



Nasal Assessment among Patients with Cleft Lip and Palate

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ABSTRACT

The cleft lip nasal deformity has been well described in respect to the facial aesthetics and plays an important role in social interactions. Rhinoplasty for patients with CLP is of immense challenge for the basic fact of the complexity in pathology, and also variation of growth potential of individual. The surgical correction for treatment of variation in nose morphology in patients with CLP is Rhinoplasty, which becomes a challenging task, keeping in mind the difficulty in evaluating the outcome. Many methods are available in the literature for nasal assessment evaluation in patients with CLP. However due to the pros and cons of different methods, aesthetic evaluation of the nose among these patients remain problematical. The purpose of this literature review was to overview the different nasal assessment methods in patients with CLP so as to analyse and identify the most objective method for such evaluation in order plan the treatment and to compare the aesthetic results.

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INTRODUCTION

Cleft lip and palate (CLP) is one of the most common congenital malformation caused due to variation in development of facial structure during gestation. The defective fusion between maxillary and medial nasal processes – anterior to incisive foramen, palatine shelves – posterior to incisive foramen, mesodermal cells in midline results in the formation of CLP¹. The occurrence of CLP is about 1.7 in 1000 live births worldwide². The incidence is highest in Afghan population as 4.9 and lowest in Negroid population as 0.4 per 1000 live births^{3,4}. Environmental and genetic factors are the major etiologic factor of cleft lip and palate⁵. Patients with CLP show variations in terms of cleft size, shape, width in the form of trace of notching of the upper lip to complete non-fusion of the lip, primary palate and secondary palate and deviation of nasal bridge and deformities of ala of nose. The position and characteristics features of the nose as a midline structure are of great importance while considering facial aesthetics⁶. The variation of form and function of nose in patients with CLP is a known fact. The distortions in the anatomic form of nose is due to skeletal structure deficiency which leads to tilt in tripodding. The distortion may range from hardly visible deformity to severely deformed nose in the form of shortened columella, downwardly rotated tip and diminished nasal projection⁷.

Nasal deformity correction forms an important part in the treatment protocols of patients with CLP and differs in timing among various protocols. Evaluating the aesthetic outcome of the nose prior to Rhinoplasty is a complex task and no single reliable method has a promising outcome. The objectives of Rhinoplasty in such patients is to position the lower lateral cartilage in near normal anatomic position, achieve symmetry alar domes projection, necessary columella elongation, achieve symmetry in nasal floor and to provide a structural support by means of bone or cartilage grafts. Rhinoplasty can be performed safely, in most cases, in adolescent girls after the age of 16 years and in

adolescent boys after the age of 17 years⁸. Rhinoplasty for patients with CLP is of immense challenge for the basic fact of the complexity in pathology, and also variation of growth potential of individual.

The significant components of nose in patients with CLP involves displaced anterior nasal spine, anterior part of septal cartilage to the non-cleft side, wider nostril, inward buckling of ala, retro positioned alar dome, short columella on the cleft side. A pleasant and harmonious face can be a great asset to ones social status and hence quantitative evaluation of facial morphology by using measurements is essential not only for clinical assessment, diagnosis but also for planning reconstructive surgery in patients with CLP.

There are various methods described in literature to assess the nose and nasal parameters for comparison with the contralateral side as well as with non cleft patients. Aesthetic assessment methods of nose in patients with CLP can be classified into 2 groups – measurements (Anthropometric, cephalometric, nose/facial casts) and scoring system objectively (clinical assessment, 2D photographs, 3D photographs, CT, video recording).

The purpose of this article is to present a comprehensive review of literatures, discuss, analyse and identify the most subjective/objective method available for the assessment of aesthetic of nose in patients with CLP.

MEASUREMENT ASSESSMENT METHODS

ANTHROPOMETRIC MEASUREMENTS -

Anthropometry is the scientific study of the proportions and measurements of the human body. The anthropometric measurements can be directly made on the patient or using indirect method i.e. employing other means like photographs, models etc Fig 1. The anthropometry has a historic background with the Greek era showing evolution of the human face measurements, proportion sciences, the golden proportion and physical anthropology⁹.

