Design Features and Simple Methods of Incorporating Nasal Stents in Presurgical Nasoalveolar Molding Appliances

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Abstract: Presurgical nasoalveolar molding (NAM) in the orofacial orthopedic treatment of unilateral clefts of the lip and palate aims to align and approximate the maxillary hemialveolar segments and simultaneously support and mold the deformed nasal cartilages, correct and center nasal tip projection, and lengthen the deficient cleft-side columella in early infancy, before the primary reparative lip surgery. A number of techniques of achieving these objectives have been described in the literature and are increasingly being practiced by cleft care teams around the world. However, a detailed description of the nasal stent is lacking in the literature and needs to be elucidated to facilitate greater usage of presurgical NAM in contemporary practice. This report fills this void by providing an analytical description of the different parts of the nasal stent; clarifies their desirable design features, anatomic correlations, and clinical importance; and illustrates in a step-by-step manner simple direct and indirect methods of incorporating a nasal stent, improvised by the author in his practice, that can be used with any of the contemporary NAM appliances and techniques. From the simple methods described, clinicians will be enabled to select one that may be most easily adaptable to their preferred appliance and clinical setting.

Key Words: Cleft, cleft lip, cleft lip and palate, presurgical, infant orthopedic, nasal, nasoalveolar molding, NAM, PNAM, nasal stent, stent, nasal cartilage, molding

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CONSTITUENT PARTS OF THE NASAL STENT

The nasal stent armature is most commonly bent in 0.036-in (0.8-mm) stainless steel wire in a shape resembling a swan’s neck (Fig. 1). The nasal stent can be divided into the following essential parts or segments, each of which has a specific purpose:

(a) anchorage (embedded) portion
(b) base of the neck
(c) upper neck portion
(d) nasal bulb with upper and lower lobes

The anchorage portion (Fig. 1) is embedded in the intraoral acrylic appliance (plate) and provides a stable base for the rest of the stent that is cantilevered from it. It ends at the point of emergence of the stent from the labial flange.

The base of the neck (Figs. 1 and 3) from the point of emergence from the labial flange until it reaches the crest of its convexity is biomechanically an important portion of the nasal stent. The clinician should mark the location of the point of emergence of the nasal stent on the labial vestibule (Fig. 2). This should ideally be aligned to the medial half of the cleft nostril. In relation to the alveolar process, the desirable point of emergence is at the lower middle third of the labial vestibular flange covering the medial edge of the noncleft segment.

The rationale for preferring this position is that, once nasal molding is begun, a sagittal, reciprocal force vector is introduced into the dynamic system of alveolar molding force vectors that already operate on the anterior alveolus from lip taping, and the effect is clinically seen as blanching of the area (Fig. 3). This reactionary force from nasal molding augments the alveolar molding of the medial alveolar region of the greater hemialveolar segment.

The wire armature at the base of the neck is usually almost horizontal and emerges out from within the triangular gap between the upwardly curving medial ends of the cleft lip elements (Fig. 4). It should not descend very low from the upper lip and alveolus to allow comfortable feeding and not obstruct the feeding bottle nipple. At the same time, it is important to avoid bending it too far up where it can interfere with lip approximation. The base of the neck is provided sufficient depth to leave about a 3- to 4-mm space between the lip and the wire convexity. For a plate with outriggers, this depth is kept just sufficient to allow the stent wire convexity to cross above the outrigger (Fig. 4). If the stent convexity is too far forward of the lip, it presents as a prominent target handle, which will be easy for the infant to grab and pull at, a tendency that infants will develop during the course of treatment as a result of their advancing grasping skills and dexterity.

The upper neck segment from the crest of the stent convexity until the point of its entry into the cleft nostril is graciously shaped like a swan’s neck (Fig. 1). A sigmoid curve should be incorporated into the neck that will allow controlled activation of the nasal stent to apply a gentle forward and upward molding vector to the dome of the lower lateral alar cartilage and a reciprocal alveolar molding vector on the medial hemialveolar segment as described earlier. Leaving the neck wire bare facilitates providing this controlled activation in the clinic by adjusting the stent with pliers. The height of location of the base of the neck and the length of the upper neck segment ultimately depend on the infant’s alveolar height and projection, and therefore, individual variation is seen.

The kidney bean-shaped nasal bulb has 2 parts: a relatively larger upper lobe that lies beneath the alar dome and a lower lobe

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FIGURE 1. Parts of nasal stent wire armature. Inset, Completed nasal bulb after polymerization.

FIGURE 2. Marking the point of emergence of the stent on the vestibular flange.

