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Case Report

Arch expansion using niti palatal expander in cleft lip and palate patient: A case report

Shivangi Mittal[1]*, Dhruv Yadav[2], Vijay Agarwal[1], Karamdeep Singh Ahluwalia[1], Lokendra Singh Dagur[1], Silky Bhargava[3], Rekha Sharma[2]

[1]Dept.of Orthodontics and Dentofacial Orthopaedics, Jaipur Dental College, Jaipur, Rajasthan, India.
[2]Dept.of Orthodontics and Dentofacial Orthopaedics, Santosh Dental College, Ghaziabad, Uttar Pradesh, India.
[3]Dept.of Orthodontics and Dentofacial Orthopaedics, Daswani Dental College, Kota, Rajasthan, India.

Abstract

Cleft lip and palate (CLP) are one of the most common congenital malformations that can occur together or in isolation due to genetic and environmental factors. Presence of scar tissue (result from surgery) is a cause of occurrence of multiple dental problems and skeletal discrepancies. CLP is also associated with speech and hearing problems and it requires complex multidisciplinary treatment and has lifelong implications for affected individuals. Management starts soon after birth and involves a series of treatments during first 20 years of life. Orthodontics burden of care for these patients is high and the duration of treatment will depend upon the diagnosis and pattern of jaw growth and need for Orthognathic surgery. The present case report describes the orthodontic treatment of a 17 years old female patient with presence of cleft lip and palate on left side using Nickel Titanium (NiTi) Palatal Expander. The objective of presenting this case report is to discuss the clinical features and management strategies associated with unilateral cleft lip and palate.

Keywords: CLP, NiTi Palatal Expander, Adult orthodontics, Camouflage, Prosthesis

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1. Introduction

One of the most prevalent congenital abnormalities in the cr aniofacial region is cleft lip and palate.[1] CLP has a wide degree of variability which varies in regards to the severity of defect. (Unilateral vs Bilateral, Complete vs Incomplete)[2\.] One in every 775 newborns is observed to have CLP.[3] In the world, 700 babies are born with CLP every day, or one with a cleft in every two minutes. It occurs in India for 1 out of every 1000 births.[4] Male infants have a twice as high incidence rate of CLP as female infants.[3]

It has been observed that the failure of fusion between the medial nasal process and the maxillary process or between the palatal process[4] are the main reasons of orofacial cleft. The most common etiology of CLP is a multifactorial origin and may entail a polygenetic inheritance. Other contributing responsible exogenous factors are chemical exposure, radiation, maternal hypoxia, teratogenic drugs etc.[1,4]

A multidisciplinary approach is used to manage CLP, and it begins with primary surgeries and continues until the end of adolescence (depending upon the severity of the problem)[1,5] Treatment of labial repair, obturation, tissue molding (for dealing with feeding difficulties) start around 3-6 months of age. Palatoplasty is usually performed at 10-12 months of age. Patient who has an alveolar bone cleft defect, maxillary arch expansion is usually done to create adequate space for alveolar bone grafting procedure followed by orthodontic fixed appliances to align the teeth in good harmony.

*Corresponding author: Shivangi Mittal
Email: svnimittal413@gmail.com

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The presented case report describes the conservative orthodontic management of an adult unilateral CLP patient.[6]

2. Case Report

This case report represents a clinical case of orthodontic camouflage treatment of a CLP patient with skeletal class III malocclusion with skeletal transverse & sagittal maxillary deficiency, unilateral cross bite on left side, microdontic maxillary lateral incisor on left side and impacted left central incisor. A NiTi palatal expander was suggested to correct the transverse maxillary deficiency and cross bite. After treatment ideal occlusion and a better profile were achieved. This article represents a successful attempt of orthodontic camouflage treatment of skeletal jaw discrepancy in cleft lip and palate in an adult patient.

A17 year old female patient reported (in the department of Orthodontics and Dentofacial Orthopaedics, Maharaj Vinayak Global University, Jaipur Dental College, Jaipur, Rajasthan, India) with the chief complaint of forwardly placed lower front teeth. Patient was referred by a plastic surgeon for the correction of irregularly placed teeth as she couldn't undergo rhinoplasty due to severity of intraoral defects.

