMAL)

Full deciduous dentition :

(BCLP < UCLP < CP = NORMAL)

Subsequent skeletal growth might lead to more severe problems.

Clinical significance:

Re-expansion will invariably be necessary because of an incompatibility in growth direction.

Antero-posterior sagittal problems :

Variability and uncertainty due to gross displacement and distortions of landmarks (i.e. ANS, PNS). In primary dentition class III molar relationship / ant.crossbite are of great concern. Retroposition of the maxillary buccal segments as a result of scar-mediated “maxillary ankylosis” as proposed by Ross..

Clinical significance :

1. A-P problems worsen with age.
2. Problem compounded by the normal anterior expression of mandibular growth.
3. Consideration to be given to the rest position of the mandible at the time of record taking.

Vertical problems :

Vertical contributions to the orthodontic problem arise during the development of the mixed dentition:

1. Progressively decreasing rate of max. vertical development by the time of early permanent dentition.
2. Increased severity due to downward and backward rotation of premaxilla.
3. Cant in the palatal plane.
4. Altered mandibular posture and assosiated increase in gonial angle.
5. Excessive freeway space.
6. Impeded vertical eruption of maxilla.
7. Local disturbances in the vertical eruption of teeth adjacent to the cleft.
8. Overclosure of the mandible aggravates Cl III condition.
9. Elongation of the facial profile.

Net result of this complex interaction - the vertical deficiency tends to accentuate the A-P discrepancy b/w jaws, and then both problems serve to create a worsening transverse imbalance. The primary dentition cannot be used to evaluate the magnitude of future problems.

Aim of cleft palate diagnosis

Cleft palate orthodontic diagnosis must evaluate potential problems in all three planes of space, with both skeletal and dental components. It must take into account features both common to and unique for the various types of clefts, as all tend to get worse with further growth and development.

Role Of the Orthodontist

Timing and sequencing of orthodontic care may be divided into four distinct developmental periods. These periods are defined by age and dental development and should be considered as time frames in which to accomplish specific objectives. Such sequencing avoids the common tendency to allow an early phase of treatment intervention to extend through infancy, childhood, adolescence, and into adulthood. With the understanding that children born with cleft lip and/or palate should be treated by an interdisciplinary team approach, the following four time periods in the child's development provide a framework for discussing and recommending defined objectives.

Timing of orthodontic treatment

Fishman

1. Pre-dental : (1-18 months)

- prior to the eruption of the primary molars.

a) Pre-surgical
b) Post-surgical

2. Deciduous dentition : (3-6 yrs)

- after full eruption of the primary dentition.

3. Early mixed dentition : (7-9 yrs)

- during eruption of permanent maxillary dentition.

4. Late mixed and early permanent dentition : (9 yrs onwards)

Profitt

1. In infancy i.e. before the initial surgical repair of the lip.

2. During late primary and early mixed dentition.

3. Late mixed and early permanent dentition. In the late teens, after completion of the facial growth in conjunction with orthognathic surgery.

Predental Rx / Infant orthopedics(Mcneil, Burston – 1950's)

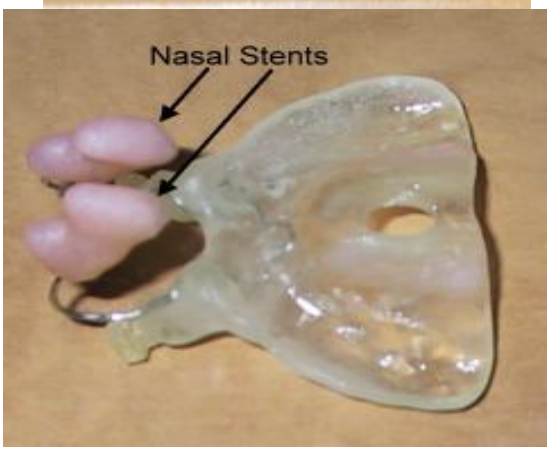
To align the distorted maxillary arch segments orthopaedically in early neonates, prior to any surgical repair. This is considered as topic of heated debate.

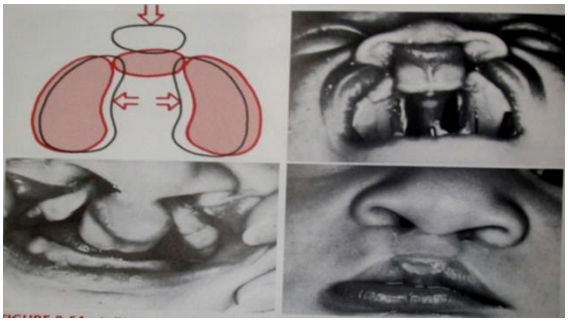
Approaches varied among different centers:

- Active orthopedic movement
- Simple passive holding appliances
- With or without primary bone grafting.
- Extra-oral pinned appliances.

