

Prosthodontic Care for Patients with Cleft Palate

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ABSTRACT

Patients with cleft palate undergo various problems. The management of these patients by prosthesis has been a challenge for many years. Rehabilitation with prosthetic treatment helps patient psychologically to increase their self-esteem, and work to lead a normal life.

A basic knowledge on managing these patients makes prosthodontist better equipped in handling emergencies if they arise. Hence, this review article addresses literature on the historical background, prevalence, etiology of the cleft palatal defect and the prosthodontic approaches available for rehabilitation.

Keywords: Cleft palate, Palatal lift prosthesis, Implants, Obturator, Prosthetic care.

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INTRODUCTION

The cleft lip and palate is a congenital defect with the presence of an oronasal communication, malformation or agenesis of the teeth close to the cleft and deficient sagittal and transverse growth of the maxilla. The increased knowledge in the nature of the defect and of the remedial measures that were helpful in allowing cleft lip and palate patients to achieve more normal participation in the community life has attracted various specialists to aid in their rehabilitation. This in turn has led to the development of different treatment philosophies. Cleft of hard and soft palates are treated with various surgeries. Initially cheiloplasty was performed in the first months and in later years of life palatoplasty is carried out. Associated with these surgical advantages there has also been a need for cleft palatal prosthesis since rehabilitation is not limited to anatomical repair of cleft. Depending on the type and extent of cleft, several functional and morphological aspects such as speech, hearing, developing of occlusion and craniofacial growth may be damaged and required intervention by multidisciplinary team at appropriate time for achievement of integral rehabilitation.¹ The trained prosthodontist has methods at his command to assist both the surgeon and the patients.² Prosthetic therapy, aids the patient in developing normal speech, promoting deglutition and mastication and in closing off the oral cavity from the nasal cavity.

Along with oronasal communication patients with cleft lip and palate suffer from missing lateral incisor and canine

and also osseous deficiency of alveolus.³ Osteoplasty of alveolar cleft is an important step in orofacial rehabilitation. This technique aims to shape a regular alveolar ridge in cleft area to support the ala of the nose and to stabilize the maxillary segments. The esthetic benefits from the treatment can be instrumental in the psychologic and social acceptance of the cleft palate patient. Possible treatment option for missing teeth includes orthodontic gap closure, bridges or dental implants.

Prosthetic treatment allows patients to feel more normal, increases their self-esteem, and offers them greater opportunities for employment and for fulfilling their social potential.⁴ As previously mentioned various prosthetic choices are available for cleft patients with the development of osseointegrated implants the number of treatment options has increased further. An implant-retained prosthetic appliance is not only more convenient for cleft lip and palate patients, but provides greater stability, retention and chewing efficiency than other types of conventional prostheses.^{5,6} However, the combination of bone grafting and implant-supported fixed or removable prostheses represents an invasive treatment approach whereas, a conventional fixed or removable prosthesis represents a more conservative alternative for patients who refuse surgical intervention.⁷⁻¹⁰ Factors such as cleft position, maxillomandibular relationship, presence of remaining teeth, and extent and position of bone grafts are the determinants of both implant alignment and type of prosthetic appliance.¹¹ Fully edentulous patients now have the opportunity to receive complete restoration through osseointegrated implants. Osseointegration also allows for the fabrication of prosthesis that maintains the integrity of sound remaining teeth of patients with some missing teeth. In addition, a treatment plan can be designed to incorporate bone-supported appliances as well as rigid attachments.¹²

A basic knowledge on managing these patients makes prosthodontist better equipped in handling emergencies if they arise. Hence, the objective of this review article is to address the literature on the historical background, prevalence, etiology of the cleft palatal defect and the prosthodontic approaches available for rehabilitation.

Search Strategy

A literature search focusing on the objective mentioned previously was performed using electronic and manual search.