1. ***Relevant Medical History:*** The patient presented with unilateral CLP, and was operated for cleft lip at the age of 7 months followed by surgery of cleft palate at the age of 2-years. Alveolar bone graft had not been performed. Post-surgical scar was present on face which extends from philtrum to posterior part of the palate on left side.
2. ***Relevant Dental History:*** Patient had no history of any previous dental treatment.
3. ***Extra-oral examination:*** Pretreatment facial photographs showed apparently asymmetrical face with nasal wings asymmetry and elevation of the left nasal wings in resting and smiling stage. Patient had Mesoprosopic face, straight facial divergence, and straight profile with everted lower lip. Nasolabial angle was acute with post-surgical scar.
4. The clinical FMPA was average and patient had competent lips. On smile assessment, lower mandibular dental midline was coincident with facial midline but maxillary dental midline was deviated to the left side. Amount of incisal exposure at rest was 0 mm and during smile were 5mm upper and 8 mm lower, amount of gingival exposure was zero mm. (**Figure 1**)
5. ***Intra-oral examination:*** Patient had permanent dentition with all teeth present in first, third and fourth quadrants. In second quadrant, 21 was missing, presence of microdontic lateral incisor (conical shape), Rest all teeth were present. (**Figure 2**)
6. Molar relation and Canine relation were Class I on both the sides, with Class III incisor relationship, Overjet and Overbite were - 4 mm and 1mm respectively. Antero-posterior unilateral crossbites were observed in relation to 11 with respect to (wrt) 31 and 41, 12 wrt 42, 23 wrt 33, 24 wrt 34, 25 wrt 35, 26 wrt 36. Upper dental midline was deviated towards the left side by 8 mm. The gingival health was satisfactory and adequate attached gingiva was present. (**Figure 2**)
7. ***Functional examination:*** Patient had normal speech pattern, Oro-nasal breathing and a typical swallowing pattern. The path of closure of the mandible was straight upwards without any deviation and there were no other associated signs or symptoms of temporomandibular disorder and hyperactive mentalis muscle activity without any abnormalities.
8. ***Examination of study models:*** The Curve of Spee was 4.5 mm, with 4 mm Overjet and Overbite of 1mm. Bolton's Analysis was inapplicable in this case as left central incisor was missing.
9. ***Radiographic examination:*** Panoramic radiograph revealed short root of microdontic lateral incisor (22), impaction of maxillary left central incisor (towards nasal septum) and all wisdom teeth in growth stage. Many studies have demonstrated a high frequency of dental anomalies in patient with CLP[7] (**Figure 3**).
10. ***Cephalometric analysis:*** Cephalometric analysis showed (**Table 1**) that the patient had skeletal Class III malocclusion and an average growth pattern with posteriorly positioned maxilla. The patient exhibited a decrease in both middle third facial height and effective maxillary length. The maxillary incisors were protruded and proclined and mandibular incisors were retruded and retroclined. The nasolabial angle was acute with skeletal concave profile. (**Figure 3**)

Table 1: Cephalometric analysis

Measurement	Normal	Pre	Post
Maxilla			
SNA	82^0	70^0	72^0
N perpendicular to Point A	0±2 mm	-8mm	0 mm
Effective Maxillary Length	70 mm	73mm	75 mm
Angle of convexity	0^0	-20^0	-1^0
Mandible			
SNB	80^0	79^0	79^0
N-perpendicular to Pog	0 to -4 mm	0 mm	0 mm
Effective Mandibular Length	85-87 mm	108 mm	108 mm
Facial Angle	87.8^0	92^0	91^0

Maxilla-Mandible			
AO-BO	0 mm	- 1 mm	1.5 mm
ANB	2^0±2	-9^0	-7^0
Mx-Md Difference	28.6 ± 3.2mm	35 mm	29mm
Vertical Parameters			
FMA	21.9^0	20^0	21^0
SN-GoGn	32^0	28^0	28^0
Y-axis	59^0	56^0	57^0
Facial axis	0^0	$+3^0$	$+3^0$
Jarabak ratio	62-66%	67.28 %	67.11 %
Maxillary and Mandibular Incisor			
Upper incisor to NA	22^0 /4mm	45^0/10 mm	50/ 15 mm
Upper incisor to point A	4 mm	7 mm	13 mm
Upper incisor to SN	102^0	114^0	120^0
Inter -incisal angle	135.4^0	131^0	119^0
IMPA	86.93^0	82^0	81^0
Lower incisor to NB	25^0 /4 mm	18^0/-2 mm	17/-3 mm
Lower incisor to A-Pog line	1 - 2 mm	7 mm	6mm