Rationale / Objectives :

1. To facilitate feeding.
2. To help establish normal tongue posture.
3. Provide a psychological boost to patients/parents.
4. Assist the surgeon in his initial repairs.
5. Stimulate palate bone growth.
6. To restore the oro-facial "functional matrix".
7. To help decrease the number of ear infections.
8. Expand or prevent collapsed segments.





9. To reduce the need for later orthodontic treatment.
10. To allow soft tissue growth.
11. To guide tooth eruption.
12. Improve esthetics.
13. To reestablish sutural growth patterns.

According to cooper :

- Emphasis on minimizing total active orthodontic intervention, limiting it to what is required to achieve the optimum results.
- Against any orthodontic/orthopedic therapy.
- Patient's monitored continuously.
- Questioned the claimed advantages of pre-surgical orthopedics.

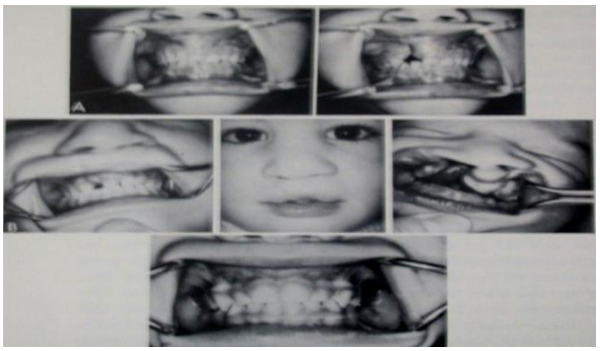
Opponents of presurgical orthopedics put forth the following claims:

Cleft always reduces in size without presurgical treatment. The cleft invariably reduces in size following primary surgery. Good surgical technique makes presurgical treatment unneces-sary. All cleft babies can be fed satisfactorily without obturation of the palatal cleft. Growth of the maxilla can be inhibited by the use of lip strapping and there is a greater incidence of cross bite.

Oslo approach (1948 ….)

One of the first cleft treatment teams, based at two places : Bergen / Oslo. Based on the principles given by Egil Harvold and Arne Bohn. Wilhelm Loennecken (plastic surgeon) became a part of the oslo team (1948) and introduced a standard surgical procedure for all cleft treatment.

Objectives :(Bergland)



1. Provide an aesthetically acceptable and healthy dentition for life and to contribute positively to the general facial form and appearance.
2. Using appliances as simple as possible.

Pre-surgical period

When introduced in 1950's not accepted in Oslo. Pre-surgical orthodontics was used in Europe/USA for over 30 years but did not demonstrate any long term benefits in relation to:

1. Facial growth
2. Appearance
3. Speech
4. Occlusion

Definitive lip repair usually is achieved by the time the infant is 3 to 6 months old, and repair of the palate typically is delayed until 12 months to 2 years of age. Palatal repair is another controversial issue, and many methods are available for repairing just the soft palate or the hard and soft palate simultaneously. The rationale for the timing of the palatal repair is related to

the developing speech and language skills of the child, which typically evolve around the first year of age. This rationale is usually in conflict with the effect of early surgical repair and the constraints of scar tissue on the growth and development of the nasomaxillary complex. Early repair of the palate and the resulting scar tissue may have an effect on the growth and development of the maxilla, which is reflected in the occlusion as a crossbite of anterior and posterior teeth. The severity of the malocclusion has been associated with certain surgical methods of palate repair, and evidence from unrepaired clefts in children and adolescents indicates that crossbites in the dentition rarely develop in the absence of surgical repair and resulting scar tissue.

Deciduous dentition

Usually no treatment provided at this stage because :

1. Dental irregularities are usually minor
2. No long-term benefits
3. Does not ensure normal eruption of permanent teeth
4. Certain need of future orthodontic treatment
5. Evaluation of super-numerary teeth.

Treatment can produce only temporary results which would be poor compensations for deeper skeletal abnormalities which become increasingly manifested later.

Patient Follow up

•Patients seen regularly at 6 monthly intervals for review.

•Motivating the family.

•Generate early rapport with the child.

•Constant monitoring of caries & oral hygiene status.

•Diet counseling.

•In some cases equilibration of deciduous canines done to prevent lateral shift of mandible.

These appointments are made to coincide with speech therapy to decrease frequency of visits. Towards end of deciduous dentition, intervention by face mask therapy if indicated.

Interceptive Orthopedic Intervention: How Early?

Tindlund, 1994: found significantly better skeletal response when maxillary protraction was started at the mean age 6.3 years than later. The goal is to allow the permanent maxillary incisors to erupt spontaneously into a normal overjet & overbite relationship. Protraction during the late deciduous dentition period reduces the unwanted dentoalveolar protrusive effect on permanent incisors. Younger patients are more co-operative than 10 year old.