Historical Background

It has been postulated that the first obturation of a cleft palate was by Demosthenes (384-323 BC). Bien suggested that the great Greek orator visited the seashore to search for appropriately sized pebbles adequate to fill his palatal defect and thereby improve his speech. More current medical literature credits Hollerius, Petronius, and Pare with descriptions of prostheses for obturation of palatal defects in the 16th century. Works by Snell, Stearn, Kingsley, and Suerson in the 19th century describe current prosthetic designs.¹³

Prevalence

The prevalence of cleft lip and palate among the general population depends on racial, ethnic and geographic origin, as well as on socioeconomic status. True prevalence is not known because fetuses with malformations are more likely to be spontaneously aborted than healthy fetuses and, the risk of cleft lip and palate is three times higher in stillbirths than live births, most studies only report the prevalence of clefts in live births. Therefore, the prevalence of cleft lip and palate is likely to be under-reported.¹⁴ Still it has been estimated to range from 1:500 to 1:2,500 live births cleft lip occurs in 20 to 30% of cases, cleft lip and palate in 35 to 50% and cleft palate alone in 30 to 45%.¹⁵ More males than females are affected, and more males have complete clefts. Unilateral clefts are most common on the left hand side.¹⁶ Few prevalence studies discriminate between unilateral CLP and bilateral CLP, although a prevalence ratio of 4:1 has been reported. With progress in antenatal scanning, cleft lip is often diagnosed before birth, yet of approximately 572 babies born each year with either cleft lip, cleft palate or both, at least 20% are undiagnosed.¹⁶

Etiology

Etiology of cleft defects is still largely unknown. The specific reason for cleft defects continues to undergo investigation. The majority of cleft defect are believed to have multifactorial etiology and often associated with a complex sequence of events involving genetic mutations and certain prenatal environmental risk factors. Evidence shows that prenatal environmental risk factors, such as the mother's use of tobacco, alcohol, prescription and nonprescription medications, and illegal drugs as well as an excess or deficiency of certain vitamins, increase the likelihood a fetus will develop a cleft.¹⁷ The role of proteins in genetic causes of clefting has been established by recent research. Along with these it is found that the small ubiquitin-related modifier (SUMO1) gene encodes a small protein. During facial development, this protein attaches to

the protein products of three genes known to cause cleft lip and palate. When this protein is not produced in sufficient amounts, cleft lip and palates can occur.¹⁸ Smoking and folic acid intake during pregnancy are two main factors that modify genetic risks for cleft lip and palate. It has been reported that the fetuses of pregnant women who smoked lacked a particular enzyme—GSTT1 (glutathione s-transferase theta-1) and were more prone to develop cleft defect. The research determined that GSTT1 helps to reduced glutathione—an antioxidant—that protects cells from free radicals, which are initiated by smoking. The data showed that the risk of developing a cleft lip or palate in a fetus lacking the GSTT1 enzyme was significantly increased when the mother smoked 15 or more cigarettes per day.¹⁹ Folic acid, which is vital to the healthy development of the fetus, has also been linked to cleft lip and palate defects.²⁰ Folic acid supplements appear to reduce the risk of an embryo developing cleft lip and palate by about one-third. Multivitamin supplementation also seems to have an effect. According to a study deficiency of multivitamins during early pregnancy is related to the development of cleft lip and palate defects—placing the embryo at two times greater risk.²¹ Braybrook et al found that mutations in the gene TBX22, which cause cleft palate defects, are inherited through the X chromosome. This gene is important for the proper growth of facial structures.²² In a study done with Icelandic, Brazilian, Canadian, and American Indian populations, a variant of gene PVRL1, which is necessary for cell fusion during development, predisposed the study participants to cleft lip and palate.²³

Problems faced by cleft palate patients as follows:

1. Feeding problem due to oronasal communication during infancy.
2. Speech defect due to inadequate palate function.
3. Recurrent middle ear infections.
4. Abnormal position of the tongue below the teeth stops the vertical development of the maxilla by interfering with normal tooth eruption.
5. Protruded premaxilla seen in bilateral cleft cases hence lip closure is difficult.
6. Associated facial defects: Such as nasal deformity, ear deformity, facial cleft, midfacial retrusion, etc.
7. Dental problems include constricted upper arch and crossbite, missing teeth (commonly lateral incisor) supernumerary teeth closed bite, severe malocclusion.
8. Sociopsychological problems.