FIGURE 3. Blanching on anterior alveolus from reciprocal force vector of nasal molding.
that lies just beneath the nostril rim. Incremental addition of soft
denture relining material to the upper lobe and controlled activation of
the upper neck portion of the nasal stent support and gently mold the
collapsed alar dome, which is clinically reflected by its mild tissue
blanching. With progressive additions of soft relining to the upper lobe
during the course of nasal molding, it will become larger than the
lower lobe. The advantage of providing a lower lobe is that the
interlobe syncline serves as a guide and positive engagement point
for the lower lateral alar cartilage and the medial part of its lateral
crus that makes up the anterior alar rim (Fig. 4). Stent activation is
clinically exhibited as a nostril lift in this region. Excessive nasal
stent activation is undesirable as the resultant stretch and pressure
may lead to plate dislodgement and may cause tissue breakdown of
the nasal mucosa with potential notching in the medial third of the
cleft nostril rim, all of which are undesirable effects. Parents should
be instructed to apply petrolatum jelly on the upper lobe as well as
the inner mucosal lining of the cleft nostril to keep the nasal mucosa
lubricated. This prevents the tissues from drying and becoming
prone to breakdown due to friction and applied pressure.

SIMPLE CLINICAL METHODS FOR ADDING NASAL STENTS TO NASOALVEOLAR MOLDING APPLIANCES

Forming and Incorporating the Wire Armature

A commonly followed method involves making a direct wax
template of the nasal stent that is used as a guide for the wire
bending. First, a 0.036-in stainless steel wire blank is adapted to the
base plate and embedded by acrylizing its anchorage portion in the
plate, leaving a horizontal 2.5- to 3-in-long straight length emerging
from the desired point on the labial vestibular flange. The free
terminal end should be bent on itself in a circle as a safeguard
against potential injury in the event of sudden infant head movement
during the clinical procedure. A piece of orthodontic rope wax of
about the same length is compressed onto the plate at the point of
emergence of the wire. The easily formable rope wax is then bent by
the clinician in situ with fingers to shape it into the form of the nasal
stent (Fig. 5A) according to the design features described earlier.
Next, the wire blank is bent ex situ using orthodontic pliers to
conform to and replicate the wax template. The plate with stent wire
is tried in situ (Fig. 5B), and minor adjustments are made as
required. The excess wire beyond the lower lobe is then cut off.

Alternatively, if the clinician desires to avoid making a
template, the author suggests a simplified method in which the
clinician can hold a flexible ruler at the desired point of emergence
of the stent on the vestibular flange and curve it in toward the cleft
nostril, positioning the ruler to overlie the nostril and ala (Fig. 6).
Then, the measurement of the length of the curve from the point of
emergence until the nostril rim is noted. The distance from the
nostril rim to the point where support for the alar dome is required is
also measured using the ruler. The wire length that will be required
to bend the framework supporting the bulb portion is almost 4 times
its desired vertical height from the nostril rim. For example, to bend
a superior lobe 4 mm high, 15 mm of 0.036-in wire is used up for
the superior and inferior lobe wire framework. Thus, the total length
of wire from the point of emergence of the nasal stent should be longer than the sum of the measured length of the stent
curve and 4 times the measured height of the alar dome from the
nostril rim. The straight wire blank emerging from the plate is
marked at these points, and the neck contour and nasal bulb are bent
ex vivo. Excess wire is cut off, and the plate with stent armature is
tried in situ. Appropriate shape adjustments are made according to
the design guidelines and regional anatomy.

Another simple, indirect alternative the author has impro-
vised, in which the need to acrylize the anchorage portion before

FIGURE 4. A and B, The stent should not obstruct use of with any kind of feeding bottle. Also, note the point of emergence
of the nasal stent in relation to the lips and the positional relation of the lower nasal bulb lobe with the alar rim.

FIGURE 5. A, Contoured wax template of nasal stent in situ. Note embedded straight wire blank that will be bent ex situ to
replicate wax template. B, Nasal stent armature is checked in situ after being bent to wax template. Note safety bend-back
at terminal end of wire, which can now be cut.
making the nasal stent is obviated, uses a malleable wire to bend the nasal stent template. After determining the point of emergence of the stent from the labial vestibular flange (Fig. 2), relief is provided in the appliance for the embedded anchorage portion of the stent (Fig. 7). A complete template of the nasal stent is made by bending an unattached piece of flexible wire in situ (Fig. 8) according to the design guidelines described previously. A sufficiently long 0.036-in stainless steel wire then is bent extraorally to duplicate this armature and superimpose on the template including the nasal bulb (Fig. 9). The steel wire armature is then positioned in the relief provided in the plate and then tried along with the plate in situ, and minor adjustments are made as appropriate. When in satisfactory relation, it is secured in position with rope wax compressed to hold it against the outrigger (Fig. 10) or acrylic button handle, or the vestibular flange, depending on the type of NAM appliance being used. The stent is then incorporated into the plate by acrylizing its anchorage portion into the relief provided. With this method, the clinician can also have a series of prebent steel wire armatures in a gradation of sizes, and the one that most closely fits the flexible wire template that

FIGURE 6. Measuring length of stent and bulb using a flexible ruler contoured like a stent.

