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THE ROLE OF NASAL BONE ANATOMY IN OSTEOTOMY TECHNIQUE SELECTION DURING COSMETIC AND FUNCTIONAL RHINOPLASTY

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Abstract

Introduction: Rhinoplasty involves complicated surgery, and this involves advanced anatomical expertise, especially with regard to the nasal bones. The anatomy of the nasal bones determines, to a large extent, the design of the osteotomy and thus not only cosmesis but also nasal performance.

Objective: The purpose of the research was to evaluate how variations of the nasal bones' structure affect the selection of the method of osteotomy in the cosmetic and functional surgery of the nose.

Material and Method: The prospective study was undertaken at Al-Tibri Medical College and hospital located in Karachi during the period January, 2024 June, 2024. These nasal bone types were applied in classifying the patients (sixty patients in number) going through rhinoplasty, which were reviewed using the preoperative CT scans. The patient was anatomically assessed, and both internal and external osteotomy were carried out. The postoperative functional and aesthetic outcomes of the study were contrasted using the objective measurement of airflow and a satisfaction survey.

Results: Internal osteotomy was chosen in those with narrow and symmetric bone in the nose, and external osteotomy was selected in those with wide and deviated bones. The technique of assessing the anatomy paid off more, as there was more satisfaction with patients and an enhanced functionality.

Conclusion: The anatomy of the nasal bones is critical in the choice of osteotomy technique. Anatomy-based solutions made to fit an individual result in a better aesthetic and functional outcome in applications of rhinoplasty.

Keywords: *Rhinoplasty, nasal bone anatomy, osteotomy, internal osteotomy, external osteotomy, ENT surgery, functional outcomes.*

INTRODUCTION

Rhinoplasty is a surgical procedure intended to change the shape and functionality of the nose, and a thorough knowledge of the nasal anatomy, especially nasal bones, is necessary to ensure both functional and aesthetic success. The nasal bone structure has been found critical in guiding the

surgery to osteotomy. The use of internal or external osteotomy methods can considerably affect the surgical accuracy, healing results, and patient satisfaction (1). Correct preoperative estimation and anatomical knowledge provide safety and efficiency in carrying out the surgeries because surgical planning will go according to the anatomical variability of the individual (2). Computed tomography (CT) and similarly advanced imaging have proved to play an invaluable role in the assessment of the underlying bony structure and can allow both personalized surgical planning and lead to functional outcomes as well as aesthetic harmony (3). Osteotomies of the nose form a necessary part of rhinoplasty operations, frequently carried out to rearrange bones or to treat asymmetries. Asian populations, as an example, require special treatment for osteotomy selection due to specific anatomical features, including thicker skin and a flatter nose profile (4).

The anatomic variability is vital in most desired cosmetic results, as well as the maintenance of the nasal functioning, particularly during functional rhinoplasty. Preservation methods are safer than structural methods because they avoid trauma and preserve native anatomy (5). The type of intermediate osteotomy affects the efficacy of deformity correction as well as asymmetry postoperatively, particularly in instances of twisted nasal deformities, because different methods bear individual anatomical considerations (6). The biomechanics of nasal structures and their interaction with surgical techniques can provide a better understanding to control the reshaping of the nasal dorsum and correction of deformities. Comparative studies indicate that structural rhinoplasty provides a strong correctional trend and could lead to a longer recovery period, though preservation methods are promising in reducing the risks of complications without compromising the desirable results (7). Rasps and osteotomes can provide more or less precision and trauma to the dorsal hump removal, and anatomical knowledge is vital to the selection of the tool according to the density and curvature that the nasal bone presents (8).