The orthodontist should consider many factors in determining when to initiate orthodontic treatment during the primary dentition stage. These factors include the ability of the child to cooperate, the severity of the malocclusion, timing of secondary bone grafts, and the need for future orthodontic treatment in the early mixed or permanent dentitions. Contemporary opinion recognizes a need for orthodontic treatment in the early mixed and permanent dentitions. However, no strong evidence supports a benefit from routinely treating dental malocclusions in the primary dentition, suggesting that orthodontic treatment may be best delayed until it can be combined with other treatment goals and thus shorten the overall duration of treatment.

Interceptive Orthopedic Treatment in the Late Primary /Early Mixed Dentition

The aims of interceptive orthopedic treatment at this stage are to:

•Correct midface skeletal deficiency.

•Eliminate anterior and/or posterior crossbite.

•Provide optimal space for spontaneous incisors eruption.

•Improve the soft tissue profile.

The rationale for orthopedic correction has been predicated on early transverse, sagittal and vertical modification and redirection of circum-maxillary growth in all three dimensions :

•Transverse expansion of the upper jaw

•Anterior protraction of the upper jaw.

•Fixed retention by a palatal arch wire.

Mixed dentition (preparation for bone graft)

The first alveolar bone graft was placed in 1977 in Oslo based on the results of cancellous bone grafts by Boyne/Sands. Height of the inter-dental septum assessed on intraoral radiographs. Best results achieved when grafting done prior to the eruption of the permanent canine.

Primary Vs Secondary bone grafting

Primary Alveolar Bone Grafting. Most cleft palate teams in the United States have discontinued primary alveolar bone grafting in the neonate following a 5-year post-treatment outcome study in 1972 by Jolleys and Robertson. However, the case for early bone grafting has been defended and, although controversial, continues to be practiced by several institutions and craniofacial teams.

Secondary Alveolar Bone Grafting. By definition secondary or delayed alveolar bone grafting is performed after primary lip repair. The age at which the bone graft is placed defines whether it is early secondary bone grafting (2 to 5 years), intermediate or secondary bone grafting (6 to 15 years), or late secondary bone grafting (adolescence to adulthood).

Intermediate or Secondary Alveolar Bone Grafting (6 to 15 years of age). The

success of this intervention requires collaborative treatment planning among the orthodontist, surgeon, and other team members.

Secondary alveolar bone grafting offers five main benefits:

1. Provision of bone support for unerupted teeth and those teeth adjacent to the cleft. If a bone graft is placed before eruption of teeth adjacent to the cleft, it will improve the periodontal support of those teeth. If a bone graft is placed after eruption of the canine, the bone will not improve the crestal height of support and will resorb quickly to its original level.

2. Closure of oronasal fistulae. By using a three-layered closure technique, with the graft sandwiched between the two soft tissue planes, an increased success rate of fistula closure has been reported.

3. Support and elevation of the alar base on the cleft side. This benefit helps to achieve nasal and lip symmetry and provides a stable platform on which the nasal structures are supported. If this procedure is performed alone or is combined with alar cartilage revisions, improved aesthetic changes occur.

4. Construction of a continuous arch form and alveolar ridge. This benefits the orthodontist for moving teeth bodily and for uprighting roots into the cleft site. A continuous arch form also benefits the surgeon and prosthodontist by enabling a more aesthetic and hygienic prosthesis in preparation for implants to be placed when teeth are missing.

5. Achieve stabilization and some repositioning of the premaxilla in those patients with a bilateral cleft. Controversies concerning alveolar bone grafting require a rational and evidence-based approach for resolution. These controversies relate to the timing of the alveolar bone graft, the sequencing of orthodontic treatment to correct a transverse discrepancy with palatal expansion, and the sites and types of bone for the graft.

Timing. The timing of surgery depends more on dental development than on chronologic age. Ideally, the permanent canine root should be half to two thirds formed at the time the graft is placed. Permanent canine root formation generally occurs between the ages of 8 and 11 years. Rarely is the graft placed before this time, although occasionally the graft may be placed at an earlier age to improve the prognosis of a lateral incisor. Once teeth have erupted into the cleft site, their periodontal support will not improve with a bone graft. Instead, the height of the crest of alveolar bone resorbs to its original level. For this reason, performing the graft before the eruption of the permanent canine is recommended. If the lateral incisor is on the distal side of the cleft, the graft should be placed earlier.

