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FACIAL PLASTICS: FUNCTIONAL RHINOPLASTY (TD WANG AND CZ JOHNSON, SECTION EDITORS)

The Ageing Nose: Challenges and Solutions

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Abstract

Purpose of Review Rhinoplasty has traditionally been considered an elective procedure for younger patients. However, increasingly older patients are undergoing nasal surgery for both functional and aesthetic indications. We provide an overview of the common problems with rhinoplasty in the elderly and the surgical techniques that can be reliably utilised to address them to produce predictable and longstanding results.

Recent Findings Outcomes from studies of older rhinoplasty patients emphasise the need for a tailored approach that preserves natural structures. However, if reinforced structural support is required, especially in functional cases, grafting techniques such as septal extension grafts, spreader grafts and alar strut grafts are required. Furthermore, special consideration must be made for the nasal skin in older patients, and utilisation of dorsal onlay grafts is often necessary.

Summary Surgery for the ageing nose is a complex challenge for the rhinoplasty surgeon. Preoperative assessment is critical and must include detailed facial analysis that considers the amplification of facial asymmetry due to the ageing process and an appreciation that expectations in this population may differ from younger patients. A comprehensive understanding of the age-related anatomical changes in the nasal structure and the wide repertoire of operative techniques are required to restore form and function.

Keywords Rhinoplasty · Ageing patient · Tip ptosis · Nasal valve collapse

Introduction

The ageing process impacts the appearance and function of the nose over time. Traditionally, rhinoplasty has been thought of as an elective procedure for younger patients. However, this operation is increasingly being performed in older patients for both functional and aesthetic indications. In 2020, rhinoplasty was the most common cosmetic surgery procedure performed in the United States of America (USA), followed by blepharoplasty and rhytidectomy. Approximately 10% of rhinoplasties performed were in patients aged 55 and above [1]. Furthermore, there has been a rising trend in the number of functional rhinoplasties being performed year on year in the USA in the over 65-year population [2].

In the older population, rhinoplasty poses a challenge to the facial plastic surgeon due to the differences in nasal anatomy and the numerous co-morbidities this patient cohort commonly have. The influence of external factors over time, such as trauma, sun exposure, the effects of gravity as well as changes in tissue structure such as bone resorption, tissue elasticity and regenerative capability makes surgery in the ageing nose more technically challenging. Appreciation of age-related changes of nasofacial proportions that can exaggerate facial asymmetry, patient psychology, nasal contours, skin pathology and overall cosmetic appearance, as well as nasal obstructive symptoms, is necessary in the preoperative assessment of patients. A comprehensive understanding of the age-related anatomical changes in the nasal structure and a wide repertoire of operative techniques are required to restore form and function in this distinct patient group.

Topical collection on *FACIAL PLASTICS: Functional Rhinoplasty*

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In this article, we provide an overview of the common problems with rhinoplasty in older patients and the surgical techniques that can be reliably utilised to address them to produce predictable and longstanding results.

Anatomy

The conventional facial analysis divides the face into equal horizontal thirds and vertical fifths in order to identify asymmetry on frontal and lateral views. The vertical landmarks include the outer edge of the pinna, the lateral and medial canthus of the eyes; horizontal landmarks include the trichion, subnasale and mentum. However, in the ageing face there is a distortion of these proportions with an overall lengthening of the upper and middle two-thirds, leading to an apparent shortening of the lower third [3–5]. Furthermore, age-related changes due to the bone resorption that occurs at differing rates in the facial skeleton can accentuate facial asymmetry [6, 7•] (Figs. 1 and 2).

In the ageing nose, the typical changes are characterised by tip ptosis and a dorsal hump, or pseudohump. Alterations in the skin, soft tissue, cartilage and bone of the nose lead to these characteristic appearances. This gives potential for several approaches to surgical intervention to improve nasal structure and form.

i) Nasal Skin

With age, the skin loses elasticity, pliability, hydration and thickness, with underlying fat loss and soft tissue atrophy [8, 9]. Decreased pliability can lead to less and slower 'shrink wrapping' of the skin with higher incidence of an initial false appearance of residual hump or occurrence of a pollybeak.

