

# Ultrasonography for Rhinoplasty

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**Abstract:** Objective: To get the desired outcome and minimize the complications in rhinoplasty it is essential that the anatomy of the nose be precisely known and an appropriate surgical technique should be chosen for the existing problem in a given patient. Preoperative assessment in rhinoplasty is usually based on a physical examination and photographs of the patient. To date, there has been no objective diagnostic test for nose anomalies such as bulbous nasal tip.

**Methods:** In this study we measured the interdomal distance and size of the interdomal fat pad using USG in a total of 40 rhinoplasty patients. Open rhinoplasty was performed in all patients. Also, interdomal fat pad was dissected and excised in all patients. The size of the specimens was determined and their histopathological diagnoses were made. All the cases were evaluated in the 6th month after the operations. Reviewing of the literature was performed.

**Results:** Before the operation, six patients had been diagnosed as bulbous nasal tip clinically. In the patients with bulbous nose both interdomal distance and interdomal fat pad proportions were found to be larger than normal. In the cases in which tip refinement had been performed the interdomal distance was measured as zero.

**Conclusions:** Joseph in 1931 used the "profilometer"; Webster *et al.* in 1977 used the projectometer in the evaluation of the nose. The evaluation of the anatomical structure of the nose has been the topic of many anthropometric studies and advanced and highly detailed studies with 3 dimensional facial plaster models; digitizer or laser surface scanners have appeared the literature. Tasman and Helbig used the ultrasonography in the evaluation of the nasal tip area. Evaluation of the interdomal space by using USG is quite simple, cheap and easily applicable. In addition, interdomal fat pad can be visualized and an objective criterion can be obtained for bulbous nose by measuring the interdomal distance on USG. Since the excision of interdomal fat pad could only be achieved by open rhinoplasty, and that tip refinement is required in order to correct the increased interdomal distance, pre-operative interdomal USG will guide the surgeon and provide objective criteria in determination of the operative technique in bulbous nose. This is the first study to show interdomal fat pad by a diagnostic test and it can be concluded that interdomal fat pad excision is necessary for the prevention of supratip.

**Keywords:** Ultrasound, rhinoplasty, interdomal fat pad, open technique.

## INTRODUCTION

Rhinoplasty is one of the earliest and most frequently investigated and practiced operations in nose surgery. As is the case with all the surgical branches, knowing all the details of the anatomical structure in question will not only provide the desired outcome after the operation, but also reduce the complications. The most difficult field to manage in rhinoplasty is nasal tip. Although detailed anatomical studies and much technique to the nasal tip surgery have been described in the literature, few studies on the diagnosis of the nasal tip deformity have been published. The pre-operative assessment is essential for the surgical planning. This is generally based on a physical examination and patients' photographs. Although, recently, digital cameras and computer software have been widely used, there is no practical objective diagnostic method.

At the origin of the greatest debates about rhinoplasty over the last two decades has been whether to choose the open or closed method. Although in many studies the advantages and disadvantages of both methods have been

emphasized, there is no study in the literature about the surgical method using an imaging technique. The choice of the technique is generally determined by the surgeon's educational background and his aptitude for the technique. Open rhinoplasty enables the surgeon to access to all anatomical structures more easily, specially enables him to perform maneuvers on the nasal tip easily and also provides a broader surgical exposure [1-3]. Various manipulations have to be made on the nasal tip especially when the patient has bulbous nose [4]. Lately many types of surgical methods have been described to get the desired post-operative outcome [5,6]. However, in no studies so far has an objective classification been made of the nasal tip by neither the use of a diagnostic test, nor the necessity of an intervention in the nasal tip has been described. Tasman and Helbig in 2000 first used ultrasonography (USG) to assess the nasal tip [7]. The authors measured the widths of operative nasal tip, interdomal distance and thickness of the soft tissue before and after the operations. Nevertheless, there is no information in their study about the interdomal fat pad (IFP) located in the interdomal space. IFP was first mentioned in the literature by Sun *et al.* [8] and a detailed anatomical study on rhinoplasty patients and on cadavers was performed by Copcu *et al.* [9]. The fact that this structure exists in all cases was ascertained on histopathological examinations.

