

## Original Article

# Namaste (counterbalancing) technique: Overcoming warping in costal cartilage

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## ABSTRACT

**Background:** Indian noses are broader and lack projection as compared to other populations, hence very often need augmentation, that too by large volume. Costal cartilage remains the material of choice in large volume augmentations and repair of complex primary and secondary nasal deformities. One major disadvantage of costal cartilage grafts (CCG) which offsets all other advantages is the tendency to warp and become distorted over a period of time. We propose a simple technique to overcome this menace of warping. **Materials and Methods:** We present the data of 51 patients of rhinoplasty done using CCG with counterbalancing technique over a period of 4 years. **Results:** No evidence of warping was found in any patient up to a maximum follow-up period of 4 years. **Conclusion:** Counterbalancing is a useful technique to overcome the problem of warping. It gives liberty to utilize even unbalanced cartilage safely to provide desired shape and use the cartilage without any wastage.

## KEY WORDS

Autogenous cartilage; costal cartilage graft; counterbalancing technique; rhinoplasty; warping

## INTRODUCTION

Correction of nasal deformity is a real challenge for aesthetic surgeons. The use of costal cartilage grafts (CCG) in rhinoplasty is a well-established technique and has gained increasing popularity in recent times amongst rhinoplasty surgeons. Nasal tip under-projection, saddle nose deformities, congenital nasal deformities and secondary rhinoplasty are some scenarios requiring a significant degree of structural augmentation and support that may necessitate the use of CCG.<sup>[1]</sup> Noses in the Indian subcontinent are characteristically broader

and lack projection as compared to other populations, thus very often requiring large volume augmentation.<sup>[2-4]</sup>

In spite of the availability of many alloplastic materials, autogenous cartilage is the preferred material for use since synthetic implants act as foreign bodies and have a high rate of infection and extrusion.<sup>[5,6]</sup> Small to moderate augmentation can be managed with conchal or septal cartilage.<sup>[6-9]</sup>

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Warping refers to the natural tendency of distortion of CCG, which results in a deformity of the reconstructed nose. It is very much the reason of drop in popularity of costal cartilage as a source of grafts in rhinoplasty in spite of its many obvious advantages over other sources of graft. Gibson and Davis<sup>[10]</sup> in 1958 concluded ‘if warping could be controlled, rib cartilage would be the ideal nasal graft’.

By using our technique, warping is not only avoided but can also be used to our advantage. A piece of cartilage is split into two equal halves; now two cartilage pieces will have a tendency to deform in opposite directions. When these pieces are sutured in the midline, these deforming forces will counterbalance the warping.

## MATERIALS AND METHODS

We present data of 51 patients of rhinoplasty done using autogenous CCG over a duration of 4 years. Grafts were used as: dorsal strut, columellar strut, septal extension graft, alar graft and intercartilaginous graft. Many patients, particularly reconstructive and cleft patients, required multiple grafts for different locations. The results were evaluated taking into consideration the patient satisfaction, graft displacement, distortion/warping of the graft and preservation of shape. The aesthetic appearance was assessed according to patient's own perception and comparison of photographs. Patients were followed up for a maximum of 4 years.

### Surgical technique

#### *Harvesting of costal cartilage graft*

Usually, 6<sup>th</sup> or 7<sup>th</sup> or both costal cartilages are harvested if other areas of the face also need to be augmented. These cartilages are usually ‘C’ shaped.



**Figure 1:** Curved cartilage is marked in midline along its long axis

Two parallel incisions are taken along the cranial and caudal margin of the rib leaving behind 2-3 mm of perichondrium along the margins. The perichondrial strip in between the incisions is harvested. The remaining perichondrial strips along the costal cartilage will provide grip during the subperichondrial harvest of costal cartilage. This not only makes the subperichondrial dissection of the cartilage easier, but also the harvested perichondrium can be used to cover the upper surface of dorsal strut prepared by counterbalancing technique. We usually harvest cartilage from the left side so as not to interfere with the team operating on the nose, on the right side of the patient.

