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Short Communication

The evaluation of various morphological aspects of septal cartilage-a cadaveric study: a 6 months observation study in KLEs, Dr. Prabhakar kore hospital, Belagavi

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ABSTRACT

The nasal septum provides support for the portion of cartilaginous nasal dorsum, and it is responsible for determining the projection of the nasal tip. Septal cartilage plays an important role as a donor graft material in modern rhinoplasty. An anatomical study was performed on 10 adult cadavers. The excised septal cartilage was placed on grid paper; digital images were taken; all septal cartilage was divided into nine equivalent quadrants; and quantitative measurements for length, height, and area were calculated and compared. The average length of the septum was 35.8 mm, while the average height was 25.9 mm. The average septal area was 679.7 mm^2. The septal thickness mean values were analysed in nine quadrants, ranging from 1.21 to 2.08 mm. Specifically, the central and cranial areas were thickest, and the area corresponding to the L-strut was thinnest. Anatomical variations of the thickness of septal cartilage excisions were found to be statistically significant, and these differences play an important role in the proper selection of the septal grafts.

Keywords: Nasal septal cartilage, Area measurements, Rhinoplasty

INTRODUCTION

Nasal septum – Key structure of the nose

The septum can be rightfully seen as key structure of the nose. It is of a crucial relevance for normal development, appearance and function of the nose. Since it is part of the cartilaginous nose, it is responsible for a normal growth of the nose and the upper maxilla, respectively from infancy to adult age.

For a normal postnatal development of nose and visceral cranium the growth plates within the septum are important. If one of these growth plates is damaged by a trauma, it leads to an aberration of the outer nose or even a deficient formation of the upper maxilla, depending how much time has passed since the trauma has happened.[1]

Linked to this phenomenon is one of those problems of nose surgery which remain unsolved: surgical correction of a pre-pubertal distortion of the septum. It remains to be seen how the growing cartilage reacts upon a surgical intervention, in some cases this might cause iatrogenic disturbance of the development.

From a functional, as well as an aesthetic point of view, the septum is often segmented in two parts. The parting line lies here between the dorsal cartilaginous and

osseous anastomosis along the nasal bridge (rhinion) and the spina nasalis.[2]

The frontal parts co-determine the form of the nasal dorsum and the location of the tip of the nose crucially. Deformations of the septum largely lead to the development of a saddle-nose, hump or a cartilaginous crooked nose.[2]

The segments lying behind this line have practically no effect on the aesthetic aspect of the nose. In addition, the septum creates a partitioning wall between the nasal cavities, as well as the median wall of each cavity. It is composed of the columella, the membranous, cartilaginous and osseous septum.

The importance of nasal septal anatomy is related to the central support to the nasal structure and stability of nasal valve provided by this structure and its articulation with the upper lateral cartilage and bony framework. This framework forms the internal valve, which is responsible for almost 50% of total airway resistance.[3]

In modern rhinoplasty and nasal reconstruction, septal cartilage plays important role of a donor graft material. The nasal septum apart from providing support for the cartilaginous portion of the nasal dorsum and tip; it is also important in determining projection of the nasal tip.[4]

Role of septum in rhinoplasty

The various options of grafts available for rhinoplasty and reconstruction of nasal dorsum, for support of the internal and external valves, and for projection of the nasal tip has led to a need for more cartilage donor sites.

The septum has been the primary graft donor site and the first choice of most authors for a long time. Some of the features that make it a preferred option include the surgeon's ability to harvest the graft from the same operative site and donor, a very low rate of absorption and infection, and a readymade supply of strong, straight cartilage in sufficient amounts.[5]

When the required graft is larger than the available septal cartilage material—and in cases of secondary and revision rhinoplasty, where the septum has already been harvested other options like costal cartilage and ear cartilage can act as alternatives.[4]

The proper selection of donor grafts has a major impact on long-term results; factors like proper thickness, sufficient length, and a low possibility of distortion (mainly in the costal cartilage) are essential features of the ideal graft.[6]

Though we know that the nasal septum provides strong and straight cartilage, very few studies have assessed the appropriate thickness, length, and area of such cartilage to determine the ideal material and site for each type of nasal graft.

METHODS

An anatomical study was performed in KLE Prabhakar Kore Hospital, Belagavi from December 2018 to May 2019 on 10 adult cadavers.

