Case Report

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Restoration of Missing Total, or Part of the Nose Using Various Retention Techniques. A Clinical Analysis and Treatment of Three Cases

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ABSTRACT

Three cases of recovering a partially or completely missing nose were shown. The various technical retention strategies were described and evaluated. In the last two cases, a medical-grade silicone supported by an acrylic resin framework or infrastructure was used to build up the nose, while in the first case, only a section of it was replaced with medical-grade silicone. The last example used a bar implant for retention, but the second used multiple techniques, including an eyeglass frame and an undercut of the problematic area. The simplest case included restoring the nose's missing ala and repairing it with only silicone material and retaining it with a simple undercut engagement. This study demonstrates a variety of efficient strategies for restoring the complete nose or a portion of it, especially when there is favourable residual tissue topography. Such a structure provides a stable foundation for mechanical retention techniques, such as undercuts or sufficient bone density for implant fixation. Furthermore, various unique improvements to increase the quality and safety of the prosthesis were stated, and the discipline is open for experienced, dedicated practitioners to carry out new ideas. The outcome was pleasing to both the patient and the maxillofacial prosthodontist.

Keywords: Partial Nose Replacement; Modification to Artificial Nose; Nose Replacement; Nose Defect

Introduction

The nose is a structure that sticks out from the middle of the human face and is the entrance to the respiratory system [1]. It warms, conditions, and filters the air you breathe. It also houses your olfactory organs, which give you your sense of smell. The nose is located on the anterior (front) aspect of the head, positioned superior to the mouth and medial to the eyes. It is a centrally located, pyramid-shaped structure with its root at the top (between the eyebrows) and apex (tip) at the bottom, pointing toward the upper lip (Figure 1). The main involved part of the maxillofacial region that needs prosthetic replacement is the maxillary bone, with variable extent from simple internal defect to more extensive loss that involves more structures, including the nose, the orbits, and the zygomatic bone. Therefore, the topographic and sectional anatomy are important to study and assign the different anatomical areas perfectly for successful prosthetic replacement alone or combined with corrective surgery. A major contributor to the failure of maxillofacial restoration of missing structures is the lack of well-defined selection criteria for students wishing to enroll in this program, combined with the undervalued teaching programs of this skill to postgraduate students at many dental institutions due to a shortage of specialized instructors in these fields. This article provides a full grasp of nasal surface anatomy, which is critical for prosthodontists interested in maxillofacial prosthetics. It underlines the value of extensive expertise in this sector. Furthermore, despite the improvement of 3D scanners and printers, establishing a good carving ability is essential for entry, degree completion, and regular professional practice in this field. In addition, specific prosthesis development recommendations were made and applied to improve the safety of the silicone nose.

Topographic Anatomy of the Nose

The nose is a complex organ serving respiratory, sensory (smell), and protective functions. Its anatomy is divided into the external nose (visible part) and the internal nasal cavity [2]. To describe the nose anatomy in a comprehensive way for the dentists who practice prosthetic replacement, the nose structures are divided into.

The External Surface and Structures of the Nose

The external nose is a pyramid-shaped structure, made of bone above and cartilage below, and covered in skin. Figure 1 shows the topographical components of the nose. The root (radix) is the area between the brows that connects to the forehead. The bridge (dorsum nasi) is the bony upper portion. The apex (tip) is the lowest and most projecting part. Ala nasi (wings) are the lateral cartilaginous "wings" that create the outside edge of the nostrils. Nares (nostrils) are the two apertures. The columella is the tissue that separates the nostrils at the base.