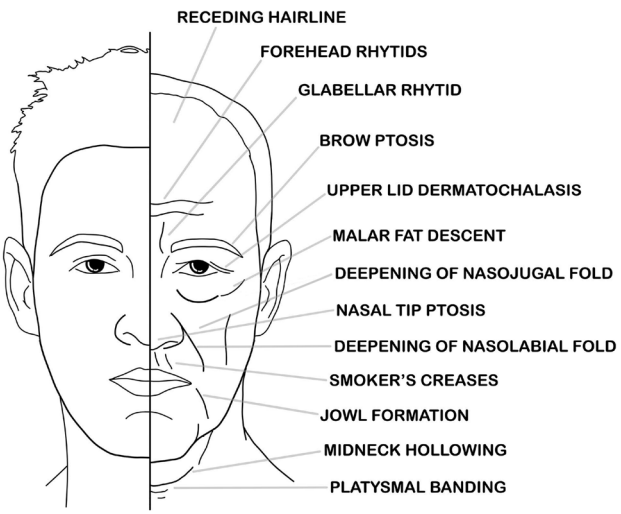

Fig. 1 Characteristics of the ageing face

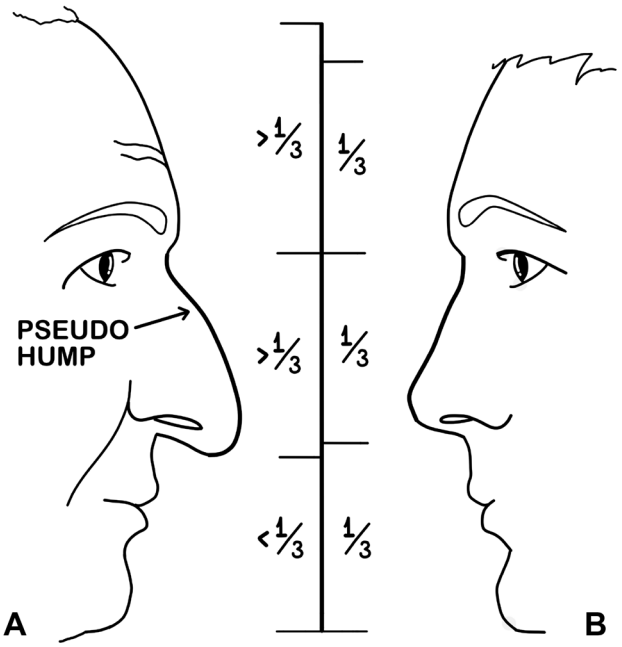

Fig. 2 Change in facial proportions with age, demonstrating development of tip ptosis and a dorsal pseudohump. **A**) 70-year-old patient. **B**) 30-year-old patient

The skin over the dorsum is thin and lacks subcutaneous tissue; this makes bony irregularities more obvious in this region. The subcutaneous tissue of the lateral nasal sidewalls becomes thicker laterally. The skin of the nasal tip and alar regions are significantly thicker, with an increased concentration of sebaceous glands. This can have the effect of derotating the nasal tip, contributing to tip ptosis.

ii) Cartilaginous Framework

The weakening of nasal cartilage with time contributes to both the reduction in tip support and consequent narrowing of the nasal valve. The degradation of the lateral fibrous attachments of the upper lateral cartilages to the frontal process of the maxilla and pyriform aperture reduces the strength of the superior aspect of the nasal tip tripod [10]. The loss of support from the pyriform ligament in this region, in combination with pyriform aperture recession, accentuates the apparent dorsal hump but, importantly, can also potentially contribute to internal nasal valve collapse. Suspensory ligaments deteriorate, leading to separation of the of the upper lateral cartilages and lower lateral cartilages and flattening and disarticulation of the scroll [11] (Fig. 3). This results in tip ptosis, increased nasal length and a more acute nasolabial angle. This is further accentuated by the weakening medial crura support, shortening of the columella and widening of the nasal tip [12] (Fig. 4).

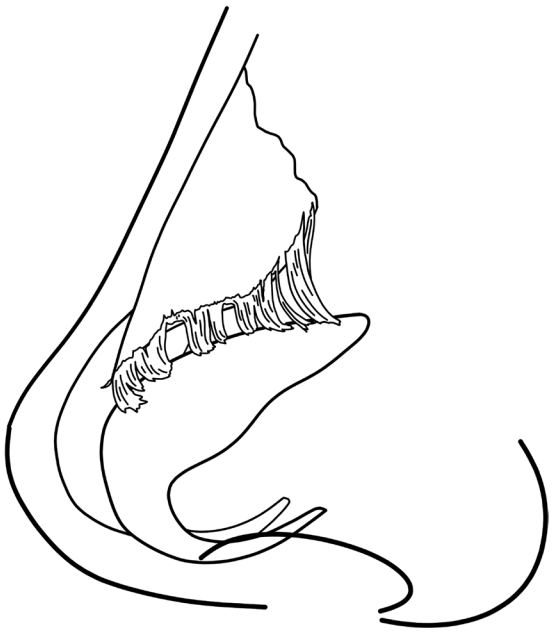

Fig. 3 Weakening of the ligaments in the scroll region with ageing leading to migration/separation of the lower lateral cartilage from the upper lateral cartilage