Sequencing. Secondary bone grafting has been divided into early (2 to 5 years of age), intermediate (6 to 15 years of age),

and late (16 years to adult). Since Bergland et al published the results from the Oslo study in which 378 consecutive patients had undergone alveolar bone grafting, contemporary opinion supports the intermediate period as the most appropriate time for grafting. Bone grafting in the intermediate period has the greatest benefits and least risk for interfering with midfacial and skeletodental growth and development. The sequencing of procedures surrounding alveolar bone grafting requires interdisciplinary communication and cooperation resulting in better and more predictable patient care. The general or pediatric dentist ensures that any decayed teeth, especially those adjacent to the cleft, are restored before the grafting procedure. Patient and parents are instructed on good oral hygiene practices to maintain at home. In addition, orthodontic treatment may be required presurgically to reposition maxillary teeth that are in traumatic occlusion or to expand a severely constricted maxilla, thus providing the surgeon better accessibility to the cleft defect. Any erupted teeth adjacent to the cleft that have poor periodontal or endodontic prognosis should be extracted at least 2 months in advance to allow healing of mucosal tissues before surgery.

Surgical Technique. The grafting procedure uses tissue lining the cleft defect to construct a nasal floor and close the nasal side of the oral-nasal fistula. The cleft lining is elevated in a subperiosteal plane that leaves bare the osseous margins of the cleft. Cancellous bone taken from the ilium, cranium, or mandibular symphysis is then packed into the cleft defect. Cancellous bone is preferred over cortical bone because it revascularizes more rapidly and is less likely to become infected. Once the cleft defect is packed with bone and the margins are overpacked, soft tissue coverage of the graft is required. The surgeon determines the choice of the donor site from which the bone is harvested. Traditionally, the iliac crest, ribs, and tibia have been used because of their abundant supply of cancellous bone. The morbidity of harvesting bone from these sites results in most patients being hospitalized postsurgically because of complications associated with the donor site more so than with the oronasal recipient site. The cranium has become an alternative site from which to harvest cancellous bone because of the lack of associated discomfort and the amount of hospitalization, time involved. However, the operating risks are higher and the abundance of cancellous bone is less than from the iliac crest. The mandibular symphysis is another donor site but should be recommended only when the permanent mandibular canines have been located so as to minimize the chances of injuring these developing teeth.

Orthodontic Considerations Associated with Secondary Bone Grafting. Orthodontic concerns regarding secondary bone grafting relate to the transverse dimension, incisor alignment, and eruption of the maxillary canines.

The Transverse Dimension. Orthodontic expansion of the posterior segments preoperatively may improve the occlusion but also widen an existing fistula. The expansion provides better access at surgery for incision and elevation of flaps with closure of the palatal and vestibular oronasal fistulae following the cancellous alveolar bone graft. Expansion also improves the buccolingual orientation of the collapsed posterior segment with the anterior segment, restoring arch symmetry. Retention of the corrected crossbite with orthodontic appliances postsurgically may be indicated because the bone graft is unlikely to stabilize the expansion.

Incisor Alignment. Alignment of incisors adjacent to the cleft, which typically are rotated, displaced, or tipped, is limited by the available bone into which the roots of the teeth may be moved. If appliances have been placed presurgically, individual orthodontic tooth movements should be delayed until 2 to 6 months following placement of the bone graft. The early movement of the roots into the grafted bone appears clinically to consolidate the alveolar bone and improve the crestal alveolar height. The orthodontist should confirm with the surgeon on the timing of tooth movement into the grafted cleft site. In bilateral cleft lip and palate cases, a vertically extruded premaxilla can be repositioned upward with the use of a labial intrusion archwire, moving the incisors en masse with the bone in vertical alignment with the posterior segments prior to bone grafting.

Eruption of the Maxillary Canine. Following surgery, the maxillary canine erupts through the graft. With orthodontic movement of teeth, sufficient space is created in the arch to allow the canines to erupt successfully. Removal of unerupted supernumerary teeth usually is performed at the time that the bone graft is placed to create an unobstructed path of eruption for the canine. Often the canine will erupt rapidly following the bone graft. If the lateral incisors are malformed or absent, especially in patients with bilateral clefts, the canine is encouraged to erupt adjacent to the central incisors. Closing the edentulous space is an advantage, thus avoiding the need for a prosthetic replacement of the absent lateral incisors. However, “canine substitution” needs to be considered in the context of the occlusion, crown morphology, and the need for orthognathic surgery. Many of the orthodontic problems encountered at this stage are effects of early surgical repair.

Problems frequently encountered :

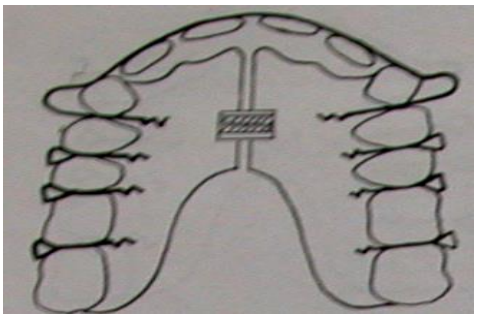
- Malposed permanent incisors
- Posterior crossbite
- A-P molar discrepancies
- Serial extraction
- Detection of dental anamolies.
- Lingual appliance kept for 3 months post-operatively i.e. to enable the bone graft to maintain the

transverse dimension of the basal bone.