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Copcu *et al.* claimed that IFP was an important anatomical structure in the interdomal distance, and that it played an important role in the supratip deformity, one of the most important and most frequent complications encountered in the post-operative period. Also, IFP was first visualized with ultrasonography by the Copcu *et al.* in 2004 [10]. According to their study, this newly defined fat pad can be assessed by ultrasonography, a safe and inexpensive technique. The surgical approach to the interdomal fat pad is solely through open rhinoplasty technique. Thus, a consideration of the interdomal fat pad and detection of its size preoperatively may play a key role in choice of technique and success of rhinoplasty [10].

In this study we aimed to evaluate the rhinoplasty patients before the operation with ultrasonography. Only by open rhinoplasty will it be possible to access IFP and excise it thereupon. Pre-operative evaluation of this structure and determination of the length of the excision and the maneuvers on the interdomal distance will require a diagnostic test. Only the results that are obtained by an objective diagnostic test will help make a firm diagnosis and choose an appropriate surgical technique. This article reviews the application of the ultrasonography to the patients who want rhinoplasty.

## MATERIALS AND METHODS

This study included 40 patients admitted to the Plastic and Reconstructive Surgery Clinic at Adnan Menderes University and wanting to undergo primary rhinoplasty. All the cases were assessed by one surgeon only and their pre-operative physical examinations were thoroughly made. Both external visual inspection of the nasal tip and palpation of the alar cartilages were performed to determine whether there was bulbous nasal tip. When both alar cartilages moved and a cavity was felt and fatty viewed tip, the patients were diagnosed as bulbous nose (Fig. 1). The pre-operative photographs of all the cases were taken. The pre-operative interdomal distances were evaluated with USG (Fig. 2). Pre-operative ultrasonography was performed in all patients. Visualization of tissues, located into interdomal space, was done. Ultrasonography of the nasal tip was performed by a 10-MHz multifrequency ultrasound transducer, with a 30-mm window and a Toshiba ultrasonograph (Toshiba Medical



**Fig. (1).** Pre-operative view of the patient.



**Fig. (2)** Application of ultrasound to the interdomal region.

Systems, Japan). A cross-section of the nasal tip structures was visualized, and the image was recorded as a JPEG file (Fig. 3). A 10-MHz transducer with the same ultrasonograph also offered adequate visualization of the nasal tip surface and alar cartilage anatomy. Ultrasound gel was used to scan the nasal tip area to prevent distortion of nasal anatomy from transducer pressure. Measurements of interdomal distance and IFP were made in each case. The cases underwent open rhinoplasty under general anesthesia. The external rhinoplasty technique was performed in all patients. Bilateral alar marginal incisions were connected by an inverted-V transcolumellar incision. The columellar skin flap was lifted off the medial crura and upward over the bony cartilaginous pyramid. The interdomal area was revealed and the IFP was easily dissected and photographed (Figs. 4 and 5). The IFP, located in the interdomal space, was excised and its pathological assessment was made with hematoxyline eosin (Fig. 6) and Sudan Black. The size of each specimen was also measured (Fig. 7). Nasal tip surgery was applied in the cases in which the pre-operative measurements made with USG showed bifidity, or in the cases in which any dimension of the tip exceeded 4 mm. Nasal tip surgery performed with interdomal suture technique as described by Gruber<sup>4</sup>. The interdomal suture is made by approximating the middle crura with a 4-0 nylon suture at a level that is approximately 3 to 4 mm posterior to the dome. The width of the dome is thus reduced. Six months after the operations, all the cases were evaluated in terms of the outcome and specially the presence of supratip deformity and the changes in the nasal tip were

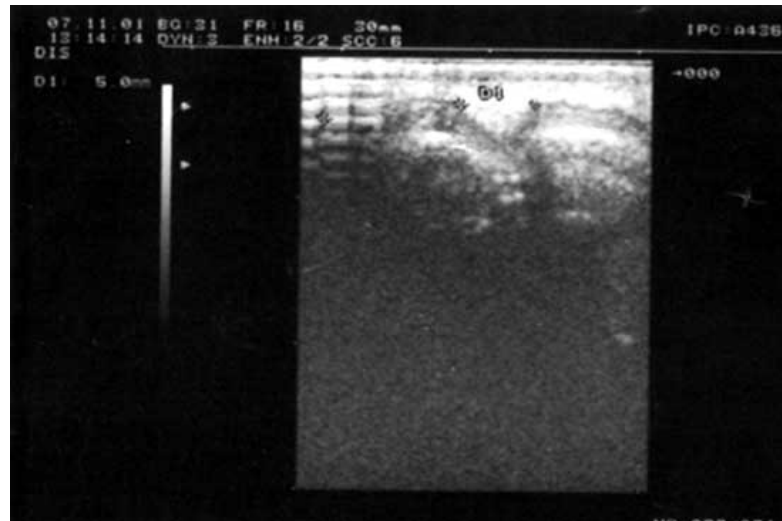


Fig. (3). Pre-operative ultrasonogram of the patient



Fig. (4). Surgical exposure of the IFP. ( anterior view)