The anthropometric studies on patients with CLP have been reported back to early 20th century. Several authors have attempted anthropometric studies on patients with CLP, Peyton is credited for first published series of articles on soft tissue anthropometry on patients with CLP, where size of cleft, and other facial parameters including position of nose & nose tip were studied ¹²⁻¹⁴.

Leslie G Farkas, a Hungarian clinician, physical anthropologist, pioneered the modern craniofacial anthropometry and stressed on finding out golden proportions for achieving a good facial esthetics. Standards for different soft tissue measurement of the head & face, anthropometrical values dealing with lateral facial dysplasia and CLP in numerous publications have been evaluated ¹⁵. The characteristic nasal presentation of patient with CLP: a comparatively wider nose, obtuse nasolabial angle ¹⁶ along with deviation in nasal tip, alae configuration and nostril shape resulting from alteration in growth process in the mid facial region ¹⁷ have been highlighted. Asymmetry in the nostrils, non uniformity & kinking of the ala, tip flattening, elongation of ala & its base on the cleft side, and deviation of the nasal bridge is also reported among patients with CLP ^{18,19}.

Even though many aspects of facial proportions and esthetics are considered in facial anthropometry, these measurements may provide lesser subjective base for the planning and evaluation of maxillofacial surgery, conservative and surgical orthodontics.

Although accuracy of direct anthropometric measurement is established among anthropologists, however the reproducibility in large numbers of patients and in comparing the results becomes the drawback.

NOSE/ FACIAL CASTS -

Nose casts and analysis of nostril structure at the angle of maximum area have also been assessed to analyse nose deformity. It is an objective and quantitative method for assessing nostril and nasal morphology in patients with CLP Fig 2 ²⁰. Plaster impressions of the face to

evaluate nasal morphology and nasal aesthetics by direct anthropometry are more precise as soft tissues are not deformed, measurements can be repeated and extended as needed, they reflect the three-dimensional contour, and the method is easily available ²¹. The various advantages with this method include ease of methodology, low cost, quantitative assessment, reliable and reflect three dimensional contours. However, this method is very cumbersome and time consuming.

CEPHALOMETRIC MEASUREMENTS-

Graber TM was the first to report on soft tissue measurements of patients with CLP on cephalograms, and correlated the influence of palatal repair on future growth ²². Burstone described the variation in integumental extension and contours of face of non cleft and patients with CLP ²³. The larger nasal bone was noted ²⁴, associated with a flat nose along with short upper lip profile for patients with repaired unilateral cleft lip and palate UCLP ²⁵⁻²⁹. The cephalometric measurements in the form of forehead nose angle, nose apex angle, nasolabial angle, nose base angle, upper lip angle, nose depth, and nose height are usually made for aesthetic assessment of nose in patients with CLP Fig 3.

There are several advantages with this objective method: simplicity, economical, non invasive, accuracy and reliability in measurements. However, it is associated with radiation exposure along with magnification in radiographic images, time consuming and reproducibility in large numbers is difficult.

Assessment of the quantitative differences between anthropometric soft tissue measurement of the face and the corresponding radiographic measurements obtained from the same person is essential when planning surgical correction.

OBJECTIVE ASSESSMENT METHODS

CLINICAL EXAMINATION-

The evaluation of nose in patients with CLP has been enumerated as guidelines in various cleft centres around the world. The extra nasal clinical examination includes irregularities and

deviation of dorsum & tip from the midline, location of the columella, alar base & nostril width, and the overlying skin Fig 4. Intranasal examination includes position of the nasal septum, vomer, nasal valve, cartilage, nasal spine and floor of the nose ³⁰.

This method of nasal assessment is safe & quick, relatively accurate with no exposure to

radiation and can be employed on young patients. However clinical evaluation can be judgemental as it may vary from individuals perception of giving a subjective opinion and recalling the same views, comparison of the results between different centres is almost impossible ^{31,32}. So the clinical examination can be used as an adjunct with other evaluative methods.