Maxillary incisors :

- Often erupt rotated, retroclined and possibly in anterior crossbite.
- Corrected for esthetic reasons and to facilitate oral hygiene (labial archwire – 3/4 months)

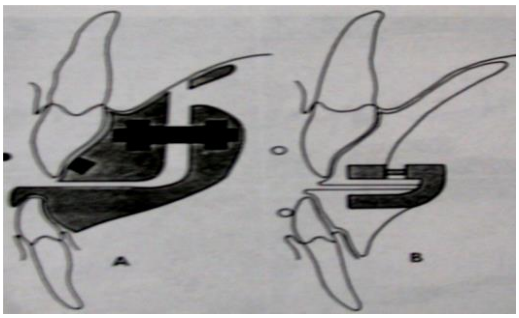
- Less severe cases can be treated with a maxillary Hawley plate or a finger spring.

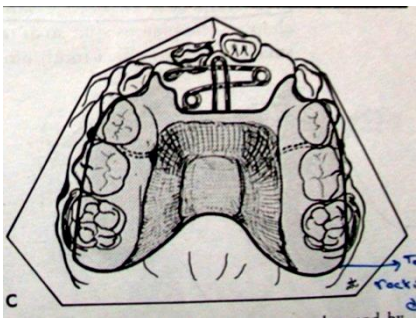


Buccal crossbite attributable to segmental displacement corrected simultaneously using a palatal arch auxillary spring / Quad helix / Removable screws.

Segmental repositioning :

- Done just prior to the bone grafting procedure





In pt's with BCLP, the mobile premaxilla is stabilized with a heavy rectangular archwire to ensure immobility.

A-P molar discrepancies : (cooper)

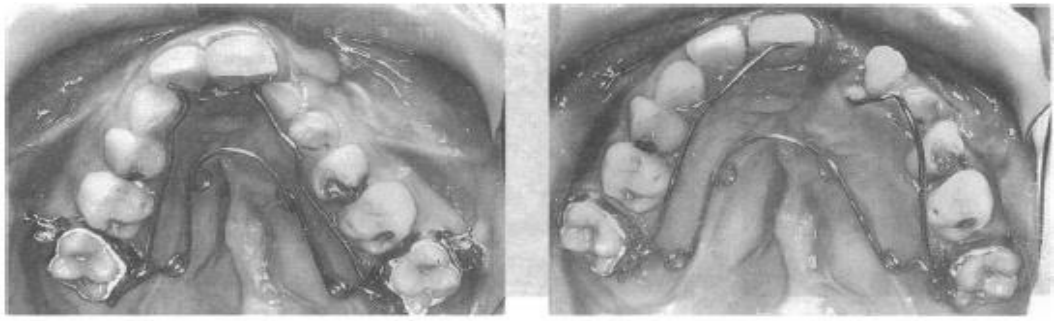
- In Cl II cases : cervical pull headgear
- In Cl III cases : reverse pull headgear (Delaire face mask) + chin cup therapy.
- Care to be taken in relation to severe antero-posterior hypoplasia.

Lip closure creates some constriction across anterior part of maxillary arch. Similarly, cleft palate closure causes lateral constriction. Early orthodontic interventions in anterior cross bite cases to avoid permanent postural adaptation of mandible. Retention of treated occlusion till completion of permanent dentition with a fixed or semi-fixed lingual retainer.

Lateral crossbites corrected in a similar way. Correction of maxillary arch collapse prevents lateral shifts of mandible, improves sagittal mandibular position by circumventing adaptive mandibular prognathism. Provide area for tongue, promote normal maxilla-mandibular development & prepare arch for secondary bone grafting. Semi-fixed & fixed appliances are superior in efficacy to removable appliances.

Quad helix : It provides controlled force application to correct severe segmental distortion. Can be constructed chairside. It has four sites of activation, exerting three-dimensional control on molars; powerful anchorage mechanism.

NiTi expanders can also be used.



When maxillary expansion has been significant & chiefly in canine-premolar region - desirable to have open end of U-shaped retainer facing posteriorly.

Use of lingual sheaths & semifixed type designs serves four advantages:

1. Ease of making major adjustments.
2. Replacements can be made at any time without increasing band inventory.
3. Time requirements are minimized.
4. Transition from expansion to retention phase is immediate.