FIGURE 7. Relief provided in plate to embed anchorage portion of stent.

FIGURE 8. Contoured flexible wire template of nasal stent armature being custom bent in situ. In this photograph, an aluminum wire ensheathed in plastic tubing is shown.

FIGURE 9. Nasal stent armature in 0.036-in stainless steel wire bent to superimpose on flexible wire template.

FIGURE 10. Nasal stent stabilized in position against outrigger with wax.
was custom bent by the clinician as described above can be selected and adjusted for exact fit in situ.

**Acrylization and Adding Soft Reline to the Bulb**

After the framework of the upper and lower lobes of the nasal bulb has been bent, the next laboratory step is to provide its three-dimensional shape and overlay its surface with soft reline material to provide a soft surface that will contact the soft tissues on the ventral alar surface. Molding pressures from a hard surface are less well tolerated by the infant's mucosal surfaces and can cause tissue breakdown. The mediolateral width of the nasal bulb is usually about 4 to 5 mm, and this thickness is determined by its purpose, which is to adequately distribute the force for comfortably supporting and molding the alar dome and lower lateral alar cartilage. A very large nasal bulb may lead to nasal obstruction and also contribute to an excessively widened cleft-side nostril. On the other hand, a very narrow stent will concentrate the force vector to a narrow region of the cartilage, which may be uncomfortable for the infant to bear, lead to notching and tissue trauma, and is unlikely to be effective in molding the alar dome. The upper and lower lobes are provided their three-dimensional shape by adding autopolymerizing resin and curing in a pressure flask. Alternatively, a light-cured polymerizing resin can be used to expedite this laboratory step. After polymerization of the bulb body, soft denture reline is added using a dental laboratory hand instrument and contoured to provide a smooth, continuous overlay (Fig. 11). The bulb is then submerged in hot water, and polymerization is undertaken in a pressure flask. Again, as an alternative, a light-cured soft denture reline can be used to expedite this step.

**Finishing and Insertion**

After the polymerization of the bulb and reline has been completed (Figs. 12A, B), the external plate surface is smoothed and finished using appropriate finishing stones, polished to a shine with slurry of pumice, and disinfected. The appliance is then tried in the infant's mouth, and any final clinical adjustments to the nasal stent are made as required. Parents are instructed on the application of petrolatum jelly for lubrication of the nasal mucosa. On the day of insertion, a gentle lift of the alar dome and medial half of the nostril rim is all that is needed to confirm that the nasal stent is providing sufficient support and is active. Excessive activation can cause frequent appliance dislodgement due to tissue spring-back from the excess pressure and also cause tissue trauma. Ability to feed without interference or plate dislodgement is checked (Fig. 4). The parents or care providers are advised that their baby might need a couple of days to get used to the sensation of a new object in the nose, but the plate must be worn at all times even during this initial period. Most babies will rapidly get used to the stent, because they are already well adapted to their maxillary orthopedic plate by the time the stent is added. Parents are also informed that during the baby's initial experience with the nasal stent, it is important for them to intermittently check that their baby does not displace the appliance, leading to the nasal bulb sitting over the ala rather than under it.
which obviously will be counterproductive to the treatment goals of nasal cartilage molding. However, such a tendency is rarely seen, and it usually will stop in a couple of days, once the baby gets used to the stent.

**CONCLUSIONS**

Regardless of the NAM appliance and technique, the broad treatment goals are universal. It is important for the clinician undertaking presurgical NAM for infants with clefts to understand the roles played by all elements of the appliance, their design features, and anatomic correlations to provide optimal treatment (Fig. 13). The author has used the described innovative methods effectively to incorporate nasal stents into appliances and recommends that, whichever method is followed, it should be an efficient, expeditious, and comfortable experience for the infant, family and clinician. Although methods of adding nasal stents to unilateral cleft appliances were illustrated on appliances with outriggers, which are the author’s preferred appliances in unilateral cleft lip and palate, the same methods are applicable for any type of the unilateral or bilateral cleft orthopedic appliances. Clinicians should use the method that is most easily adaptable to their preferred appliance and setting.

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**REFERENCES**


**FIGURE 13.** Typical clinical outcome. A, Pretreatment presentation with wide cleft and typical dome collapse and alar distortion. B, After NAM showing cleft approximation and favorable presurgical lip element placement, nasal tip alignment, projection, columellar lengthening, and lift of alar dome. C, After surgical lip repair with Fisher’s anatomic subunit approximation technique, without primary surgical nasal correction or gingivoperiosteoplasty. Lip repair for the infant in this figure was undertaken by David Fisher after NAM by the author.