#### *Preparation of graft using counterbalancing technique*

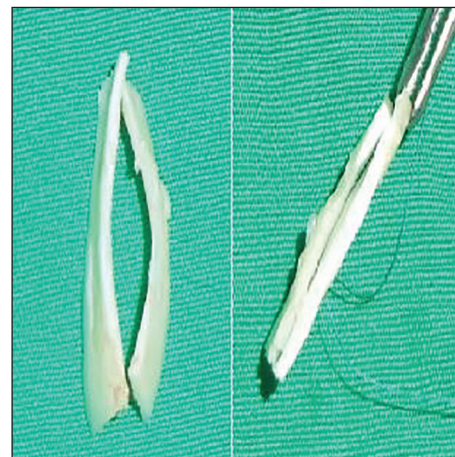
The desired height of the graft should be determined, and the anterior and posterior surface carved accordingly.

#### *Splitting of graft*

Once the desired height is obtained, the curved cartilage is marked in midline along its long axis/curvature and is divided into two equal halves as shown in Figure 1. Now there are two equally curved pieces. The concave surfaces of the equally cut cartilages are kept facing each other and sutured in the midline [Figure 2].

#### *Method of suturing*

Cartilages are sutured to each other using non-absorbable sutures, beginning from the centre and going to either end. Simple box sutures are taken using polypropylene 3-0 from the middle part of the cartilage and not from the lateral edges as these edges need to be carved to adjust the width of graft and to make them rounded [Figure 3a]. These two pieces of cartilage sutured together counter



**Figure 2:** Concave surfaces of the equally cut cartilages are kept facing each other and sutured

each other's deforming forces and remain straight and prevent warping.

Once the midline sutures are taken, the graft can be carved for desired width and length. If the curvature of the cartilage is more, or the cartilage is tougher than usual, then it is difficult to suture two concave surfaces together. In this situation, the concavity has to be reduced by placing multiple partial cuts on the concave surfaces of both the pieces to make them slightly straight and pliable that facilitates suturing of the two grafts. All types of grafts needed in rhinoplasty (spreader graft, columellar strut, septal extension graft, dorsal strut) can be prepared by this technique [Figure 4a-d].

Once the dorsal strut is carved to the desired shape and dimensions, the harvested perichondrial strip is wrapped over the superior portion of the dorsal strut and fixed to the sides taking few sutures by polyglactin 5-0. This gives smooth contour to the dorsum and softens the edges of the strut.

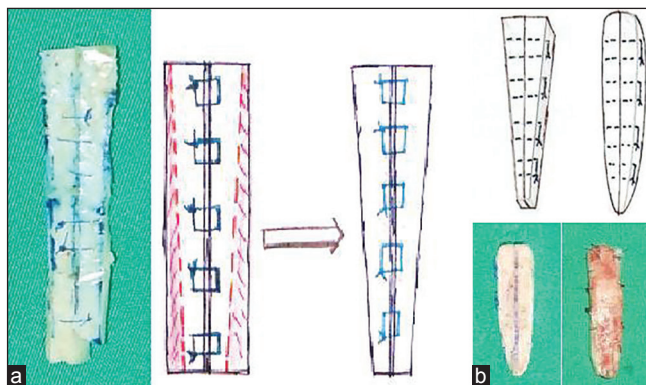
When a curved piece is needed by choice, a single piece of naturally curved cartilage can be used as for lateral crus of ala and intercartilaginous graft between upper and lower lateral cartilages.

All peripheral, thin, curved pieces can be used by stacking them together using counterbalancing technique.

The rest of the rhinoplasty is performed as per the standard technique. Nasal packing is done with liquid paraffin soaked tape gauze piece. Plaster of Paris splint is applied for 2 weeks.

#### Points to be remembered

- After taking midline sutures, the length and the width of CCG can be carved. Now, what remains is the height



**Figure 3:** (a) Midline box sutures and carving laterally, (b) lateral sutures taken and carving anteriorly

or thickness of the graft, adjustment of which requires carving on superior or inferior surface which is difficult with midline sutures in place. To avoid this difficulty, the authors usually determine the height and carve the anteroposterior surface before cutting into two pieces. In cases where height needs to be adjusted further or has not been addressed before, then after obtaining desired length and width we take few sutures from lateral edges and carve anteroposterior surfaces by sacrificing midline sutures [Figure 3b].

- Knots are to be kept on the inferior surface of the graft to avoid the complication of palpable sutures postoperatively and thus making a smooth dorsum.
- We always try to leave equal cartilage on either side of midline while carving the width and thickness fearing that an unequally strong cartilage may bend/warp.