iii) Bony Structure

As described earlier, there is a lengthening of the upper 1/3 of face. This is commonly attributed to receding hairline, but expansion of the frontal bone can also occur, especially in men [5]. There is also bony resorption in the maxillary region; this manifests itself through widening of the orbital aperture at the superomedial and inferolateral aspects leading to a more acute brow-tip aesthetic line. Resorption of bone in the mandibular region shortens the lower third of the face, amplifying any increased nasal length. This is even more marked in edentulous patients [13].

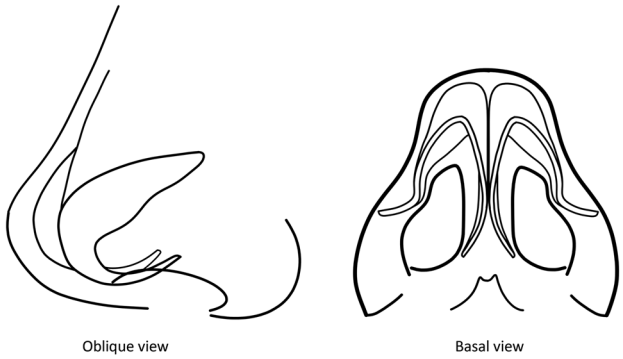

Fig. 4 Ageing nasal tip demonstrating external valve collapse secondary to buckled lateral crura and weaking of the medial crura support leading to a shortened columella and wider nasal tip

Challenges and Solutions in Rhinoplasty for the Ageing Nose

Psychology

Elderly patients may have different goals when seeking rhinoplasty compared to younger patients. Their motivation for surgery may stem from long held desires which they have decided to act upon later in life when the opportunity presented itself [14]. This can affect the patient's perception of any outcome of surgery, as they may also have feelings of guilt regarding changing their appearance later in life [15, 16]. It must be recognised that patients in this age group typically have a well-established self-identity and may not be prepared for a dramatic change in nasal and facial appearance. Furthermore, for patients with facial features that are family traits (e.g. dorsal hump), significant changes in appearance may affect personal relationships with relatives [17].

Although the majority of patients will request surgery for positive reasons, there will be a cohort of patients that pursue rhinoplasty after significant life events such as a bereavement or divorce from a partner [18]. The potential for dissatisfaction with the outcome in these patients is high, and therefore it is essential that this information is obtained from the history and approaches to counselling and patient selection are modified accordingly.

The psychological impact that rhinoplasty can have in older patients needs to be considered in the preoperative assessment and surgical planning. Careful evaluation of the patient's emotional reserve and motivations for surgery will enable a surgeon to select the correct management (including avoidance of surgery) and manage patient expectations. Ensuring patients understand what can be achieved with the limitations of ageing tissue and aesthetic balance with the whole face is crucial [3]. It is often better to choose more subtle refinements than drastic changes for older rhinoplasty patients. Furthermore, because of the nose's profound significance in a patient's psychology, a good physical outcome may not always lead to a good emotional response initially due to the changes in long held appearances. Therefore, a longer period of adjustment with support from clinicians, and in some cases psychologists, post operatively, is often required for patient satisfaction [19].

Approach Considerations

As with rhinoplasty surgery in general, the overall approach in nasal surgery in older ages groups should be dictated by the necessary modifications required with both endonasal and open techniques being potentially appropriate. Due to the reduced resilience of the soft tissue, brittle nature of the bone and delayed wound healing in elderly patients,

surgical approaches should be conservative, with the aim to preserve natural structures and attachments where possible. However, if reinforced structural support is required, especially in functional cases, suturing and scoring techniques will often not suffice, and therefore grafting techniques such as septal extension grafts, spreader grafts, alar strut grafts and cap grafts are required (Fig. 5). These cartilage grafting techniques are often more easily employed through an open approach.