2.1. Diagnosis

The Case of CLP was diagnosed with Skeletal Class III base due to retrognathic maxilla with average growth pattern, Angle's Class I malocclusion, reverse overjet, impaction wrt 21(towards the nasal septum), microdontic lateral incisor wrt 22, upper left posterior crowding, Antero-posterior unilateral cross bites, upper dental midline deviated towards the left side, deep curve of pee, competent lips, acute naso-labial angle, concave profile and facial asymmetry.

2.2. Treatment objectives

1. Correct maxillary transverse deficiency and to align and level dental arches.
2. Resolve the antero-posterior unilateral cross bites and crowding in upper left posterior region.
3. To achieve ideal upper and lower incisor, canine and molar relation.
4. To obtain ideal overjet, overbite and midline.
5. Correct curve of Spee.
6. To achieve esthetic profile.
7. To achieve and maintain stable results.

2.3. Treatment plan

1. Slow maxillary expansion using NiTi palatal expander.
2. Fixed mechanotherapy using pre-adjusted edgewise (MBT prescription).
3. Leveling and alignment of upper and lower teeth.
4. Finishing and detailing.
5. Prosthetic rehabilitation of upper Anteriors for esthetics purpose.

Orthognathic surgery was the treatment of choice for maxillary advancement to correct maxillary transverse and sagittal discrepancy but since the patient was reluctant to undergo orthognathic surgery, an alternative, nonsurgical treatment was planned. The treatment was started with NiTi palatal expander to achieve slow maxillary expansion (SME), to achieve expansion in maxillary posterior region and to correct the unilateral cross bite (**Figure 4**). The idea was to choose SME over Rapid Maxillary expansion (RME) because SME takes place with lesser forces spread over longer times. SME improves bone development in the inter-maxillary suture by producing less tissue resistance all around circummaxillary structures[8]. The patient had an impacted maxillary right central incisor towards the nasal septum, but because of its unfavorable position, it was decided to keep it as such.