General Treatment for Cleft Palate

The surgical treatment starts at around the age of 2 to 3 months, so that the protruding premaxilla is shifted to a more distal position and aids in sucking.²⁴ At 1 or 2 years

of age the cleft palate is repaired to reduce the joint abnormalities associated with speech, eating and drinking.^{25,26} In the early mixed dentition stage there will be an increased discrepancy in the size of the maxilla and the mandible, a crossed bite, a retruded premaxilla and a shallow palate. Later at the age of 20, no adjustments in the tooth position required hence fixed partial denture can be provided. Prosthetic need will vary with each patient. Although majority of cleft palate are reconstructed by surgery some situations indicates a prosthetic approach.

They are:

1. A wide cleft with a deficient soft palate and a wide cleft of hard palate
2. At the time of delayed surgery
3. Expansion prosthesis to improve spatial relation
4. Combined prosthesis and orthodontic appliance
5. Incompetent palate-pharyngeal mechanism
6. Surgical failures
7. For tooth replacement and modifications.²

Prosthesis used in Cleft Palate Patients

- A. *Prosthesis in infancy period:* (i) Feeding obturator, (ii) premaxilla positioning appliances, (iii) palatal lift prosthesis, (iv) speech aid or speech bulb prosthesis (3rd and 4th given in adult patient also).
- B. *Obturator:* Palatal obturator with solid or hollow bulbs meatus.
- C. *Prosthesis for tooth replacement:*
 - Removable prosthesis
 - Complete dentures prosthesis
 - Fixed prosthesis
 - Implant prosthesis.

Feeding Obturator

Prosthetic aid that is designed to close the cleft and provide the separation between oral and nasal cavities.

1. It helps in feeding
2. Reduces nasal regurgitation
3. Prevents tongue from entering the defect
4. Allows spontaneous growth of palatal shelves
5. Contribute to speech development
6. Reduces incidence of otitis media and other pharyngeal infections.

Studies have demonstrated while making impression the infant positioned face downwards is the best position to prevent airway obstruction and aspiration of impression material and choking.²⁷

Premaxilla Positioning Appliances

Patients with complete bilateral cleft lip, the premaxilla and prolabium are protrusive and rotated upward. There will be

difficulty in surgical repair of these cases because the clefts may be wide and there would be excessive tension along the suture lines of the surgically corrected lip. The premaxilla positioning appliance is a nonsurgical technique that retracts and rotates the malposed segment to a more favorable position for lip repair.²⁵

Palatal Lift

When the surgically repaired soft palate is of adequate length but of inadequate mobility to elevate soft palate the condition is known as velopharyngeal incompetency. Here, there is absence of velopharyngeal closure so air escapes through the nose affecting the speech and producing abnormal sounds which are difficult to understand. A palatal lift prosthesis covers the hard palate and extends posteriorly to engage the soft palate and physically elevate the soft palate and extend it to the proper position to achieve closure.² This prosthesis has advantage only when the soft palate has little muscle tone and offers less resistance to elevation else there can be an opposing downward muscle force that can dislodge the prosthesis.²⁶

Speech Bulb

This prosthesis is fabricated when the soft palate is of inadequate length even though there is adequate mobility leading to absence of velopharyngeal closure and air escape through the nose affecting the speech. The prosthesis has two sections the palatal section and the pharyngeal or bulb section. The bulb section extends posteriorly to provide proper velopharyngeal closure thus helping for speech production.