Furthermore, in trauma and revision cases, there may be insufficient septal cartilage to use for grafting techniques. In elderly patients, there are limited sources of autologous cartilage graft material especially when robust grafts such as septal extension grafts are needed. The 6th,7th and 8th ribs are often ossified in older patients, especially in females [20], and therefore cannot be reliably utilised for these patients. Conchal cartilage is a useful graft material both for smaller grafts and when diced for aesthetic augmentation purposes. However, it often does not have sufficient strength or the correct shape to be used as a septal extension graft. The authors prefer to use homologous irradiated cadaveric rib cartilage for reconstructive purposes as it provides reliable and reproducible results [21].

Ptotic Tip

The characteristic feature of an ageing nose is tip ptosis. To address an underrotated nasal tip, a graded approach can be employed that is tailored to the severity of ptosis. Correcting the ptotic tip not only refines the cosmesis of the nose, but it also has a dramatic effect on improving nasal obstruction by addressing the external nasal valve.

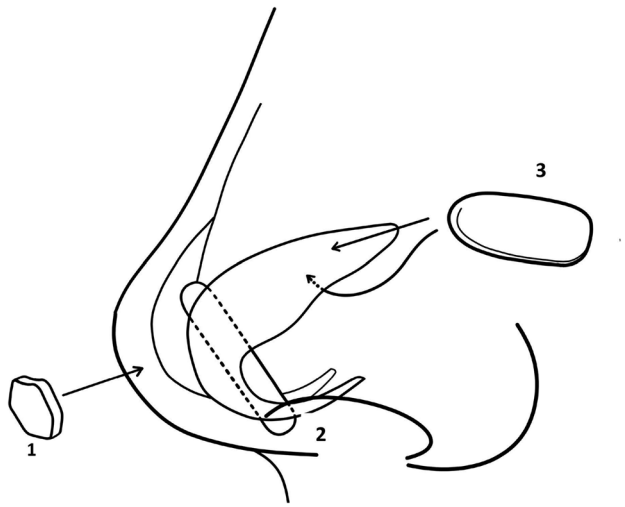

Fig. 5 Grafts to manage tip ptosis. Cap graft (1), floating columella strut (2), alar strut (3) (can be placed as an onlay or underlay graft), septal extension graft (not drawn)

i) Endonasal Technique

In mild cases of tip ptosis, an endonasal approach can be utilised to rotate the nasal tip although this can be technically challenging. This technique enables faster post operative healing which is desirable in older patients. Delivery of the lower lateral cartilages through marginal, intercartilaginous incisions and full transfixion incisions can be undertaken. Transdomal and interdomal sutures can be used to define the nasal tip. With the lower lateral cartilages replaced under the skin, the medial crura are repositioned cephaloposteriorly and can be attached to the caudal edge of the nasal septum in a tongue in groove technique, with or without a septal extension graft, therefore rotating the nasal tip. Initially, the medial crura can be positioned with 2 fine bore needles through the skin, medial crura and caudal nasal septum. Once the desired position is achieved, the medial crura is sutured to the nasal septum with a combination of 4.0 vicryl and 5.0 polydioxanone (PDS) sutures.

ii) Columellar Strut

In cases of mild tip ptosis, a floating columella strut graft can be utilised to stabilise the nasal tip in combination with interdomal sutures. The structural integrity of the tripod segment formed by the conjoined medial crura is often weak in elderly patients due to resorption of the fat pad below the medial crura especially in edentulous patient. The columellar strut can improve the integrity of the inferior limb of this tripod.

As this is a thin small graft, only a minimal amount of septal cartilage is required to be harvested (usually 20 mm in length by 5 mm in width) which can often be taken from the inferior cartilaginous septum. Additionally, the dissection between the medial crura can be limited to simply creating a pocket between the medial crura limbs and therefore preserving most of the medial crural ligaments. The strut can be held in place initially with a fine bore needle and sutured with 4.0 vicryl or 5.0 PDS in a horizontal mattress fashion.

Cochran et al. used this technique in a series of 51 patients over the age of 65 and modified the columellar strut placement with a medial crura-septal suture to enable better control of tip projection and rotation [22].

iii) Septal Extension Graft

Septal extension grafts provide direct control of the nasal tip and can be used to address moderate to severe tip ptosis in the ageing nose. This is a powerful graft which can be employed in patients with weak middle and medial crura and an under projected tip. Sawh-Martinez et al. found that septal extension grafts provided better

Fig. 6 Cap graft to nasal tip

preservation of nasal tip rotation over columellar strut grafts [23••], and Khetpal et al. found that septal extension grafts performed reliably in rhinoplasty in older patients [24••]. Septal extension grafts may confer better lifetime results in the context of anticipated changes with age and in our institution; it is the preferred technique for patients with severe ptosis.