Inclusion and exclusion criteria

Although the medical histories were unavailable, any specimens with physical signs of facial trauma, nasal abnormality, or prior nasal surgery were excluded. Ethical clearance is not required.

Figure 1: Harvested septum.

Figure 2: Insize digital caliper.

The excised septal cartilage was placed on a flat surface; digital images were captured (Figure 1); and measurements of specific areas were made with Image J 1.42q software (National Institutes of Health, Bethesda, Maryland; software is open source). The total area was

calculated, along with the points of greatest length and height in millimeters.

All septal cartilages were divided into nine equivalent quadrants by drawing two straight lines parallel to the nasal dorsum and two lines perpendicular to those markings. These quadrants were identified as A through I.

The thickness was measured at the midpoint of each quadrant with an insize digital caliper. This calliper had 0.01 mm resolution, and its accuracy provided an acceptably low margin of error in the measurement. (Figure 2)

Analysis was performed with descriptive and inferential statistics, according to the nonparametric Kruskal-Wallis test and a subsequent Student-Newman-Keuls test (when applicable). Results were tabulated with Bio Stat 5.0 software. Statistical significance was assumed at $p<0.05$

RESULTS

The mean length was found to be 35.8mm. The mean height was found to be 25.9mm. The mean area was found to be 679.7mm^2 (Table 1).

Table 1: Anthropometric measurement of septal cartilages.

S.no	Length (mm)	Height(mm)	Area(mm^2)
1	37	27	785
2	34	23	640
3	34	24	674
4	38	28	683
5	38	29	654
6	35	25	676
7	38	25	706
8	37	21	567
9	37	29	788
10	30	28	624
Mean	35.8	25.9	679.7

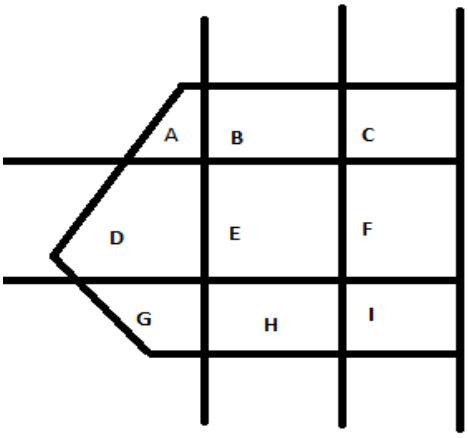

Figure 3: Division of cartilage into nine quadrants.

A posterior division in eight zones was proposed: Dorsal septum=ABC, Caudal septum=DG, Septal base=GHI, Septal base remaining=HI, Central remaining=EF, Anterior to ethmoid=CFI, Posterior to caudal septum=BEH, Central=DEF (Figure 3).

The average length of the septum in the 10 cadavers studied was 35.8 mm (range, 30 to 38 mm), while the average height was 25.9 mm (range, 21 to 29 mm). The average septal area was 679.7 mm2 (range, 788 mm2) (Table 1). Mean septal thickness was measured in nine quadrants and ranged from 1.21 to 2.08 mm (Table 2).

Table 2: Nasal Septal Thickness in Eight Zones.

Zone	Mean	SD	CV %
Dorsal septum	1.66	0.44	26.6
Caudal septum	1.79	0.35	20.0
Septal base (Above vomer)	1.51	0.43	28.9
Anterior to ethmoid	1.31	0.36	27.9
Posterior to caudal septum	1.86	0.38	20.8
Central	1.79	0.40	22.3
Central remaining	1.76	0.45	25.5
Septal base remaining	1.43	0.49	34.2

DISCUSSION

The septal cartilage has important relationship in rhinoplasty, its dorsal part forms the shape of cartilaginous profile. If the septum is injured deviated or depressed, the cartilaginous dorsum will also become deviated or depressed. The caudal part of the septal cartilage also affects the position of columella.[4]

Diniz et al conducted a cadaveric study on 14 cadavers, and found that the average length of the septum was 35.14 mm, and the average height was 32.5 mm. They found the average septal area to be 933.11 mm^2. The mean values of septal thickness were analyzed in nine quadrants, ranging from 1.04 to 1.71 mm. Statistically significant differences in mean values were found in 13 of the 14 cadavers. Specifically, the central and cranial areas were thickest.[6]

The initial enthusiasm for the use of cartilage grafts to correct nasal deformities was fueled by the ease with which cartilage could be harvested and sculpted to make a suitable graft. It was in the beginning of 20th century, (1907) when Jacques Joseph reported the insertion of the first free cartilage graft through intranasal incision.[7]

When augmentation of the nose is required as a part of rhinoplasty, the surgeon has a number of options regarding the choice of grafting material, but autogenous cartilage has steadfastly remained the tissue of choice for reconstruction, contouring and skeletal support repair of

the nasal frame work.[2] Autogenous cartilage is a versatile dependable tissue that is readily available, has an extremely low infection rate even when transplanted into a relatively avascular area. It is malleable and can be shaped and contoured by current techniques to match almost any existing structure.