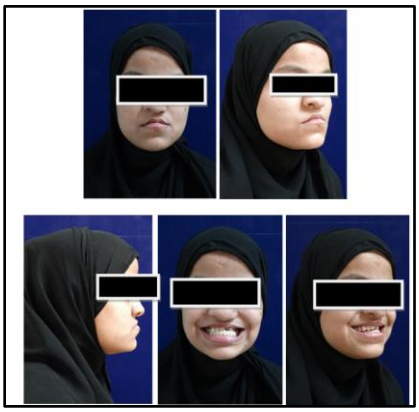

Figure 1: Treatment extra oral photographs

Figure 2: Treatment intraoral photographs

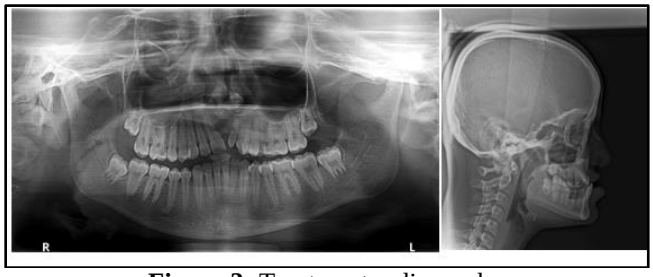

Figure 3: Treatment radiographs

Figure 4: NiTi palatal expander

Figure 5: Mid treatment intraoral photographs

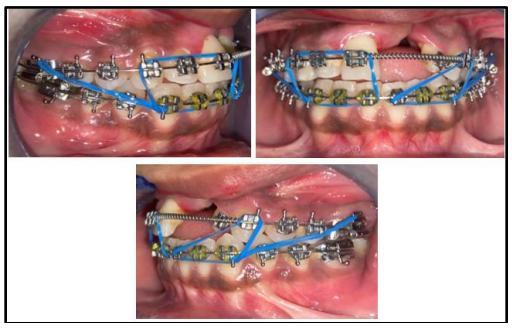

Figure 6: Settling elastics

Figure 7: Extra oral retention phase photographs

Figure 8: Intraoral retention phase photographs

Figure 9: Post treatment extraoral photographs

Figure 10: Post treatment intraoral radiographs

Figure 11: Intraoral & Extraoral Prosthetic Rehabilitation photographs

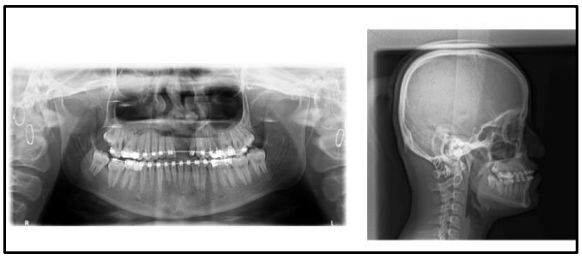

Figure 12: Post treatment radiographs

Figure 13: Superimposition

After 6 months when functional occlusion and posterior cross bite was relieved, both the arches were bonded with MBT prescription "0.022×0.028" slot size bracket with 0.012 NiTi wire, and a bite block were used on lower first and second molars to disocclude both the arches and to procline the maxillary anterior teeth and to correct anterior cross bite (**Figure 5**). NiTi palatal expander was removed after 6 months of retentive phase to maintain the inter-molar and inter-premolar width.

Initial alignment was carried out with 0.014 NiTi arch wire followed by sequential NiTi arch wire placement continued to 0.016 NiTi and 0.018Niti, in upper and lower arch to align and level the teeth. A Begg's bracket was also bonded on left lateral incisor (Peg lateral) to bring the tooth in the arch with the use of 0.012 NiTi piggy back with 0.018 stainless steel (SS) arch wire. After 12 months of the active treatment, an active open coil NiTi spring was placed in 0.018 SS arch wire from 11 bracket to 23 bracket. Purpose of placement of NiTi coil spring was to correct midline deviation (as midline was shifted toward left side), to achieve the amount of required space for 21, (prosthetic rehabilitation) and to achieve some amount of incisor proclination. After the achievements of above goals, NiTi coil was used passively to maintain the space in between to 11 and 23 and sequential rectangular wires 0.016 x 0.025 NiTi, 0.017 x 0.025NiTi, 0.019 x 0.025NiTi and 0.019 x 0.026 SS were placed in both the arches for expression of good amount of torque. After alignment and leveling, antero-posterior correction was achieved with 3mm overjet (**Figure 6**), followed by use of class III and anterior settling elastics for sagittal and vertical traction in the anterior teeth to settle the anterior bite and occlusion for 3 weeks (**Figure 6**). This process took additional 9 months to reach till here. After the achievement of functional occlusion, 2 mm overbite and 3 mm overjet (**Figure 7**,**Figure 8**) the appliance was debonded with complete sets of records and lower canine to canine fixed retainer was placed.(**Figure 9**-**Figure 10**). Upper retainer was not given as the patient was concerned with non-satisfactory smile. It was decided to perform prosthetic rehabilitation of upper canine to canine teeth. Patient went to the Department of Prosthodontics and maxillary anterior teeth were restored with PFM FPD with pink color ceramic near gingival margin for esthetic purpose (**Figure 11**)

2.4. Treatment results

Total treatment duration was 28 months. Class I canine relation was achieved on both the sides with antero-posterior correction. Expansion of maxillary arch was achieved to correct transverse skeletal discrepancy. Incisor relation, overjet and overbite were obtained with good midline correction and stable occlusion. Space was created for impacted 21 followed by prosthetic rehabilitation of maxillary canine to canine using Porcelain fused to metal crown(PFM FPD) with pink ceramic (to cover labial cleft scar) in the anterior region. This resulted in maintenance of overjet and overbite with good anterior teeth retention. Profile was changed from concave to straight and facial esthetics was improved. Patient was satisfied with her more

pleasant smile. She was advised to consult the plastic surgeon for further soft tissue treatment, that is, for cosmetic repair of lip and nose. With an exceptional cooperation from the patient, we were able to fulfil all our treatment objectives.