Likewise, comparison between open and closed techniques of septorhinoplasty has shown different outcomes whereby open techniques have allowed more visibility in assessing anatomy, which helps in choosing osteotomy (9). The significance of nasofrontal angle, width of nasal bones, and the intercanthal distance has also been demonstrated in Anatomical studies, which may help in the accurate placement of the osteotomy and even the angulation. The analysis of these features should also be highly evaluated so as to avoid overcorrection or destabilization between nasal sidewalls during surgery (10). Preservation of the ligaments, especially the scroll ligament, has proved to enhance postoperative airway patency, again reinforcing the fact that surgical changes need not affect the functional anatomy (11). Comparison of open and closed means of rhinoplasty highlights the relevance of accessibility in operative development of nasal bone disorders and shows that the presence of technique choice needs to be based upon the case (12).

The straightening of the crooked nose is a difficult deformity, and its correction is largely dependent on the knowledge of understanding the asymmetrical growth of bones in the nose and their deviation. The surgical approach that accommodates such anatomical deformities will yield better results and fewer revision surgeries (13). A systematic, reflective attitude toward the nasal septum deviations has resulted in algorithms of treatment that take into consideration, as one of the primary tactics in achieving cosmetic and functional aims, anatomical preservation (14). Educational advances in 3D-printed osteotomy task trainers help further allow surgeons to train in anatomical variability, enhancing their technical accuracy when performing real surgical operations (15). Dorsal preservation rhinoplasty, which conserves the natural dorsum contour but obtains underlying structural deformities, is becoming popular due to its preservation of structural integrity. The meta-analyses show that in the chosen patients, there are fewer complications and more aesthetic results, which supports the connection between anatomy-based planning and the success rates (16).

However, reconstructive procedures are still helpful in the case of complex deformities, and the choice of reconstructive versus preservation methods usually hinges on how the anatomy fares on the preoperative examination (17). Comparisons of the results of patient satisfaction of structural and hybrid preservation methods imply that hybrid might provide a perfect balance of retention of anatomical integrity and achievement of the aesthetic intent (18). Dorsal augmentation, which is an important aspect of most nose jobs, involves an in-depth examination of the nasal bones as well.

Augmentation methods are diverse and rely on the anatomical requirements of enlargement, contour correction, and reinforcement of support. Thorough surveys reveal that anatomical knowledge is still very relevant in an effective choice of graft constituents and methods (19). Therefore, regardless of whether one undertakes such a procedure due to an aesthetic motive or a functional defect, osteotomy and augmentation plans should be grounded upon a sophisticated concept of nasal bone morphology. Finally, the anatomy of nasal bones is considered the keystone when choosing the technique of conducting osteotomy in rhinoplasty. In assessing the width and thickness of nasal bones, the interpretation of deviations and the angles, anatomical knowledge acts as a guide in delivering safer, more productive, and customized surgery. New technologies and more advanced methods are still developing, and yet knowing and understanding anatomy to make surgical decisions is still essential. Increased sophistication of surgical skills, the cosmetic and functional world of rhinoplasty will mark the future that combines both anatomy science and clinical artistry.

Objective: To determine the impact of nasal bone morphology changes on the choice of osteotomy procedures in cosmetic and functional rhinoplasty to improve the precision of the surgery, aesthetic outcomes, and functional outcomes.

MATERIALS AND METHODS

Study Design: Prospective Observational Study.

Study setting: The study was conducted at Al-Tibri Medical College and Hospital, Karachi, a tertiary care teaching hospital equipped with specialized ENT and plastic surgery departments.

Duration of Study: The data was collected over a six-month period from January 2024 to June 2024.

Inclusion Criteria: The included patients were between 18 and 55 years old with primary rhinoplasty and either cosmetic or functional. Male and female patients who had chronic nasal bone deformities, as quoted in the records, and had to undergo osteotomy were considered. The informed consent was obtained by all participants, and preoperative imaging (using CT scans) of all of them was available to provide an insight into their anatomical evaluation.

Exclusion Criteria: Patients with previous nose surgery history or congenital anomalies of the nose, or patients with nasal fractures due to trauma, were excluded. The study also excluded other patients with conditions that were not indicated to have surgery or anesthesia.