The unique properties of biocompatibility, low risk of extrusion, low donor site morbidity, low rate of resorption and which does not induce any immune response, make autogenous cartilage grafting an indispensable technique for the reconstructive rhinoplasty surgeon.8 Nasal anatomy receives a great deal of attention in rhinoplasty literature. The complex anatomy of the nose and its relationship to nasal support, respiratory function, and facial development have been well established.

The placement of autogenous septal cartilage in rhinoplasty and complex nasal reconstruction has also been extensively discussed. However, studies regarding septal morphology and its relation to cartilage graft choice are rare.

If we go by the embryology, the quadrilateral cartilage is the unossified part of the vertical plate of ethmoid and hence the perichondrium of septal cartilage is continuous with the periosteum of the ethmoid plate. The perichondrium is continuous with the other side along the inferior border of cartilage.[9]

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Tardy states that residual cartilage excess from the nose during septal rhinoplasty serve as satisfactory implant for nasal support and contouring. Generous segments of septal cartilage can be harvested from the quadrangular cartilage posterior to an imaginary line connecting the osseocartilaginous junction with the nasal spine without jeopardizing septal support.[2]

Our study had a lower mean area which may reflect the apparently smaller noses of the native Southeast Asians compared to East Asians and South Asians. Septal cartilage may be available in different populations as graft materials if less than 400 mm^2 is needed.

Surgeons can decide if septal cartilage is enough or additional donor sites are needed. Prior knowledge of the area available to the operating surgeon can lessen the possibility of extensive resection of nasal septum. Too much resection can lead to weakening of the structural support of the nose which can bring about saddle nose deformities and problems in airway function related to internal nasal valve.

Also, harvesting a deviated septum has additional advantage of relief of obstructive symptoms.9 However, a major limitation in the use of septoplasty is the limited availability, particularly in eastern Asian countries who have smaller noses.

Hwang et al evaluated septal cartilage thickness in 14 adult Korean cadavers and found that the septal base (anterior to the vomer) was the thickest area (range, 2.19 to 3.03 mm), while the thinnest was the area superior to the septal base (range, 0.74 to 0.97 mm). The mean septal cartilage height was 2.99 cm, and the mean length was 3.31 cm.[10]

In another study, Mowlavi et al examined 11 cadavers and identified the septal base as the thickest area (2.7 mm), the dorsal septum as having intermediate thickness (2.0 mm), and the central portion and the septal angle as the thinnest areas (1.3 and 1.2 mm, respectively). In their study, the authors suggested preserving a more generous L-shaped strut in the caudal septum.[11]

Columella struts must be harvested from the central remaining area to provide strong support to the nasal tip, whereas tip grafts should be harvested on the basis of the patient's anatomical demand for thicker versus thinner and smoother grafts.[11]

In septal surgeries to decrease the potential for loss of the tip and dorsal nasal support, the surgeon preserves at least 1 cm width portion of the dorsal and caudal septal segments. This portion has been termed the L-strut.[11]

Deformities of L-strut create functional and aesthetic problems such as twisted nose, malposition tip, saddle deformity and internal valve deficiency. It is important to preserve the 1cm width of the inferior portion of the caudal L-strut segment, which is also the portion posterior to a vertical line drawn from the rhinion to anterior nasal spine. When septoplasty or rhinoplasty is performed, the caudal segment of L-strut in contact with the maxillary crest posterior to anterior nasal spine must be conserved.[12]

CONCLUSION

Knowledge of these anatomical characteristics in the cartilaginous septum will allow the surgeon to more effectively plan rhinoplasty procedures in advance, since there will be a need for longer grafts in many cases (eg, extended spreader grafts, lateral crural strut grafts, and dorsal grafts). Limitation of study: Short duration of study limits its application on larger scale and can be further enhanced by addition of other parameters like histology and tensile strength of various segments of septal cartilage.

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