Fig 1: Profilometer used for anthropometric measurements (Source: Naini FB. Facial aesthetics. Concepts & clinical diagnosis. Blackwell Publishing Ltd: Wiley-Blackwell; 2011.p228)

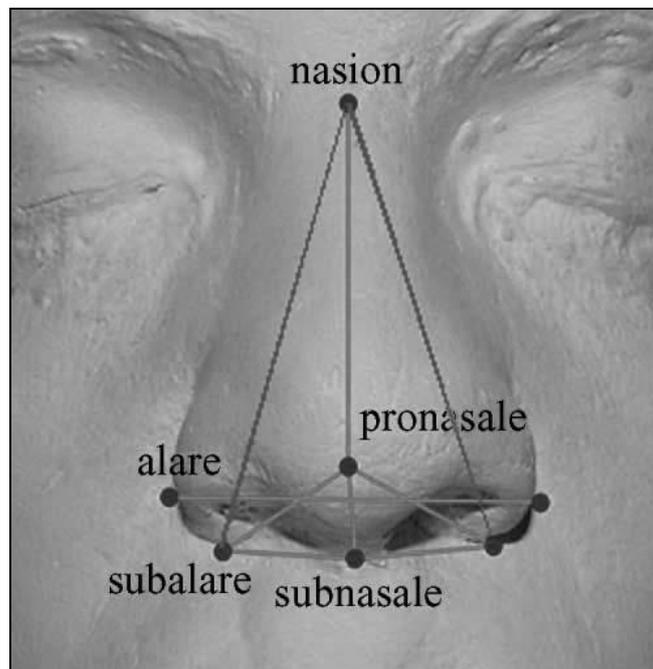


Fig 2: Measurements from nose casts (Source: Duskova M, Kristen M, Smahel Z. The anthropometric verification of corrective surgery outcome in cleft secondary deformities. J Craniofac Surg. 2006;17(3):447-53.)