To avoid wire crossing cleft site from interfering with surgical bone grafting procedures, retainer can be removed prior to intubation & secured back immediately after extubation, allowing no time for relapse. Allows for rapid replacement with second design, with open end facing anteriorly, which is often useful during transitional phase of dentition.

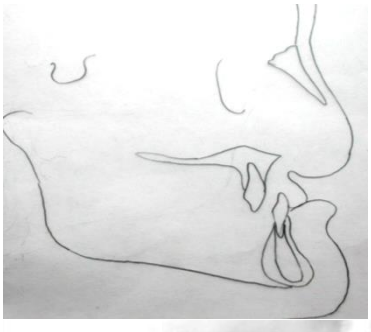
Open end anteriorly allows intercanine width maintenance when maxillary premolars have replaced deciduous molars, which usually occurs before permanent maxillary canines erupt. Severely rotated maxillary central incisors corrected for esthetic reasons, facilitate oral hygiene, allow secondary lip surgeries & avoid deleterious sequelae on lower dentition & jaw relation. Semifixed appliances such as 0 by 2 ASTBA (anterior sectional twin bracket appliance), employing reciprocal anchorage.

Erupting occlusion kept under surveillance with help of OPGs as well as guided with space management procedures. 2 to 3 years after bone

grafting usually when the cleft side canine has erupted spontaneously through the graft or has been surgically exposed.

Orthodontic Vs Prosthodontic space closure.

Every effort is made to mesialize the posterior teeth and to correct maxillary hypoplasia. Maxillary hypoplasia is a common problem encountered in almost 25% of the cleft population – *Ross (87).*



Center of Resistance of Maxilla (Cres) – Postero-superior border of the Pterygomaxillary fissure. (*Tanne*)

Center of Resistance for maxillary dentition – Between root apices of deciduous molars / premolars.

Reverse pull headgear v/s Distraction

Factors to be considered:

Methods of correcting Maxillary hypoplasia

- Reverse pull headgear
- Distraction osteogenesis
- Orhthognathic surgery

Before 1970, the chin cup provided mainly dentoalveolar retroclination of the mandibular incisors to correct the class III incisal relationship with limited effect. The introduction of the facial mask for early protraction by heavy forces to the maxillary complex in CLP patients was reported by Delaire and colleagues 1972.

Biomechanics of Conventional Reverse Pull Headgear

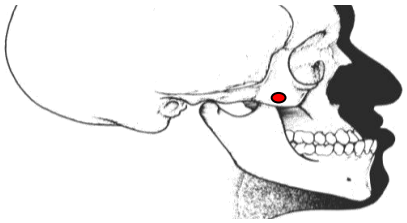
maxillary sutures.

Design : Consists of Wire & acrylic maxillary splint with occlusal coverage. It is cemented with GIC. Provides attachment sites for heavy elastics which are engaged on to a splint anchorage type reverse headgear (facemask).

1. Age and compliance of the patient
2. Amount of correction
3. Biomechanics (Force Vector).

Maxillary protraction (facemask)

Indications



Sagittal deficiency of maxilla, anterior crossbite, downward rotation of maxillary plane, and low angle cases.

Age : Ideal age for Protraction headgear is between 5-8 yrs. Early intervention eliminates need for RME to free circum-

Angle of about 10 degrees to occlusal plane & delivering 500 gm force on each side for 14-16 hrs a day for 6-12 months. Rapid correction of sagittal relation. Maxillary base protraction, canting of maxillary plane upward, remodeling changes in anterior maxilla & a backward rotation of mandible. Avoided in patients with true mandibular prognathism, very large sagittal discrepancy in early childhood & in high angle cases.

Permanent dentition – phase of comprehensive orthodontic care

Recognition of orthodontic limitations in correction of malocclusion- "Therapeutic diagnosis". Comprehensive orthodontic mechanotherapy with fixed appliances to improve overall occlusal, esthetic & functional prognosis.

Main features include:

• management of arches

•Tooth movements to finalize the occlusion

•Closure of spaces when possible or planned space management in areas of missing teeth for prosthetic rehabilitation

• Pre- & post-surgical orthodontics

Achieved by controlled force application, gently paced mechanics.

Extraction decisions

Fissural & supernumerary teeth near cleft mostly extracted for adequate bone support to move or use them. Lower premolar extractions based on space needs in the arch & cephalometric goals set in accordance with maxillary arch.

Atypical extractions include a lower central incisor. Common in non-surgical compensation plans when space requirements are minimal in lower arch. An edge-to-edge relation with the upper arch at the end of a non-extraction plan.

Bolton's index reveals a larger mandibular tooth size ratio. Posterior occlusion is favorable. Contracted or V-shaped basilar arch is diagnosed

Advantages include :

1. Rapid alignment of crowded lower anteriors.
2. Accomodation of all remaining incisors in the central trough of bone which is often thin in cleft patients.
3. Decreased need for overexpansion in upper arch.
4. Maintenance of lower intercanine width.