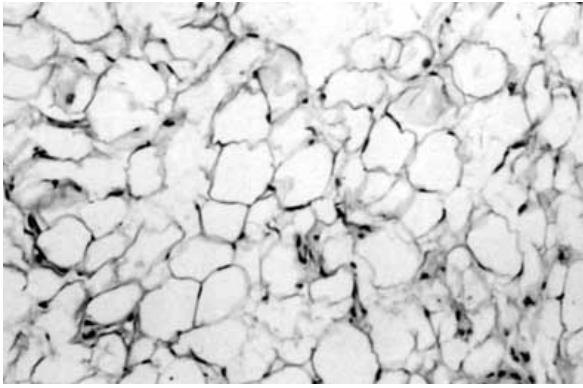


Fig. (5). Surgical exposure of the IFP. ( lateral view)

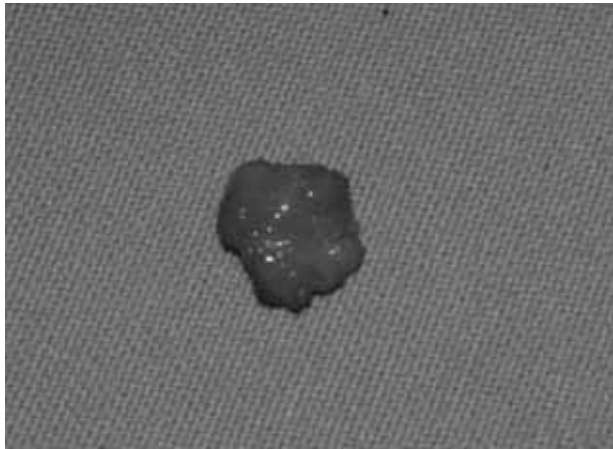
recorded. Their post-operative photos were taken. Interdomal USG was performed and the interdomal space was re-evaluated.

### RESULTS

There were 27 females and 13 males, with a mean age of 28.4 years. Before the operation, eight patients had been diagnosed as bulbous nasal tip clinically. On pre-operative USG the interdomal distance was found to be a minimum of 2.1 mm, a maximum of 5.6 mm and 3.7 mm on average. In the cases with pre-operative bifidity these values were as follows: interdomal distance was a minimum of 3.8 mm, a maximum of 5.6 mm, 4.7 mm on average. The size of IFP was a minimum of 1.2 mm X 3.2 mm; a maximum of 2.8 X 5.6 mm and 1.9 mm X 4.2 mm on average. The height of IFP could not be measured with USG. However, the sizes of the specimens excised were generally minimum 1 mm X 2 mm, maximum 3 mm X 5 mm, 2 mm X 4 mm on average and the height was 2 mm. The difference between the preoperative and postoperative values may be explained in two ways: First, during ultrasound scan the probe is pressed against the tip of the nose thereby causing fat pad to be broken up and measured at values larger than normal. Second, the excised fat pad tissue is retracted and therefore lower values are obtained. No complication occurred during the operations. IFP was excised in each case, and it was done with ease because this structure was separated from the other structures located in the interdomal distance. Excision of this structure did not cause a circulation disorder or necrosis in the nasal tip after the operations. Pathological examinations showed that all the structures excised were fat tissue composed of pure adiposites. Within the six months of the operations, USG demonstrated that the interdomal distance was zero in the cases in which approximation was performed on the nasal tip, and that none had an interdomal fat-like appearance. In the cases in which no intervention was performed on the nasal tip, the interdomal distance was measured as minimum 2.1 mm, maximum 4.1 mm and 2.9 mm on average. Only in two cases was observed a structure



**Fig. (6).** Microscopically view of the specimen ( Hematoxyline eosine stainig X 200 magnification)



**Fig. (7).** Excised IFP.

that looked like IFP in the interdomal distance, and their sizes are 1.2 mm X 2.0 mm and 1.6 mm X 2.1 mm. During the physical examination in the post-operative 6th month only one case was observed to have a supratip deformity.