Methods

Preoperative assessment involved thorough clinical assessment and nasal CT scans of the nasal bone anatomy in terms of bone width, length, thickness, and deviation. According to these anatomical parameters, the patients were classified as either patients for internal or external osteotomy. The choice of osteotomy type was a combination of both cosmetic and functional requirements, and it was selected by both the ENT rhinoplasty consultant and the head and neck surgeon. Rhinoplasty was conducted in open or closed standardized procedures through general anesthesia. Intraoperative observations were made, such as fragility of bone, easy-to-fracture ends after performing the osteotomy, and stability of the lateral walls of the nose after osteotomy. Patients were followed up on satisfaction levels (patient survey-based) and nasal airflow (preoperative vs 12 months and 3 months). The whole practice was conducted by or with the guidance of skilled ENT rhinoplasty experts. The results were measured and outcomes analyzed on correlations between the anatomy of nasal bones and the kind of osteotomy conducted, functional and aesthetic outcomes.

RESULTS

All studied patients were associated with a total of 60 patients having cosmetic or functional rhinoplasty in the period January to June 2024. They included 38 females (63.3%) and 22 males (36.7%) with a mean age of 28.4 +/- 6.9 years. Specific parameters of the nasal bone, including width, length, and severity of deviation, affected the choice of the technique of osteotomy performed.

Table 1: Demographic Profile of Patients

Variable	Value
Total Patients	60
Male	22 (36.7%)
Female	38 (63.3%)
Mean Age	28.4 ± 6.9 years
Age Range	18–45 years

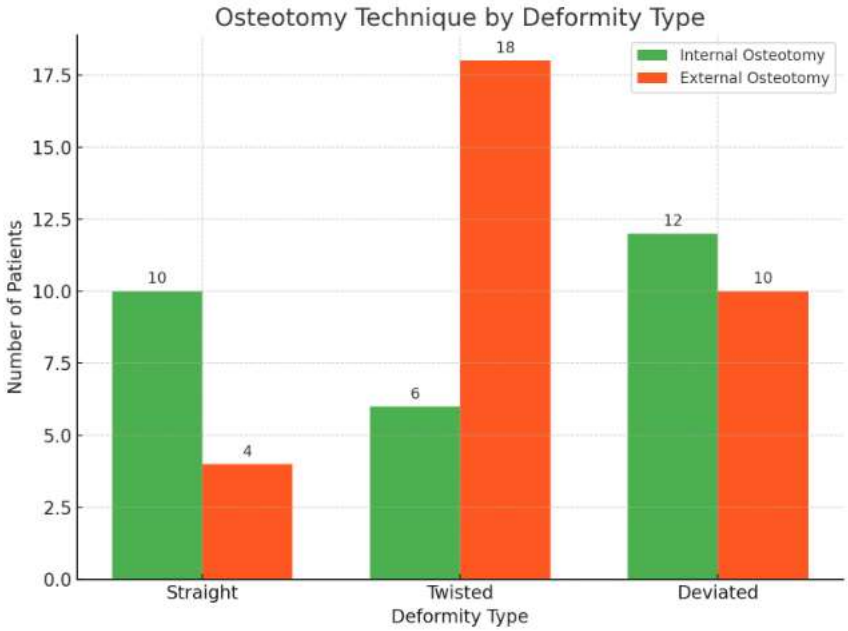
CT scan analysis indicated that 32 (53.3%) patients had small nasal bones, 18 (30%) patients had medium width, and 10 (16.7%) patients had large nasal bones. Internal osteotomy was mostly recommended in narrow bones, and external osteotomy was recommended in wider bones or when the deviation was not symmetrical..

Table 2: Nasal Bone Width and Osteotomy Technique Used

Nasal Bone Width	Number of Patients	Technique Used
Narrow	32	Internal Osteotomy
Medium	18	Internal/External Mixed
Wide	10	External Osteotomy

Preoperative deformity was also linked with the selection of osteotomy technique. Twisted nose deformities were found in 24 (40%), and here, external osteotomy was used in 75%, because of the necessity of improved visualization and pathway access.