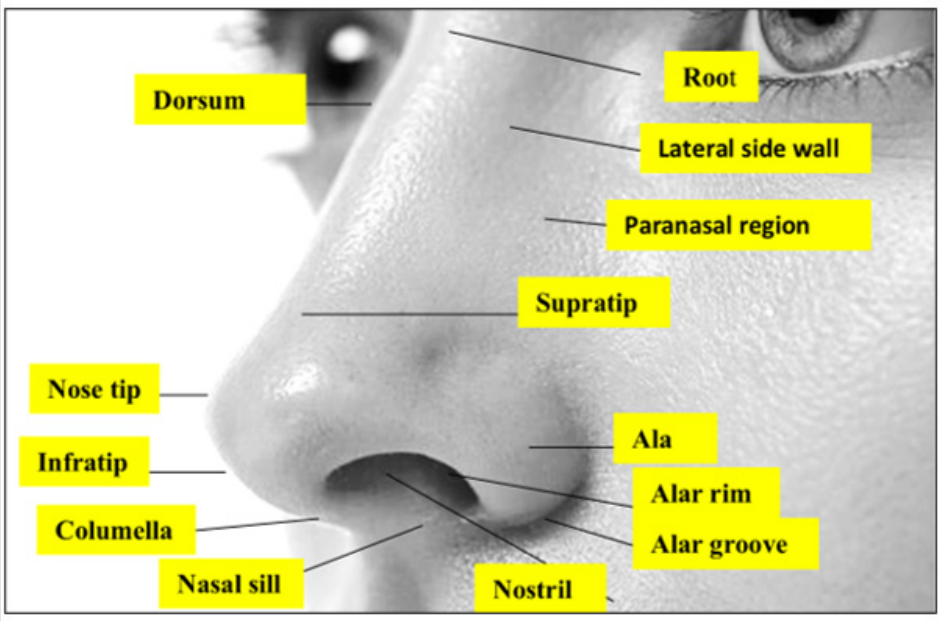

Figure 1: The most important topographic landmarks of the nose to be duplicated on the silicone nose.

Internal Nose (Nasal Cavity)

The internal cavity extends from the nostrils to the pharynx. The nasal septum divides the cavity into right and left halves (made of bone and cartilage). The nasal vestibule is the entrance just inside the nares, containing hair (vibrissae). The turbinates (conchae) are three bony shelves (superior, middle, and inferior) on the side walls that increase surface area. The meatuses are passages beneath each turbinate for drainage. The olfactory region is the roof of the cavity containing smell receptors. Maxillofacial prosthodontists primarily rely on the external topographic anatomy of the nose and its surrounding areas to perfectly match the replaced nose.

Causes of Partial or Total Nose Defects

A missing nose can be caused by a variety of factors, including congenital abnormalities, acquired issues such as trauma, severe infections, drug usage, surgical operations to remove cancer, and numerous medical difficulties [3]. Congenital nose absence, also known as arrhinia, is a rare disorder in which a baby is born without an external nose, mostly due to abnormalities in the SMCHD1 gene (structural maintenance of chromosomes flexible hinge domain containing 1 gene). Some genetic disorders, such as cleidocranial dysplasia, can create a flat or nonexistent nose due to an RUNX2 gene deficiency (runt-related transcription factor 2). Physical trauma from sports or accidents can damage the nasal bones and cartilage, resulting in a condition that cannot be rectified by cosmetic surgery. Severe bacterial infections such as syphilis, leprosy, or tuberculosis, as well as fungi such as mucormycosis of the nose and paranasal sinuses, can cause cartilage and nasal bone degradation, resulting in malformed or collapsed nasal structures [4]. Snorting substances such as cocaine, methamphetamine, or opiates can severely damage the nasal tissues. Medical and surgical complications: A failed or extremely aggressive rhinoplasty might result in extensive cartilage removal, which may cause the nasal structure to collapse [5]. Untreated blood or pus buildup in the septum can obstruct blood flow, resulting in cartilage death and nose collapse. An uncommon autoimmune condition, such as granulomatosis with polyangiitis (previously known as Wegener's) or lupus, can cause inflammation that affects nasal cartilage [6]. Nose loss for any reason can be restored by corrective surgery or prosthetic materials depending on the cause and extent of the defects, the patient's desire, and the other operational factors (Figure 2). When the cause of nose loss is due to a lesion that needs observational attention for a long time, like after cancer removal, the surgical correction

considered is not indicated, and prosthetic replacement becomes the appropriate choice. The artificial replacement of the whole nose requires full knowledge of the nose's functions and how to offer at least the equivalent safety features to help the patient protect the respiratory system from foreign objects in addition to cosmetic correction of the defect.