## DISCUSSION

Rhinoplasty is a corner stone in the nose surgery. In other words, it is an indispensable operation. Therefore, the nose takes the lead among the most studied organs in Plastic Surgery and ENT. In fact, numerous surgical techniques have been described to correct the deformities of this organ. To maximize the aesthetic result of nasal tip surgery, the surgeon is required to have a thorough understanding of local anatomical structures [11]. The application of Outcomes Research Methodology to facial plastic surgery thus requires the availability of standardized instruments, or questionnaires, that have been pilot tested to illustrate their reliability and validity in such application [12]. It is a quantitative evaluation that will help researchers in cosmetic facial plastic surgery and better assess to those techniques, in the end lead to a satisfied patients [12].

The nasal tip surgery is an integral part of rhinoplasty. The anatomy of the nasal tip has been described in detail. Of all the most detailed studies on the subject is Letourneau

and Daniel's study in which they defined nasal SMAS [13]. These authors mention five layers of soft tissues underneath the dermis; they are:

- (1) The superficial fatty panniculus,
- (2) The fibromuscular layer proper,
- (3) The deep fatty layer,
- (4) The longitudinal fibrous sheet, and
- (5) The interdomal ligament.

The nasal SMAS is continuation of the superficial muscular aponeurotic system, which covers the entire face, interconnecting the facial musculature, the galeal frontalis layer, and the platysma [14]. The domal junction is the transition from middle to lateral crura and is the critical landmark in the refined tip. In a study by Daniel, the surface markings of the tip defining points were found to superpose consistently on the domal junction line. The axis of the domal junction is about 45 degrees from the midline, with the intersecting angle of the two sides being 90 degrees [15]. Sheen defined four landmarks on the nasal tip:

- 1) The point of tip differentiation (supratip breakpoint),
- 2) The right dome,
- 3) The left dome, and
- 4) The columella-lobular breakpoint [16].

The intercrural distance interconnected the two domes, whereas the two breakpoints were interconnected by the nasal midline. Two important angles were added: the angle of divergence, which referred to the separation between the two middle crura, and the angle of rotation, which was essentially the columella-lobular angle. The medial and middle crura were also tightly bound together by transverse fibrous connective tissue. The most anterior thickening was termed the interdomal ligament [14]. Dermocartilaginous ligament (also called the "ligamentous attachment") was first reported by Pitanguy in 1965 and extensive review was published 30 years later [17]. During an open rhinoplasty, this ligament is the only element visible to the naked eye between the skin and the cartilaginous framework and is situated along the midline. It originates in the fascia of the upper third of the nose, and extends down to the domal segment of the middle crus, merging into the subseptum [12].

While there are a number of detailed studies about interdomal ligaments [12,14], there are only two studies in the literature on IFP, which is located in the interdomal distance. Sun *et al.* are the first investigators to define IFP in the literature [8]. Copcu *et al.*, on the other hand, examined the structure histopathologically in detail on the cadavers and the rhinoplasty patients and they emphasized the fact that IFP exists in everyone in different proportions and the idea that it is of larger sizes in the cases with bulbous nose [9]. Copcu *et al.* pointed out that IFP located between the anterior surfaces of the medial crura in all patients and cadavers. The IFP starts at the antero-superior surfaces of the alar cartilages and ends in the supratip region. Patients with bulbous noses and/or with divergent intermediate crura of the alar cartilage had larger fat pads [9]. Evaluations

concerning anatomical structures in the nose have been more understandable with open rhinoplasty [1-3]. However, the pre-operative evaluation of the nose is based on the outer appearance of the nose and the surgeon's clinical experience. In fact, as Tasman and Helbig emphasized in the section of historical development in their study, Joseph in 1931 used the "profilometer"; Webster *et al.* in 1977 used the projectometer in the evaluation of the nose [7]. The evaluation of the anatomical structure of the nose has been the topic of many anthropometric studies and advanced and highly detailed studies with 3 dimensional facial plaster models; digitizer or laser surface scanners have appeared in the literature [18,19]. Yet, it seems impossible for such practices to be used routinely for reasons that they are difficult to apply and costly. Although the physical examination is simple and free, it is only based on subjective judgments. Nasal tip projection described as the paramount of the plastic surgery in the study of the Peck *et al.* and discussing of their article by Rohrich [20]. They agreed that, evaluating of the nasal tip might be done with visual inspection, and sophisticated tests were not necessary. The ultrasonographic evaluation of the nasal tip, in contrast, is quite cheap and easy, requires no great technical expertise and can be done in a short while. An analysis of alar cartilage anatomy by computed tomography or magnetic resonance imaging may be suggested to be done but has not been reported. Ultrasonography allows rapid documentation and analysis of facial surface cross sections if it is used in a non-contact mode.