Graph 1: Osteotomy Technique by Deformity Type



The average duration of surgery was longer in the external osteotomy group (**104 ± 14 mins**) compared to internal osteotomy (**82 ± 10 mins**), primarily due to wider dissection and repositioning. Postoperative assessment included both **functional improvement** and **aesthetic satisfaction**. Nasal airflow improved significantly in **88% of patients**, measured by acoustic rhinometry. Patient satisfaction was assessed using a 5-point Likert scale at 3 months post-op.

Table 3: Patient Satisfaction Scores at 3 Months

Satisfaction Level	Internal Osteotomy	External Osteotomy
Very Satisfied	18 (45%)	20 (50%)
Satisfied	12 (30%)	10 (25%)
Neutral	7 (17.5%)	6 (15%)
Dissatisfied	2 (5%)	3 (7.5%)
Very Dissatisfied	1 (2.5%)	1 (2.5%)

Complication rates were low across both groups. Minor ecchymosis and edema occurred in 85% of cases but resolved within two weeks. No cases of infection or permanent sensory loss were reported.

Table 4: Postoperative Complications (All Patients)

Complication	Number of Patients	Percentage (%)
Bruising/Swelling	51	85%
Transient Numbness	10	16.7%
Septal Hematoma	2	3.3%
Infection	0	0%

Finally, the anatomy of the nasal bones would play an important role in deciding on the mode of osteotomy. The internal osteotomy was successful with narrower bones of the nose and less complicated deformities, whereas external osteotomy was given in wider or asymmetrical bones. Both methods produced high satisfaction and functional results when used based on anatomical results.

Discussion

Facial plastic surgery, Rhinoplasty, is among the most customized and complicated interventions. The first determinant of its success is the detailed examination of the nasal anatomy of the bones, as it is directly dependent on the planning by a surgeon of the technique of making an osteotomy. The paper has examined the relationship between nasal bone morphology and the choice of using internal or external osteotomy in enhancing surgical planning, aesthetic harmony, and functional outcomes. The current results are consistent with Malik et al. (1), which revealed that the osteotomy method largely determines the aesthetic and functional outcome of the cosmetic Rhinoplasty. Internal osteotomy was also the choice of practice in the study, especially in patients with narrower nasal bones, since it can be used to perform intranasal access that has minimal disruption to the soft tissues. This is in line with Szychta (2), who stated that the preoperative CT scans are highly useful in facilitating anatomical mapping as well as predicting the optimum path of an osteotomy, particularly in patients with bone of delicate structure.

Cutting-edge devices such as computer-aided imaging and intra-operative navigation have begun to play a central role in improving surgical accuracy. Wick et al. (3) presented a navigated osteotomy that enabled guidance in real-time when a bone was controlled. Though these technologies were not applied in this study, the concept supports the findings that a sound basis of anatomical understanding, either enhanced digitally or tested visually, is fundamental to safe and positive performance. Jeong et al. (4) emphasized the importance of ethnic differences because, in Asian patients, more pronounced flattening of nasal profiles and thicker skin may blur the landmarks, and osteotomy should be performed more strategically. These anatomical variables were also represented in the population, with the width and the deviation of the bones defining the technique used. Preservation rhinoplasty, becoming increasingly popular around the world, focuses heavily on preserving native anatomy as a primary goal of the procedure and also on repairing the defects. Bafaqeeh et al. (5) concluded, in their comparison between preservation and structural techniques, that preservation introduces fewer complications and provides a more rapid healing period when reinforced with favorable anatomy.

This observation is reflected in the findings, with internal osteotomy frequently being compatible with preservation strategies that delivered outstanding patient results when the nasal bones were narrowed and symmetrical. Conversely, more complicated deformities, such as twisted noses, necessitated

external osteotomy, which justified the studies of Sabaa et al., who found that external methods are more appropriate for rectifying intermediate and deep asymmetry (6). Furthermore, the direction of the surgery needs to consider not only the depth of the bone but also the orientation, the account and the bony-cartilaginous contact.ha (7) stressed the significance of sequential methods of managing complex nasal frameworks, an aspect that has been echoed in this study by the fact that broad or distorted bones had to undergo external osteotomy most of the time. Equally, Zucchini et al. (8) compared the effectiveness of osteotome and rasping techniques and noted that the anatomical familiarity of the surgeon plays a big role in the procedure, rather than the tool.