Midline centering not a goal, though always attempted.

Appliance designs & choice of appliance systems

Removable quad helix design & semifixed lingual retainer. Sectional archwires for control of isolated segments. Utility arches are also frequently applied (BCLP cases) to create desired moments for control of premaxillary structures. Standard edgewise brackets allow good wire bending capabilities for self-determined control & freedom as per individual case requirement. Built in three dimensional control in straight wire appliance / pre-adjusted edgewise appliance may cause restrictions by setting teeth to a mean value of 'normal' non-cleft occlusion.

Riding pontics *(Dr. Suri, Dr. Utreja, Dr. S.P. Singh 1999)*

Decision to close spaces vs planned space management depends on amount of bone available to move teeth. Successful secondary bone grafts allow movement of teeth into graft site. Missing upper anterior teeth affect facial esthetics adversely. 'Riding pontics' are carefully selected acrylic teeth, which ride most efficiently on rectangular archwires. Enhance smile esthetics to have a motivating influence during comprehensive orthodontic therapy.

Teeth selected chair-side with their shade, shape & size camouflaging well with adjacent teeth. Bracket bonded on to the pontic. Reversing preadjusted bracket to avoid lingual root torque effect. Prevent gingival impingement by cervical end of pontic. Maintenance of adequate hygiene. Support to depressed upper lip.

Figure 8 stainless steel ligature tie with archwire ensures stabilization. Following completion of orthodontic treatment, bracket debonded along with rest of the arch & acrylic tooth integrated into retainer.

Relapse & retention

Long-term retention is needed. It is provided by:

-Soldered lingual retainers

-Upper Hawley's or circumferential retainer with pontic to replace missing tooth.

Serves purpose of retainer, partial denture, obturator and helps in speech.

Precautions in treaing cleft patients

-Avoid overzealous tooth movement into cleft sites for want of adequate bone support.

-Mechanics should be gently paced.

-Abstain from proclining upper anteriors into tight-scarred upper lip.

-Longer treatment time.

-Decision of orthodontics vs orthognathic surgery to be judiciously made.

-Expanded cleft arches maintained by long-term retention.

-Treated cleft cases followed up on a 6 monthly basis till atleast 21 years of age.

Surgical vs nonsurgical treatment

Goslon Yardstick *(Mars 1987)* - useful indicator of severity of maxilla-mandibular discrepancy, which can be corrected by orthodontics or would require maxillo-mandibular osteotomies.

Severe skeletal discrepancy – surgical treatment plan. As patients grow, growth deficiency becomes increasingly apparent. Important to follow growth pattern & not try to overcompensate dentition to camouflage even when unfavorable skeletal relationship develops. Surgery – usually maxillary advancement. Bimaxillary surgery in more severe cases, where otherwise unreasonably large maxillary advancement required. Include severe malocclusions that result in compromised mastication and speech and nasal pharyngeal airway patency.

Current protocols include a LeFort I maxillary advancement with concomitant fistula closure, and maxillary and alveolar bone grafting. Also require mandibular setback surgery because of the severity of the maxillary hypoplasia. Main disadvantage to this two-jaw approach is that majority have a mandible that is normal in both size and position or even small and retrognathic. Setback of the mandible to reduce the amount of maxillary advancement compromises final lower facial form.

Palatal fistulae & obturators

Surgical repair of palate is aimed at restoring speech. Residual fistula at junction of anterior & middle third of palate in some patients is difficult to

close by surgical means & may require palatal obturators. Occasional complaint of regurgitation is not an indication & patient/parents feel satisfied on being assured that there are no major consequences. Anteriorly located fistula contributes negligibly to speech distortion. As fistula shifts more posteriorly, more speech distortion & obturator becomes a compulsion.

When an obturator has to be given, patient instructed for proper oral hygiene, palatal massage & routine caries check-up. Acrylic teeth for edentulous areas & palatal obturator for improved speech may be motivating factor for post-orthodontic retainer in maxillary arch – 'three-in-one' obturator-retainer-partial denture.

Distraction osteogenesis

" Biologic process of new bone formation between the surfaces of bone segments that are gradually separated by incremental traction". Its origins can be traced back to the work of Codivilla in 1905. Distraction osteogenesis was first applied to the maxillofacial complex in 1972 by Snyder et al. to lengthen mandible by an external fixation device.