The panoramic radiograph evidenced root parallelism with no root resorption of upper and lower anterior teeth especially in microdontic lateral incisor.(**Figure 12**).

Cephalometric analysis and superimposition demonstrated protrusion and proclination of upper incisors and uprighting of mandibular incisors. N perpendicular to point A distance also increased, resulting in increased effective maxillary length and change in profile from concave to straight. No change in mandibular plane angle was seen (Table-1, **Figure 12**, **Figure 13**)

3. Discussion

The role of orthodontist in the management of orofacial clefts challenging because of difficulties inherent in the deformity and as varied as the different types of clefts encountered. No two clefts are alike and each patient has different needs, desires, aspirations, and cooperation.[5,9] Because the aim of full rehabilitation of patients with clefts is to limit interventions and maximize treatment outcome, orthodontists must make important decisions on orthodontic intervention at the appropriate time and prioritize treatment goals for each intervention.1 Complete care for CLP patients necessitates a multidisciplinary approach due to their structural, functional, and aesthetic problems.[10]

Reconstruction of CLP starts with in 10-12 weeks of age of the patient with primary repair of lip and nasal construction. After reconstruction of lip and nasal defect, cleft palate repair can then start at 12-18 week, but it is still a subject of controversy as early closure of cleft lip results in retardation of maxillary growth due to scarring. Phase I orthodontic therapy can begin after palate surgery as deemed necessary to optimize the position of the dent alveolar structures and to anchorage the growth in appropriate directions.[11] These surgical procedures can help achieve esthetic objectives but may results in retardation of maxillary transverse, sagittal and vertical growth center. This often create a skeletal class III malocclusion due to maxillary retrusion and incisor proclination, anterior crossbite and A hyper divergent pattern.[12] The phase II orthodontic therapy can be started during interceptive stageas the permanent canines and premolars erupt in the oral cavity. Treatment starts from maxillary arch expansion and protraction to correct transverse and anteroposterior discrepancy. This approach has exhibited positive outcomes for young patients with growth potential and alignment of the dentition with the use of fixed appliance. If perfect timing was missed or in complex cases, orthodontic camouflage or surgery becomes the only option.[7,8,13] Clear aligners therapy can be utilized as a good alternative treatment option with fewer appointments, even if standard multibracket pre surgical or camouflage treatment is still the most popular choice.[14] In this case report camouflage treatment was performed with multibracket appliance system that involved displacement of the teeth to cover up the defect and discrepancy. If the case requires any prosthodontic therapy, dental implants can be performed after completion of orthodontic treatment, followed by revision of the lip and nose.[8]

Expansion is often performed by an orthodontist using a plethora of appliances that is SME or RME[14-15] SME using Niti palatal expander was used in this case to generate slow forces for midpalatal suture opening. An additional benefit of this method is that it alters the airway space by increasing nasal volume, decreasing nasal resistance, and increasing nasal airflow, which facilitates unrestricted breathing through the nasal route and aids in the treatment of mouth breathing.[16]

Vertical deficiency in CLP can be coupled with an occlusalcant, excessive freeway space and altered mandibular growth pattern.[17] Normalization and elimination of these orofacial defects are important to correct maxillomandibular dysfunction. This also generates normal impulses for growth center of maxilla by transmitting masticatory force and function.[18] The patient's aesthetics and self-confidence significantly improves as a result of the orthodontic, restorative, and prosthetic rehabilitation treatments.[8,]

4. Conclusion

Successful cleft lip and palate orthodontic treatment requires an interdisciplinary approach. In this case report patient was reluctant for orthognathic surgery, so the treatment became more challenging. However, the presented case showed improved aesthetics with nonsurgical orthodontic treatment. The total treatment duration was 2.5 year and all the objectives of treatment were achieved. The dental arches were well aligned with maintained class I molar and canine relationship. Positive overjet was achieved by proclination of incisors and overbite was maintained. The maxillary left incisor was left in its original positions as its position was unfavorable to take it out in the arch. Lower lingual retainer and upper canine to canine FPD with pink ceramic (FP2) was placed for aesthetic purpose which also acted as a retainer. Patient was satisfied with improved aesthetics and showed marked improvement in her self-confidence.

5. Source of Funding

None.

6. Conflict of Interest

None.

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