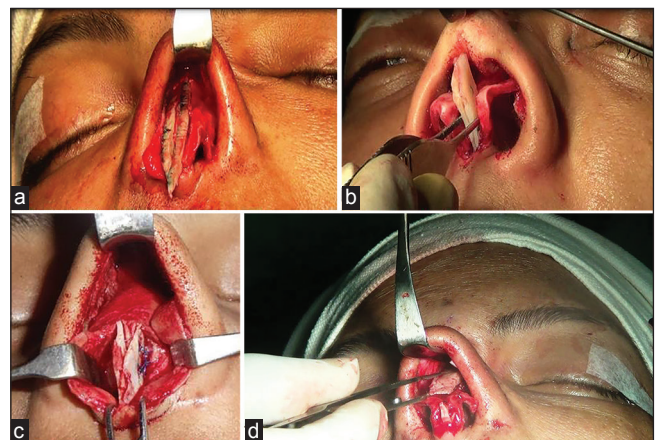
## RESULTS

In our study, there were 15 males and 36 females. The follow-up period ranged from 12 months to 4 years with a mean of 26 months. All patients were satisfied with the nasal profile. There was no evidence of warping in the post-operative follow-up. Clinical evaluation was performed by inspection of the nasal profile, palpation and serial photographic documentation every 3 months for first 6 months, then 6 monthly for 2 years and yearly thereafter.

There was no incidence of fractured nasal graft. There was no extrusion of graft or palpable sutures.

#### Following complications were noted

One patient had a pleural tear detected intraoperatively by Valsalva manoeuvre, which was managed by immediate



**Figure 4:** (a) Spreader graft, (b) columellar strut, (c) septal extension graft, (d) dorsal strut

suturing. Post-operative course was uneventful. 3 out of 51 patients (<6%) developed infection which was managed conservatively by intravenous antibiotics. 5 patients (10%) developed hypertrophic scar on donor site which was excised and resutured during rhinoplasty and settled well later. Of these, 3 were managed by scar revision and 2 were managed conservatively by silicone gel sheet.

The post-operative results of some of the patients of this series are as follows:

- Case 1: A case of crooked nose [Figure 5a-c]
- Case 2: A case of secondary cleft lip nasal deformity [Figure 6a and b]
- Case 3: A case of aesthetic rhinoplasty [Figure 7a and b].

## DISCUSSION

Autogenous CCG is the preferred method for nasal reconstruction, particularly augmentation, owing to the ease of harvest, strength of cartilage and adequacy of volume.<sup>[1,8]</sup> The use of septal and the auricular conchal cartilage is limited by small volume available.<sup>[8]</sup> In some conditions, a large volume of cartilage is required at multiple locations to correct the deformity. Judicious use of costal cartilage is a logical and realistic solution for these challenging cases. Though costal cartilage is best suited for nasal augmentation in volume, availability and properties, its major disadvantage is the distortion due to warping.

Warping refers to the natural tendency of the cartilage to bend or curve over a period of time which results in distorted nasal profile in the post-operative period and is a major concern amongst practicing aesthetic surgeons today. Gibson and Davis described that surface tension forces lead to bending of costal cartilage.<sup>[10]</sup> Fry<sup>[11]</sup> demonstrated that protein polysaccharides in the cartilage lead to internal tensile stresses that change the shape. The combined effect of all such forces is warping.

The remedy for this malady has been sought since the times when Gibson and Davis described the balanced cross-sectional carving in their landmark paper in 1958. Since then, various methods have been tried, but none has been successful in completely eliminating it till date. A brief analysis of such techniques is as follows:



**Figure 5:** (a) A case of crooked nose: Preoperative, (b) 1-year post-operative (c) 4-year post-operative



**Figure 6:** (a) A case of secondary cleft lip nasal deformity: Preoperative (b) 18 months post-operative



**Figure 7:** (a) A case of aesthetic rhinoplasty: Preoperative (b) 15 months post-operative

Gibson and Davis<sup>[10]</sup> introduced the technique of balanced crossed section in which only the core piece is used and valuable peripheral graft is discarded thus limiting the width of the graft. Also, with intact perichondrium,

the graft cannot be carved circumferentially. They have also discussed the option of making parallel cuts on the taut outer zone of the graft, but they were skeptical to use it due to possibility of delayed distortion of the graft secondary to contraction of fibrous tissues in the cuts. Furthermore, if the cuts are made on outer edges, it may cause irregular lateral margins, and complete straightening might not be possible in severely curved cartilage.