Obturator

After cleft palate surgery, there may be a residual oronasal communication (Fig. 1). This may occur on the palate or in the alveolar ridge or labial vestibule. It usually does not cause a problem for feeding, but speech may be affected. It may allow undesirable nasal air emission or contribute to compromised articulation. A palatal obturator (Figs 2 and 3) covers the opening and contributes to normal speech production. It eliminates hypernasality and assists speech therapy for correction of compensatory articulations. The obturating portion can be made either hollow or solid.

In edentulous patients with maxillary defect, effective retention, support and stability of an obturator prosthesis must be obtained from residual palatal structure and by engaging suitable undercut within the defect. A sectional, magnetically retained hollow obturator prosthesis is beneficial to the patients by permitting easy insertion and removal and minimizing weight. For the maximum



Fig. 1: Cleft palate after surgery with residual oronasal communication



Fig. 2: Palatal obturator

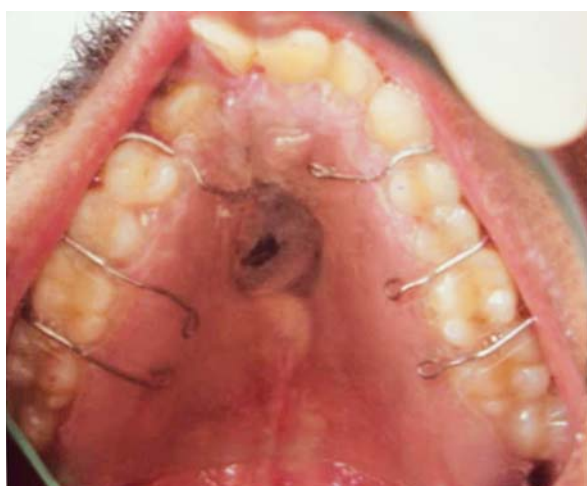


Fig. 3: Obturator covering the cleft

efficiency of the magnet retained obturator recently an author suggested to use powerful neodymium magnet which allows little horizontal movement hence, reduces the stress transmission to the lateral walls of the defect.²⁸

Meatus

Meatus type involves a mass of acrylic that hinges to the base and supportedly moves up and down. It is not used because it produces limited motion of soft palate cleft leading to absences of velopharyngeal closure and also because of its excess weight.

Tooth Replacement

Options for tooth replacement include a fixed or removable partial denture, complete or a dental implant.

Removable Partial Denture

In unilateral or bilateral clefts involving the alveolar ridge, the lateral incisors are most often missing, but cuspids and central incisors may also be affected. A removable partial denture is most often used but it is a temporary form of tooth replacement. Although it provides good esthetics, it rest on soft tissues of the palate and causes irritation. There may be movement of the prosthesis during function. Hence, it is used only as a definitive means of tooth replacement in which there are multiple teeth missing and the edentulous space is too long to be spanned by a fixed restoration and when patient cannot afford implants.

Fixed Partial Denture

A fixed partial denture provides a more natural tooth replacement (Fig. 4). Whenever, possible conservative, i.e. resin-bonded fixed partial denture should be provided for anterior replacement only. This conservative restoration requires very little tooth preparation, and provides excellent appearance and function. Alternatively, a conventional fixed partial denture can be used. This provides long-term success. Sometimes canine may need to undergo enameloplasty to flatten the facial surface and tooth-colored composite resin



Fig. 4: Fixed partial denture replacing lateral incisor for successfully operated cleft lip

restorative material may be added to the incisal edge to make it appear more like a lateral incisor. The premolar may also require modification, either with composite resin or a porcelain laminate veneer restoration to 'cuspidize' its appearance. Likewise, a malformed tooth in the cleft area, such as a peg lateral incisor, can be normalized in appearance either by adding composite resin or a porcelain laminate veneer.²⁵