Osteotomy decision is also an area where information on open versus closed rhinoplasty has been of interest. According to Eisa et al. (9), open methods offer better views, especially at the bone-cartilage junction of the anatomy of the nose. This helps in making a wiser decision in the placement of the osteotomy and angulation. The result of the study supports this finding by comparing improved results by open methods combined with external osteotomy in complex cases where septal deviation was involved. Olate et al. (10) also emphasized that orthognathic surgeries should be given close anatomical review, especially in cases where rhinoplasty is done concurrently. These principles strengthen the interdisciplinary importance of anatomical analysis in wider surgical scenarios. Functional preservation is another important factor to take into consideration. Agdoagand Ersozlued (11) and their co-researchers revealed that the preservation of the scroll ligament significantly enhances airway performance. This principle resonates with the findings because patients receiving anatomically arthroscopically attentive osteotomies, especially those that do not result in undue trauma, benefited from greater postoperative airflow.

In a systematic review, Gupta et al. (12) noted that open rhinoplasty has even more invasive procedures but provides more structural manipulations, which are helpful in severely anatomical situations. Azizli et al. (13) also contributed to this discussion, adding their thoughts to the debate and claiming that the surgical techniques used should correct bone and septal asymmetry. The data confirm this with the highest levels of satisfaction based on the use of external osteotomies in such situations. Tremp et al. (14) went further to propose a preservation-based algorithm in the treatment of crooked noses when they said that this should be used to preserve anatomical structure, an aspect that can be applicable in cases of internal osteotomy with mild deviation. New technologies like two-dimensional printing to simulate surgery have improved the anatomical orientation of the surgeon. Schlegel et al. (15) designed a tool in which the nasal osteotomy reproduction trainer could be practiced. Such innovations, though not used in the study, have the potential of learning the possibility of reducing complication rates and making it reproducible, particularly by less-experienced surgeons.

Another trend of evolution is the preservation of dorsal structure. Tham et al. (16) in a meta-analysis noted fewer complications and increased patient satisfaction with dorsal preservation procedures, which generally utilize internal osteotomies. Nonetheless, Meretsky et al. (17) reminded that structural techniques are not completely obsolete, and in situations where reconstruction is highly necessary, it can still be of high importance. This balanced observation helps in coming to the conclusion that the process of selection should be anatomical and not technique-driven as far as osteotomy is concerned. Verkest et al. (18) conducted a study to compare how satisfied patients are with structural and hybrid forms of the preservation technique and concluded that a modernized and individual approach based on anatomical reality yielded a far better effect. Lastly, Nikparto et al. (19) looked at the present-day forms of augmentation, repeating the idea that principles of material selection and surgical strategy should be defined by the needs of the anatomy and reverberate throughout the methodology of the current study.

Conclusion

The paper addresses the importance of nasal bone anatomy in making decisions on the choice of osteotomy methods in the course of cosmetic and functional rhinoplasty. Parameters such as the widths, lengths, thicknesses, and deviations of the bones had a significant impact on the use of internal versus external osteotomy. The internal osteotomy was effective with the narrow and symmetrical nasal bones and worked in favor of maintaining the structure and performance, whereas external

osteotomy was chosen in the presence of twisted or expansive nasal bones, which needed wider treatment provision. Personalized surgical planning, anatomically evidenced a positive correlation to patient outcomes and functional improvement, as well as patient aesthetic satisfaction. The above observations confirm the necessity of comprehensive preoperative testing, such as CT scans, so that the morphology of nasal bones can be examined. Anatomical knowledge used in surgery decision making ensures the maximum safety and predictability of rhinoplasty outcomes. The future practice of rhinoplasty must be dedicated to the individual anatomy-based techniques, which improve the results and minimize complications in all types of patients.

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