Gunter *et al.*<sup>[12]</sup> in 1997 came out with a solution to this problem by passing axial Kirschner wire through the graft for internal stabilisation. The major criticism drawn by the study was the possibility of extrusion of K-wire. Furthermore, it may be distressing for the patient and made the patient uncomfortable.

In 1999, Erol used the technique of diced cartilage wrapped in surgicel, which he described as the ‘Turkish delight’ technique<sup>[13]</sup> in 2365 patients with excellent results. This was critically analysed by Daniel and Calvert<sup>[14]</sup> who revealed that the long-term results of the technique were poor with high absorption rate. Daniel proposed the idea of wrapping diced cartilage in fascia with better long-term viability. However, these grafts do not have structural integrity and can only be used for contour and shape. Recently, Nassab reported that diced cartilage wrapped in fascia can undergo significant fibrosis.<sup>[15]</sup>

Irradiating the CCG and use of infra-red lasers<sup>[16]</sup> has also been described as a method of prevention of warping.<sup>[17]</sup> In an *in vitro* study<sup>[18]</sup> by Adams *et al.*, irradiated and non-irradiated cartilage have been found to have similar warping characteristics and hence irradiation should not solely be relied upon to prevent warpage. Irradiated cartilage was found to have a higher rate of resorption. Shortcomings of the study were that this was an *in vitro* study in cadavers and the follow-up period was only 4 weeks.

Kim *et al.*<sup>[19]</sup> in their study have compared concentric carving technique of costal cartilage with eccentric carving technique and found that the use of centre of rib segment results in diminished warping. However, the authors also suggest that inherent forces are more evident in these grafts, but they speculate that side to side warping is more clinically evident due to less soft tissue resistance. Also in this technique the complete piece of the graft is not used, and warping

is only minimised without a definitive solution to the problem.

Another cadaveric study performed by Farkas *et al.*<sup>[20]</sup> analysed the rate of warping and the effect of oppositional suturing in costal cartilage, which was studied in laboratory conditions at 1 h and 1-month. This study showed no difference in severity of warping after manipulation, including orientation of harvest and oppositional suturing. However, the authors have stated limitations of the study as small sample size (six cadavers) leading to underpowered study creating clear bias. Furthermore, the cadaveric cartilage was more dehydrated, brittle, and calcified as compared to autologous cartilage.

The timing of warping is another area of concern. Reports are conflicting regarding when the actual warping occurs. Some studies suggest the distortion occurs in the first 30 min after carving while others report it to continue for weeks.<sup>[18,20,21]</sup> With counterbalancing technique, as the amount of warping will be equal in both the carved pieces there is no need to wait for warping to occur. Moreover even for delayed warping, the forces will neutralize each other, keeping the graft straight.

In this technique, the cartilage is harvested subperichondrially. The exclusion of perichondrium does not alter the shape of the harvested piece. The small sleeve of harvested perichondrium can be used in tip-plasty or lining superior surface of cartilage graft to smoothen the dorsum and to soften the graft edges. The remaining perichondrial sleeve at the donor site results in regeneration of cartilage.<sup>[22]</sup>

All cases in our series had a good outcome as the shape and the volume of the graft were estimated preoperatively. Counterbalancing technique helped us to attain and maintain the shape of the nose after surgery with satisfactory long-term results. Our use of this technique prevented warping and kept the graft straight by balancing deforming forces.

With our technique all pieces of cartilage, whether curved, straight or of small size can be used. There is no need to discard any piece and hence there is no wastage of the precious graft. Though the technique is unique in its ability to negate the warping, it is not complex to master and does not have a long learning curve. If one

follows the basic steps as described earlier, this method is reproducible in daily practice.

All these manoeuvres may take 30-40 min or even an hour extra, but it is worth investing few extra minutes when things can be rectified, than having a distorted dorsum mocking your sincere efforts later on.

## CONCLUSION

The natural tendency of cartilage to warp can be used by counterbalancing technique to keep it straight. This technique also gives liberty to utilize even unbalanced CCG safely for providing required shape. All available length of the graft is maintained with this technique; also adequate breadth of the graft is provided as there is no need to discard curved margins as in taking only a central straight piece. It can also be used as a two-layered graft if more augmentation is required.

Authors wonder, if this is the end of the warping menace and finally we have got an ideal nasal graft.

PS: Why the title ‘Namaste’?

The title of the technique is based on the traditional Indian way of greeting by joining hands which is akin to the way the cartilage blocks are sutured together to prevent warping.

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## Conflicts of interest

There are no conflicts of interest.

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