Dental Implants

Treatment option for the alveolar cleft including fixed and removable prosthesis requires the preparation of healthy teeth and is associated with functional or social difficulties. Recently several researches reported the efficacy of dental implant treatment after the repair of alveolar cleft with secondary bone grafting. Dental implant insertion into the reconstructed alveolus gives functional stimulation to the grafted bone and can prevent resorption of grafted bone.²⁹ Different authors have described the use of zygomatic implants for the functional and esthetic reconstruction of palatal deformities with satisfactory results in all cases.³⁰⁻³³

A current research reported that implant-borne prosthetic rehabilitation of bone-grafted cleft lip and palate with nonsubmerged ITI Straumann implant loaded at 3 months represents a reliable treatment option with high success rate in long-term. Functional aspects are comparable to those of noncleft patients.³⁴

CONCLUSION

Prosthodontist are one of member of the multidisciplinary cleft team. In the care of patients with cleft lip and palate prosthetic treatment retains an important place. So prosthodontist must be able to diagnose the defects and provide a preventive, interventional and rehabilitative treatment to reduce the impact of the defect in patient's quality of life.

REFERENCES

- Lopes JF, Pinto JH, de Almeida AL, Lopes MM, da Silva Dalben G. Cleft palate obturation with brånemark protocol implant-supported fixed denture and removable obturator. *Cleft Palate Craniofac J* 2010 Mar;47(2):211-15.
- Berkowitz S. Cleft lip and palate diagnosis and management (2nd ed). San Diego, London: Singular Publishing Group 1996:719-26.
- Dhanrajani PJ. Hypodontia: Etiology, clinical features and management. *Quintessence Int* 2002;33:249-302.
- Wiens J, Wiens R, Taylor T. Psychological management of the maxillofacial prosthetic patient. *Clin Maxillofac Prosthet* Chicago: Quintessence 2000:1-13.
- Lund TW, Wade M. Use of osseointegrated implants to support a maxillary denture for a patient with repaired cleft lip and palate. *Cleft Palate Craniofac J* 1993;30:418-20.
- Koyama S, Sasaki K, Inai T, Watanabe M. Effects of defect configuration, size, and remaining teeth on masticatory function in postmaxillectomy patients. *J Oral Rehabil* 2005;32:635-41.
- Brosco HB. Prosthetic problems and solutions without osseointegrated implants. In: Brånemark PI, Higuchi KW, Oliveira MF (Eds). *Rehabilitation of complex cleft palate and craniomaxillofacial defects*. Chicago: Quintessence 1999:7-20.
- Moore D, McCord JF. Prosthetic dentistry and the unilateral cleft and lip palate patient. The last 30 years. A review of the prosthodontic literature in respect of treatment options. *Eur J Prosthodont Restor Dent* 2004;12:70-74.
- Watanabe I, Kurtz KS, Watanabe E, Yamada M, Yoshida N, Miller AW. Multi-unit fixed partial denture for a bilateral cleft palate patient: A clinical report. *J Oral Rehabil* 2005;32: 620-22.
- Hickey AJ, Salter M. Prosthodontic and psychological factors in treating patients with congenital and craniofacial defects. *J Prosthet Dent* 2006;95:392-96.
- Francischone CE. Intraoral prosthetic aspects of bone-anchored prostheses for patients with cleft palate. In: Brånemark PI, Higuchi KW, Oliveira MF (Eds). *Rehabilitation of complex cleft palate and craniomaxillofacial defects*. Chicago: Quintessence 1999:21-27.
- Rangert B, Gunne J, Sullivan DY. Mechanical aspects of a Brånemark implant connected to a natural tooth: An in vitro study. *Int J Oral Maxillofac Implants* 1991;6:177-86.
- Aramany MA. A history of prosthetic management of cleft palate. *Cleft Palate J* 1971;8:415-30.
- Abyholm FE. Cleft lip and palate in Norway. Registration, incidence and early mortality of infants with CLP. *Scand J Plast Reconstr Surg* 1978;19:295-300.
- Bender PL. Genetics of cleft lip and palate. *J Pediatr Nurs* 2000;15:242-49.
- Births and Deaths: Preliminary Data for 1998. National Vital Statistics Reports. DHHS Publication, USA 47(25).
- Abramowitz S, Cooper ME, Bardi K, Weyant RJ, Marazita ML. Demographic and prenatal factors of patients with cleft lip and cleft palate. A pilot study. *J Am Dent Assoc* 2003;134:1371-76.
- Alkuraya FS, Saadi I, Lund JJ, et al. SUMO1 haploinsufficiency leads to cleft lip and palate. *Science* 2006;313:1751.
- Shi M, Christensen K, Weinberg CR, et al. Orofacial cleft risk is increased with maternal smoking and specific detoxification-gene variants. *Am J Hum Genet* 2007;80:76-90.
- Lammer EJ, Shaw GM, Iovannisci DM, Finnell RH. Periconceptional multivitamin intake during early pregnancy, genetic variation of acetyl-N-transferase 1 (NAT1), and risk for orofacial clefts. *Birth Defects Res A Clin Mol Teratol* 2004;70:846-52.
- Braybrook C, Doudney K, Marçano AC, et al. The T-box transcription factor gene TBX22 is mutated in X-linked cleft palate and ankyloglossia. *Nat Genet* 2001;29:179-83.
- Sözen MA, Suzuki K, Tolarova MM, Bustos T, Fernández Iglesias JE, Spritz RA. Mutation of PVRL1 is associated with sporadic, non-syndromic cleft lip/palate in northern Venezuela. *Nat Genet* 2001;29:141-42.
- Sapp B, Galen Q, Kenneth P. Treatment of cleft lip and palate patients. *J Prosthet Dent* 1972;28:66-75.
- Abadi B, Johnson JD. The prosthodontic management of cleft palate patients. *Prosthet Dent* 1982; 48:297-302.
- Reisberg DJ. Dental and prosthodontic care for patients with cleft or craniofacial conditions. *Cleft Palate Craniofac J* 2000 Nov;37(6):534-37.