This graft can be either placed end to end with the caudal edge of the nasal septum and can be held in place with extended spreader grafts or placed side to side with the nasal septum. This is a larger and more robust graft and therefore will need to be sourced from septal cartilage, rib cartilage (unlikely in elderly patients) or irradiated homologous cadaveric cartilage. The extension graft can be placed several millimetres above the anterior septal angle in order to rotate the nasal tip, and the lower lateral cartilage medial crura are attached to the graft in a tongue in groove fashion to enable tip rotation and precise projection.

iv) Tongue in Groove

This is another effective method of increasing tip rotation and controlling tip projection. The final tip position is more predictable than in other cartilage-modifying techniques which may be subject to changes with contracture during the healing process. However, the integrity of the caudal septum itself may be limited due to the age-related changes, and there may not be a good base on which to build the inferior limb of the nasal tip tripod. If this technique is utilised in older patients, doubling of the caudal cartilage with a second piece of cartilage will increase the strength of the reconstruction.

This procedure consists of advancing the medial crura cephaloposteriorly onto the caudal septum into a surgically created space (pocket or detachment) between the medial crura [25]. The amount of tip rotation may be adjusted based on the degree of superior advancement of the medial crura onto the septum. Similarly, the projection may be decreased by positioning the medial crura posteriorly onto the septum. The medial crura are then attached to the caudal septum using a combination of 4.0 vicryl and 5.0 PDS.

v) Lower Lateral Cartilage Augmentation

In the ptotic ageing nose, the aforementioned reconstructions of the nasal tip may need to be undertaken in combination with lower lateral cartilage augmentation techniques to increase projection (lateral crural steal) or deproject the nose (lateral crura overlay). Both these techniques also rotate the nose and therefore are of value in managing age-related nasal ptosis.

Fig. 7 Spreader grafts. Grafts use to maintain the internal nasal valve

The lateral crural steal technique involves placing an interdomal mattress suture (5.0 PDS) in such a way as to advance the lateral crura onto the medial crura [26].

Lateral crural overlay techniques to deproject the tip involve dividing the lateral crura at its midsection and overlapping the proximal ends over the distal ends. Once the desired position is achieved, the overlapped ends are sutured together using horizontal mattress sutures (5.0PDS). The degree of overlap is modified to impart the intended amount of tip deprojection. Lateral crural overlay effectively shortens the upper tripod limbs, resulting in decreasing projection along with increasing rotation [27].

Aesthetic Tip Defining Modifications

Often techniques to rotate and create adequate projection of the nasal tip should suffice in improving the nasal airway and creating an aesthetically acceptable outcome. Further refinement can be undertaken with transdomal and interdomal sutures. However, if further projection and refinement of the nasal tip are required, tip grafts (shield or cap grafts) can be placed. However, they must be used with caution as there can be increased visibility of the graft in patients with thinned soft tissue and skin [28]. With correct modifications and careful patient selection, it is a useful technique to refine the nasal tip in older patients [24••].

The shape of the cap graft is approximately hexagonal. It is carved intentionally slightly larger than required and fixated to the lower lateral cartilage domes using 5.0 PDS sutures or tissue glue. Once in place, its shape and size are refined using a 15 blade, and circumferential bevelling should be performed to minimise visible edges of the graft (Fig. 6).

Nasal Valve Collapse

Nasal obstruction is not always successfully managed by septoplasty alone in the elderly [29] due to the impact of nasal valve compromise [30]. This is as a consequence of the separation and down migration of the upper and lower lateral cartilages. In functional septorhinoplasty cases for older patients, once tip ptosis and nasal septal deviation have been addressed, attention must then be paid to the internal nasal valve and to any remaining external nasal valve compromise left after improving tip rotation. Again, there are a variety of

Fig. 8 Preoperative photographs in a 53-year-old patient. **a**) Anterior, **b**) superior (bird's eye view), **c**) inferior (worm's eye view), **d**) left oblique, **e**) right oblique, **f**) left lateral, **g**) right lateral

techniques that can be employed; we will now describe those that perform most reliably in the older patients.

i) Spreader Grafts

Spreader grafts provide the benefit of stabilising the middle 1/3 of the nose and opening the internal nasal valve. The graft does this by moving the upper lateral cartilage away from the septum and therefore decreases the resistance to nasal breathing. Multiple case series studies of older patients demonstrate the efficacy of this technique [22, 24••]. Patients should be warned that this may widen the middle 1/3 of the nose, and elderly patients with thin skin may notice any irregularities created by the spreader grafts.