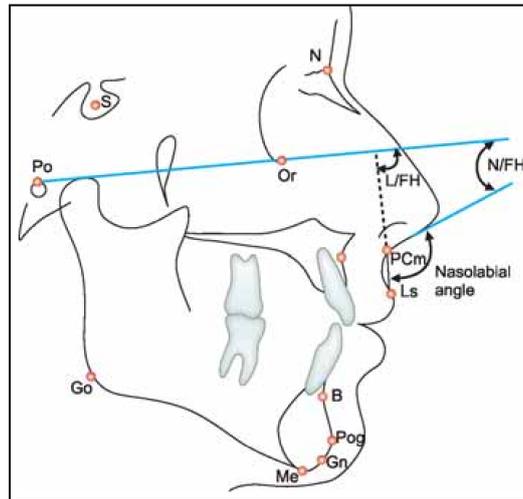


Fig 3: Cephalometric measurements



Fig 4: Clinical examination

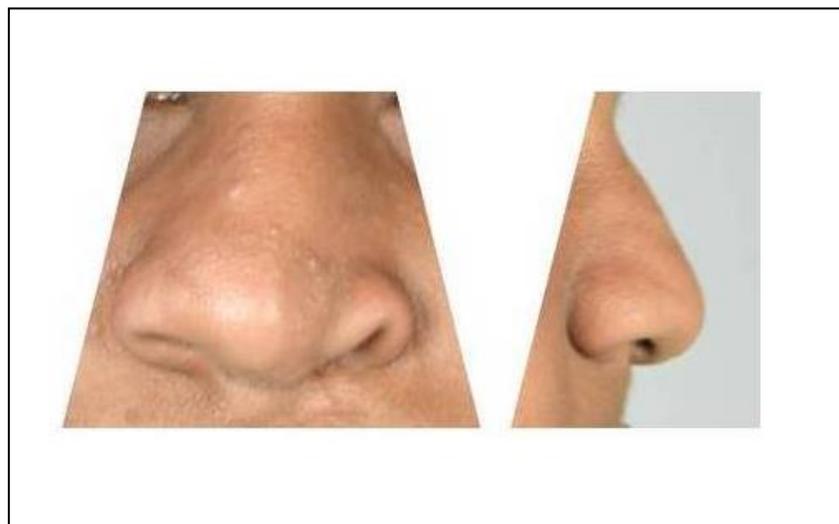


Fig 5: Asher-McDade method: Frontal and profile view of nasolabial area

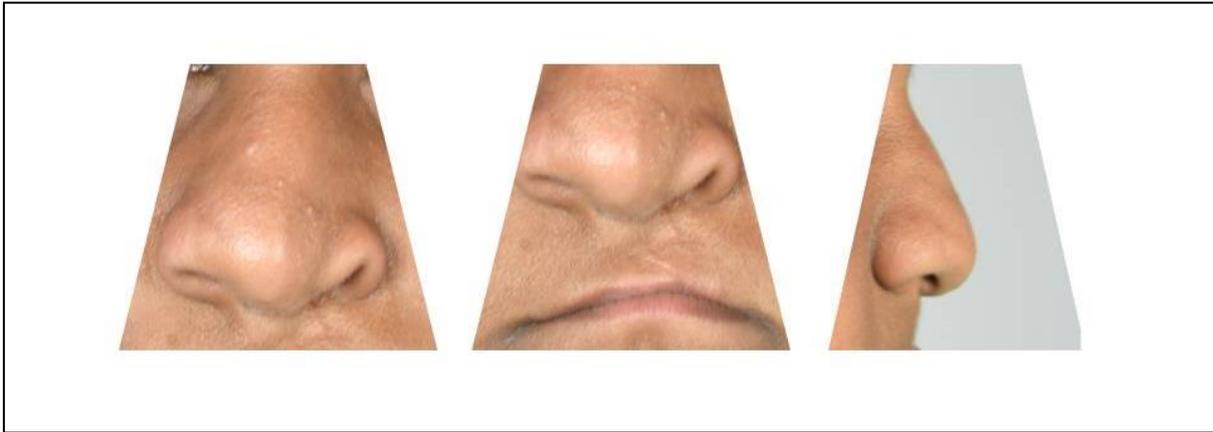


Fig 6: Modified Asher-McDade method: Frontal, vermilion border and profile view of nasolabial area