Maxillary distraction is useful when maxilla needs to be moved forward a considerable distance which by orthognathic surgery may not be feasible. 25% to 60% patients require maxillary advancement to correct the maxillary hypoplasia & improve aesthetic facial proportions. *(Figueroa & Polley, AJODO 1999)*

McCarthy in 1992 applied this concept to the human facial skeleton and opened the floodgates through which the next technical revolution in craniofacial surgery would pass. Clinically, distraction osteogenesis consists of five sequential stages (Mc Carthy, 1992) :

-Osteotomy

-Latency

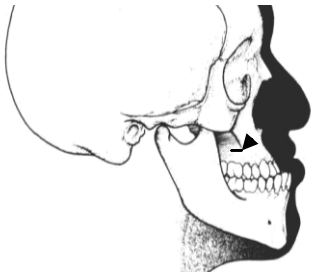
-Distraction

-Consolidation

-Remodeling

When the maxilla is osteotomized as in a Le-Fort I osteotomy, the consideration of vector will vary.

Center of mass for the maxilla – on the mesial aspect of the root of the upper permanent first molar.

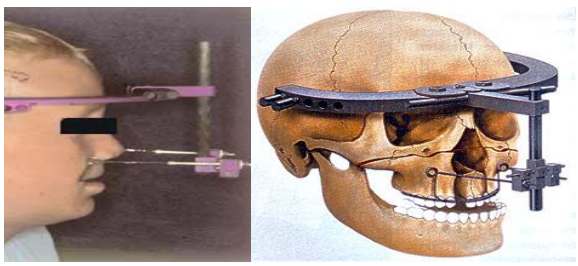


Surgical correction

Popularized by Obwegeser. Most commonly used Le-Fort I osteotomy. Use of secondry bone grafts.

Orthognathic Surgery

Treatment Planning. The timing and sequencing of treatment require close collaboration of the team. The decision to delay surgical orthodontic treatment until growth is stabilized may be sound but not always in the patient's best interest, especially when psychosocial development is affected. In some instances, skeletal surgery may be indicated before growth is completed, knowing that another procedure may be necessary if the patient outgrows the correction. As a general rule, skeletal surgery, orthodontic intervention, and final prosthetic rehabilitation should be completed before final soft tissue nose and lip revisions or rhinoplasty are instituted. The outcome of soft tissue surgical revisions, combined with osteotomies for the mobilization of the maxilla and mandible, is often unpredictable until the skeletal discrepancy has been corrected.



Role of the Orthodontist. A coordinated approach to the presurgical phase of orthodontic treatment is indicated. Twelve to 18 months of presurgical orthodontics are usually necessary to align the teeth, correct any compensations in axial inclination of teeth and any dental midline discrepancy, coordinate arches, and localize space for prosthetic replacement of the teeth. The provision of space for surgical cuts between the crown and the roots of adjacent teeth is also an important part of the presurgical preparations. Ideally, the patient is referred to the surgeon for a presurgical consultation, and the surgical movements are performed on mounted dental casts. Close communication between the surgeon and the orthodontist should identify any occlusal discrepancies that may prevent coordination of arches. The placement of full-size edgewise arch wires, with lugs, provides a means of intermaxillary fixation at the time rigid internal fixation is performed. After surgery is completed, the postsurgical phase of orthodontics details the occlusion, which should be completed within 4 to 6 months.

CONCLUSION:

Facial clefting is the second most common congenital deformity (after clubfoot). Problems are cosmetic, dental, speech, swallowing, hearing, facial growth, emotional. The orthodontist is a key member of the cleft palate team, and is in a unique position to identify and manage many of these problems.

The orthodontist's role in the cleft palate team requires close collaboration with the other team members. The rationale of timing and sequencing of orthodontic treatment have been discussed in four periods of development:

(1) neonatal or infant maxillary orthopedics,

(2) orthodontic considerations in the primary dentition,

(3) mixed dentition to include presurgical considerations before an alveolar bone graft is placed, and

(4) final treatment in the permanent dentition with orthodontics only or combined with orthognathic surgery. The latter period combines orthodontic and surgical approach to the correction of dental and skeletal components of malocclusion and facilitation of any necessary prosthodontic treatment.

Speech considerations and the communicative skills of the patient with a cleft are important aspects in planning orthognathic surgery for these patients. Subsequent nose and lip revisions for cosmetic improvement must not be underestimated in the enhancement of the final soft tissue facial aesthetic result following correction of the skeletal and dental discrepancies. Provided that the team members plan the timing and sequencing of appropriate treatment modalities in a closely coordinated, problem-oriented approach, patients with clefts should have optimal functional and aesthetic results. Outcome measures for reporting the results of surgical interventions require the choice of valid and reliable measures to be identified and implemented.

The ultimate outcome for team-based care is to have a fully rehabilitated patient who is satisfied with the treatment outcomes in terms of speech, occlusion, facial and dental aesthetics, and function. The patient should continue to receive conventional dental and medical routine evaluations similar to any adult to maintain optimal oral health.

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