26. Taylor TD. Clinical maxillofacial prosthesis. Quintessence Publishing Co, Inc 2000:121-24.
27. Karayazgan B, Gunay Y, Gurbuzer B, Erkan M, Atay A. A preoperative appliance for a new born with cleft palate. *Cleft Palate Craniofacial J* 2009 Sep;46(1):53-57.
28. Yenisey M, Cengin S, Sarikaya I. Prosthetic treatment of congenital hard and soft palate defects. *Cleft Palate Craniofacial J* 2012 Sep;49(5):618-21.
29. Sawaki M, Ueno T, Kagawa T, Kanou M, Honda K. Dental implant treatment for a patient with bilateral cleft lip and palate. *Acta Med Okayama* 2008;62(1):59-62.
30. Parel SM, Brånemark PI, Ohnells LO, Svensson B. Remote implant anchorage for the rehabilitation of maxillary defects. *J Prosthet Dent* 2001 Oct;86(4):377-81.
31. Balshi TJ, Wolfinger GJ. Treatment of congenital ectodermal dysplasia with zygomatic implants: A case report. *Int J Oral Maxillofacial Implants* 2002;17(2):277-81.
32. Pham AV, Abarca M, De Mey A, Malevez C. Rehabilitation of a patient with cleft lip and palate with an extremely edentulous atrophied posterior maxilla using zygomatic implants: Case report. *Cleft Palate Craniofacial J* 2004 Sep;41(5):571-74.
33. Peñarrocha-Diago M, Uribe-Origone R, Rambla-Ferrer J, Guarinos-Carbó J. Fixed rehabilitation of a patient with hypohidrotic ectodermal dysplasia using zygomatic implants. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004 Aug;98(2):161-65.
34. Landees CA, Bundgen L, Laudemann K, Ghanaati S. Patient satisfaction after rehabilitation of bone-grafted alveolar cleft with nonsubmerged ITI straumann dental implants loaded at 3 months. *Cleft Palate Craniofacial J* 2012 Sep;49(5):601-08.

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