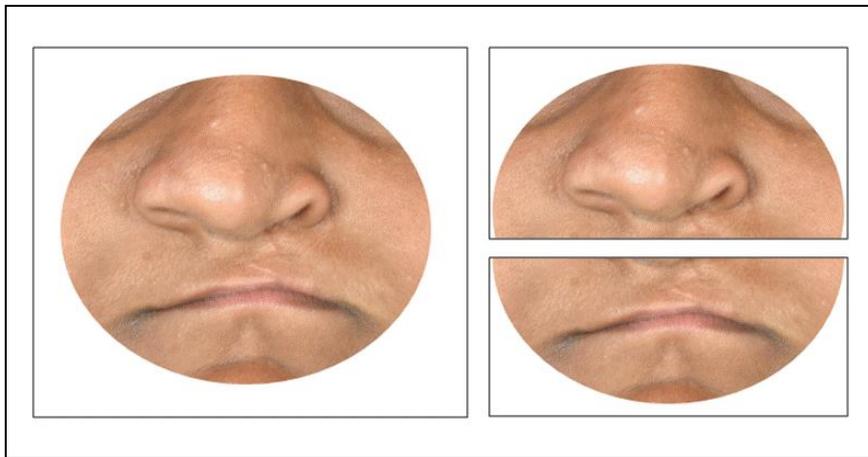


Fig 7: CARS Method: Cropped photograph with a circle around the nasolabial area

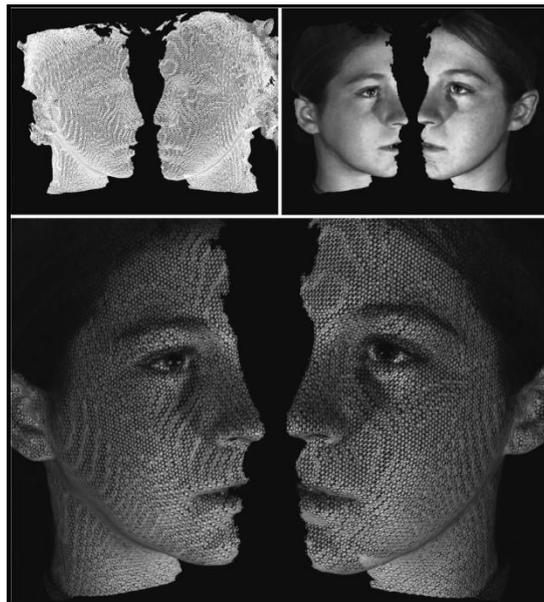


Fig 8: 3D imaging of the face (Source: Hajeer, MY, Millett, DT, Ayoub A F, Siebert JP. Current Products and Practices. J Orthod.2014; 31: 62–70.)

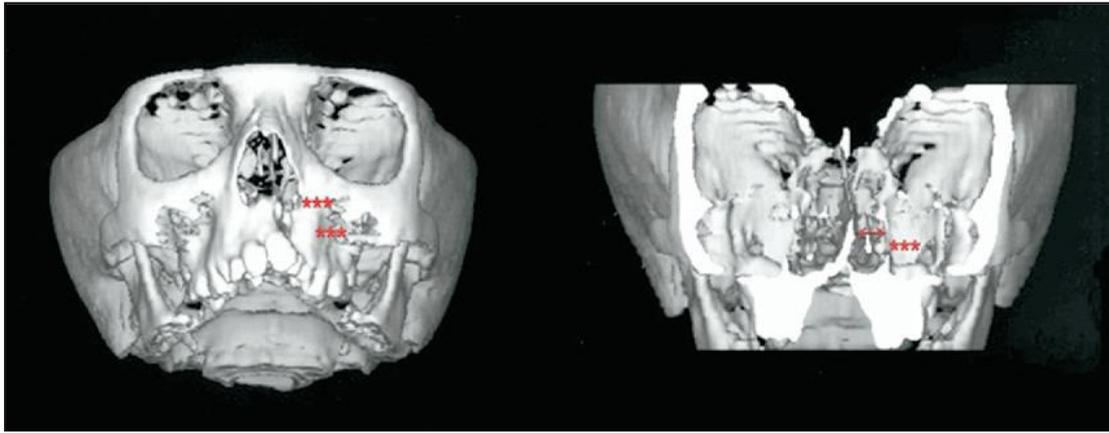


Fig 9: 3D reconstruction using CT (Source: Suri S, Utreja A, Khandelwal N, Mago SK. Craniofacial computerized tomography analysis of the midface of patients with repaired complete unilateral cleft lip and palate. *Am J Orthod Dentofac Orthop.* 2008;134:418-29.)

TWO-DIMENSIONAL IMAGES-

The most popular method for evaluation of nasal aesthetics is the two-dimensional imaging. The two dimensional photographs is a method for rating nasolabial appearance in patients with CLP. 5-point scale (Asher- McDade) is most frequently used scoring systems. This system uses 4 photographs of patients (Frontal & Profile photograph of face and, frontal & profile of nasolabial area) to rate the aesthetic appearance between 1 & 5 i.e. very good appearance, good appearance, fair appearance, poor appearance or very poor appearance Fig 5³³. A modified Asher-McDade nasolabial yardstick was introduced in which new reference photographs were added to existing scale in the form of vermilion border and nasofrontal photographs Fig 6³⁴. A computer-based program 'SymNose' was introduced by Pigott, helps the user to quantify asymmetry of the front view of the lip, nose and also the nose from the base view, using the area of mismatch of one side reflected over the other. The program is easy, simpler and quick to use³⁵. 'CARS-Cleft aesthetic rating scale' introduced by Mosmuller, attempt to crop the photographs, revealing only the nasolabial area in order to reduce the influence of surrounding features. The ratings are classified separately for nose and lip. This scale takes care of Helsinki Declaration by which the identity of patients with CLP should be anonymous Fig 7³⁶.