This is a thin rectangular cartilage graft which is placed between the nasal septum and upper lateral cartilage; it can be unilateral or bilateral depending on the patient's symptoms and appearance. The upper lateral cartilage is detached from the septum prior to placement of the graft. The graft is initially placed and held in place with a narrow bore needle before being sutured with 5.0 PDS to both the nasal septum and upper lateral cartilage. Typically, these grafts extend from the rhinion to the caudal end of the upper lateral cartilage (Fig. 7).

ii) Alar Strut Grafts

When there is evidence of dynamic collapse of the nasal valve, which can be a consequence of age-related weakness of the scroll region, alar strut grafts can be utilised to prevent nasal obstruction.

Alar strut grafts should be fashioned to less than 1.5 mm thick and placed at or close to the pyriform aperture extending obliquely towards the nasal tip to resist internal valve collapse. It is the authors' preference to place these grafts into a pocket created between the lateral crus and the vestibular skin (underlay), therefore maintaining the integrity of the internal nasal valve and reducing the risk of an unfavourable cosmetic appearance of the alar subunits.

Fig. 9 Six months post operative photographs. Rhinoplasty views: **a**) anterior, **b**) superior (bird's eye view), **c**) inferior (worm's eye view), **d**) left oblique, **e**) right oblique, **f**) left lateral, **g**) right lateral. Patient had open approach septorhinoplasty with split hump removal technique (rasping to nasal bones), lateral percutaneous osteotomies, septoplasty, spreader grafts (left wider than right), septal extension graft and transdomal and interdomal tip sutures

Manipulation of the Nasal Bones

In this patient group, the nasal bones are typically brittle and may result in comminution if excessive manipulation is undertaken leading to unpredictable results. The typical indications for osteotomies of the nasal bones are after a dehump or distortion of the nasal bones after trauma. Often a dehump is not required in patients in this age group as the 'pseudohump' is often corrected with technique to rotate and project the nasal tip.

Therefore, if contouring of the nasal bones is required, rasping should be utilised to achieve the desired effect. If osteotomies are a necessity for the procedure, they should be undertaken in a conservative manner. 'Postage stamp' lateral osteotomies which enable greenstick fracturing of nasal bones should be able to create the intended outcome in the majority of cases without causing comminution.

Managing the Skin

The skin of the dorsum in elderly patients can be very thin, and therefore any irregularities of the nasal bones after osteotomies, or the middle third after reconstruction, may be prominent and aesthetically unacceptable. Owing to delayed wound healing and reduced elasticity, skin in the older patient may not contract consistently leading to unpredictable outcomes.

To augment the nasal dorsum in these cases, a variety of soft tissue materials can be used as a dorsal onlay graft that is placed under the skin envelope to create a smooth contour for the nasal dorsum. Temporalis fascia is an autogenous option that reduces any risk of reaction and has the benefits of being the patient's own tissue [31]. However, it needs to be harvested from a separate donor site, and although the incision is often covered with hair, a scar in this region may not be acceptable to all patients, especially if there is temporary hair loss at the incision site. Furthermore, there are potential donor site complications such as haematoma, numbness and pain. Other suitable grafts include allografts such as Alloderm [32] and xenografts such as Permacol [33]. These grafts have the benefit of no additional incisions beyond the nose but pose the risk of adverse reactions. Furthermore, due to the porcine source of Permacol, patients much be consented for its application in case their personal or religious beliefs preclude its use.

Conclusions

The rhinoplasty surgeon must consider several psychological, anatomical and operative factors when treating older patients. Many patients complain of both aesthetic and functional deficits related to the nasal airway. Surgical techniques are more challenging as tissues are more delicate, potential donor sites are fewer and the healing process post operatively is more unpredictable.

We advocate a conservative approach to changes in cosmetic appearance and a graduated approach to management of functional deficits. Addressing nasal tip ptosis is a cornerstone of management in the majority of cases of rhinoplasty in the ageing nose, and further interventions should be tailored in a patient-specific manner once improvement in tip rotation has been achieved (Figs. 8 and 9).

Declarations

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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