Ultrasonography can also be used for different aims in facial region. For example sonographic fracture diagnosis of the midface was reported to be successful in several midfacial regions including orbit, zygomatic arc and nasal bone [21-23]. Freidrich concluded that ultrasound is an effective tool in emergency medicine in many specialties. It is safe without radiation exposure, inexpensive, non-invasive, portable, readily available and fast, but has to be performed by experienced investigators [21].

One of the most important reasons for nasal ultrasonography is evaluation of fetal nasal bones in different anomalies. Rembouskos *et al.* used the three-dimensional (3D) ultrasound in the examination of the fetal nasal bone at 11-14 weeks of gestation and they concluded In a 3D volume the extent to which the nasal bone can be demonstrated to be present in a given reconstructed section is entirely dependent on obtaining a good initial 2D view [24]. Fong *et al.* was used ultrasound in facial region for detection of fetal structures in early pregnancy [25]. According to their study Ultrasonography (USG) is performed during early pregnancy for dating, determination of the number of fetuses, assessment of early complications, and increasingly for evaluation of the fetus, including measurement of the thickness of the nuchal translucency (NT). The anatomic survey can be performed with a standardized protocol by using transabdominal USG and, when necessary, transvaginal USG. A thorough knowledge of the USG features of normal fetal development is necessary to avoid potential diagnostic pitfalls.

Although ultrasound is widely used in facial region in obstetric discipline, there is no more report in Plastic Surgery and ENT era.

Tasman and Helbig stated that pre-operative interdomal distance correlated with pre-operative nasal tip width; however, there was no correlation between nasal tip soft-tissue thickness and either preoperative tip width or preoperative interdomal distance [7].

In this study we did not measure the thickness of skin. However, Sun *et al.* in their study evaluated IFP by the thickness of skin and subjectively concluded that the thicker the skin was, the more the IFP formed. This is the first study to provide information about the size of the IFP. We found that the interdomal distance was 4.8 mm on average in the cases with pre-operative bulbous nose and we realized that this value was significantly higher than the average values. There are not any objective criteria defined for bulbous nose in the literature. Actually, it was only through clinical palpation that the definition was given. The classification of the nasal tip thus can be made easily with USG. It is of great importance for this classification to be made objectively in terms of nasal tip surgery because a number of definitions about nasal tip projections have been made. Constantian, pointed out that the wide, amorphous tip is the product not only of the soft tissue thickness, but also of the character, width, substance, volume, and configuration of the alar cartilages [26]. A refinement on the nasal tip may be planned for the cases with interdomal distance being higher than 4 mm. The most significant step in this study is the display of the existence of IFP by USG. This structure is important in that it is a determinant of interdomal distance. The removal of the IFP above the average must be part of the operation. In the studies carried out by Sun *et al.* and Copcu *et al.* it was shown that the excision of this structure caused no complication. We think that the excision of this structure will be as important in obtaining the desired outcome in nasal tip and especially in interdomal distance as in the prevention of the supratip, which is one of the most common complications in rhinoplasty.

The most detailed study about the etiology of supratip was done by Guyuron and it was stated that the main tissue in the specimens taken from supratip deformities was in the nature of fibroadipose [27]. Guyuron stated that scar tissue is not always the cause of a supratip deformity. In fact, the incidences of supratip deformity are caused by over resection or underresection of the supratip area. The fact that steroids are used in the treatment of supratip has been reported in the literature [28-30]. That steroids cause atrophy in fat tissue is quite an old piece of information [31]. We claim that the steroids applied on the developing supratip deformity cause atrophy in the fat tissue in this region (most probably in IFP). However, detection and excision of this structure pre-operatively will not only prevent supratip deformity but also enable us to avoid complications, such as major atrophy, like blindness [32], or local atrophy, which are encountered while treating the existing supratip by applying triamcinolone.

## CONCLUSIONS

Evaluation of the interdomal space with USG is quite simple, cheap and easily applicable. The measurement of interdomal distance and dimensions of IFP will help the surgeon to evaluate the condition objectively, determine the surgical method and be able to avoid supratip deformity, a frequently encountered problem in nose surgery.

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