The assessments of facial deformity by two dimensional imaging showed reproducibility and reliability³⁷. Two-dimensional images can be stored permanently and be evaluated & measured consistently. The images can be communicated worldwide when required form standardized evaluations on different places for multicentre studies or for independent observers³¹. Various combinations of two dimensional images with other nasal aesthetic assessment methods have shown augmented results. It has been used in combination with computer tomography, cephalograms, three-dimensional images and clinical examination.

There are several advantages with two dimensional imaging which include: simplicity, economical, non-invasive, convenient, non-ionizing, easily available, reliable and reproducible. The results can be permanently stored and can be used to compare between different centres. However the drawbacks of this methods include errors in orientation of head, distortion & magnification errors in images, dynamics of lip cannot be judged and most of all it gives an two-dimensional image of a three dimensional object.

THREE-DIMENSIONAL IMAGES-

The advent of three-dimensional (3D) imaging Fig 8 and the ease at which it can be used, it has become commonly employed and highly rated mode for evaluation of nose³⁸. The different modes used are: 3D stereophotogrametry with

facial curve analysis³⁹, optical scanning using 3D sensors⁴⁰, a noncontact type semiconductor laser 3D measurement system⁴¹, 3D vision-based capture⁴², 3D video-based tracking system⁴³, and 3D symmetry analysis using nasal plaster casts scanned with an electromagnetic scanner⁴⁴. Better assessment of cleft lip and nose can be done using different 3 dimensional methods and among which 3D stereophotogrammetry a non-invasive, reliable, accurate method pioneers⁴⁵.

This method is preferred because it is quick & non invasive procedure, accurate, qualitative, easily reproducible, non-ionizing, can be employed on young patients and facilitate easy storage of data. However, this method is more expensive, time consuming, require non-portable system and there can be 3D reconstruction & software errors.

COMPUTER TOMOGRAPHY-

Computer tomography is an exceptional method for evaluation and analysis of surface and as well as deeper craniofacial structures Fig 9^{46,47}. It is the only mode of detecting nasal septum deviation⁴⁸. Photograph-CBCT combination appeared to be more reliable in evaluating hard-soft tissue relationships in the nasolabial area⁴⁹.

This method provides hard tissue details and is excellent method for quantifying surface & deep craniofacial structures. It provides quantitative data which is repeatable verifiable, easily storable. The disadvantages include radiation exposure and sedation needed for carrying out procedure in children.

VIDEO RECORDING-

Video recording based tracking system have been used to measure the circumoral movements in patients with CLP, retro-reflective markers secured to different facial landmarks are tracked in the system. Recordings are made in 6 different angles and the reliability varies for features of the lip and nose. This technique is useful for quality assurance, inter-centre comparisons or outcome studies of surgical techniques. However, there is requirement of patient cooperation,

hence may not be possible for very young patients and there is requirement of appropriate trained operators to ensure reproducible recording^{43,50}.

This technique is unique in assessing the nasal & facial aesthetics, as it allows movements to be assessed which no other method assesses. Also, photographs can be generated from video records captured. However, the procedure is time consuming, require patient cooperation, multiple editing may be needed and there may be loss of definition of the images.

With the availability of several methods for assessment of nasal aesthetics, authors have compared the different methods for aesthetic assessment of nose in patients with CLP and demonstrated that there is no single reliable method for aesthetic evaluation of the nose in patients with CLP. However, 3D images provide a better assessment rather than 2D images³⁷. In spite of popularity of 2D photography and measurements using anthropometric facial landmarks, 3D images seem to be the most objective method in aesthetic assessment of nose in patients with CLP⁵¹.

CONCLUSION

The nose is a prominent part of the face and hence a masterly executed cleft lip repair directs the beholders eyes from the lip to the deformed nose, which has to be addressed upon. Anthropometric and cephalometric methods have been used to evaluate the aesthetic appearance of nose in patients with CLP in 20th century. But it was realized that only correction of hard tissue alone does not bring about the desired results, soft tissue also plays a major role in determining the final outcome of facial aesthetic surgical procedures. 3D images appear to be the most objective method and the accuracy in automated facial anthropometric landmark has an edge over other methods. Different methods are used in combination for quick assessment and evaluation of the nose in patients with CLP, in order plan the treatment and to compare the aesthetic results.

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