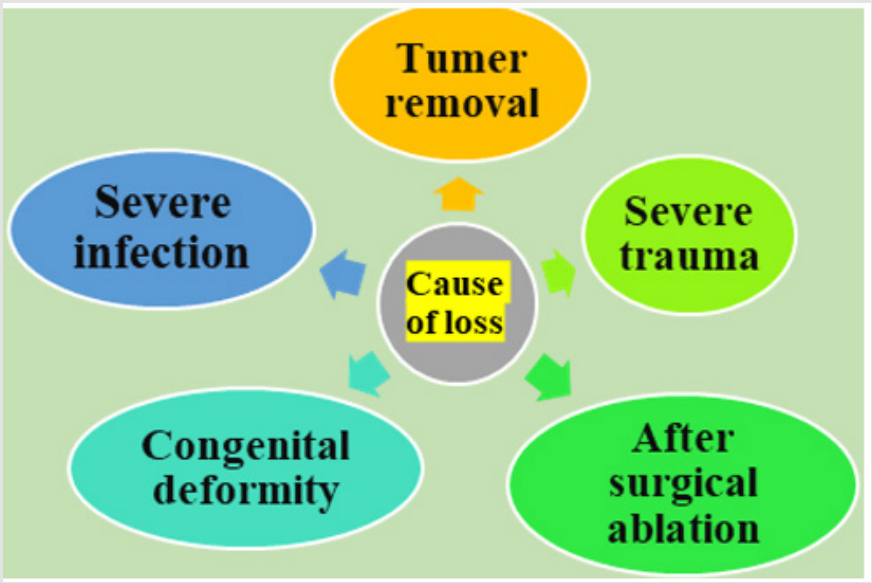

Figure 2: The possible causes of partial, half, or total nose missing.

Retention Modes and Extra Features for the Artificial Nose

The fixation of the artificial nose in its designated area is another requirement to satisfy the patient's needs. Many retentive methods were employed to secure the artificial nose in place. The simplest way is to use the medical-grade silicone adhesive. Implants serve as an excellent anchoring method that is frequently used to retain the nose, depending on the size of the defect and the specific surgical requirements. Undercut engagement can be employed to retain missing structure in specific helpful conditions where the site is not sensitive and the patient is able to tolerate it. Mini dental or medium-sized magnets are another connection mode for the nose retention. The use of certain devices like spectacle frames is also a present option. However, each retention method has its proper indications and disadvantages as well. The selection of any mode depends mainly on the clinical indication, patient acceptance, skill and capacity of the practitioner, and the laboratory facilities. The various methods of retention and their respective indications are summarized in Table 1. Each method of restoration, whether corrective surgery or prosthetic rehabilitation, has particular indications and prerequisites for therapy.

Table 1: A summary of the different clinical scenarios and the available prosthetic rehabilitation.

Extent of the loss	Retention means	Patient prospect
Small part of nose cartilage or bone	Undercut or adhesive	Surgery if possible or undercut retention
Half or total nose without intraoral defect	Undercut, adhesive, implant, implant-bar system or magnets, glasses frame	± adhesive, implant, depending on the cost and cause of defect
Half or total nose with stable intraoral device	Attached through magnets, undercut connect or any creative mean to the internal	The magnet connection is preferred by the patient.
Total nose defect with unstable intraoral device	Implant system for each device if ok or undercut, adhesive, glass frame	Disassociation between the 2 parts is preferred by the patient.
Nose and part of face only	Implant with bar or magnets if no risk, undercut with multi means	implant is preferred by dentists and undercut by patient

Tumours, like other missing structures in the head and neck, cannot be surgically repaired depending on their kind and aggressiveness. Instead, they necessitate a prolonged period of observation before being declared safe and stimulate corrective treatment. As a result, a prosthetic replacement becomes the best option until the patient's deformity has fully healed and the correction surgery can be performed successfully. Other factors influencing the restoration technique include the amount and kind of tissues around the lost section of the nose. Bonny structures that provide good support for any nose anchoring system, such as an implant or an implant-bar system with or without a mini-magnet, are insufficient to provide sealing and shock-absorbing activity for the replaced nose, as the patient may experience abrasion and pain around the prosthesis. A tiny defect caused by the removal of a noncancerous lesion in the nose is prioritized for surgical repair based on location, patient preference, and the prediction of eventual cosmetic results. In many situations, septal cartilage repair has a high success rate (+80%); however, it needs excellent practitioner skill [7].

Total nose reconstruction is a difficult, multi-stage surgical technique that rebuilds the nose's three layers: the inner lining, the structural framework (which includes cartilage and bone), and the outside skin envelope. This method is intended to restore both function and beauty. Typically, it involves methods such as forehead flaps, cartilage grafts extracted from the ears or ribs, and free tissue transfers, which may necessitate multiple revisions during the treatment. To summarize, surgical replacement and reconstruction after total or partial nose loss (nasal amputation) is a complex procedure, with success rates varying significantly depending on whether tissue is replanted or reconstructed, the cause of loss, the technique used, and practitioner factors. Prosthetic nose replacement has various advantages over surgery, including lower cost, greater versatility, patient acceptance, and better cosmetic results. In this clinical report, three examples of partial or complete nose loss were restored, and the various prosthetic rehabilitation procedures were explained, and one was chosen based on the best prognosis outcome in accordance with the patient's opinion and perspective. The steps of prosthetic restoration of nasal defect are summarized in (Figure 3).

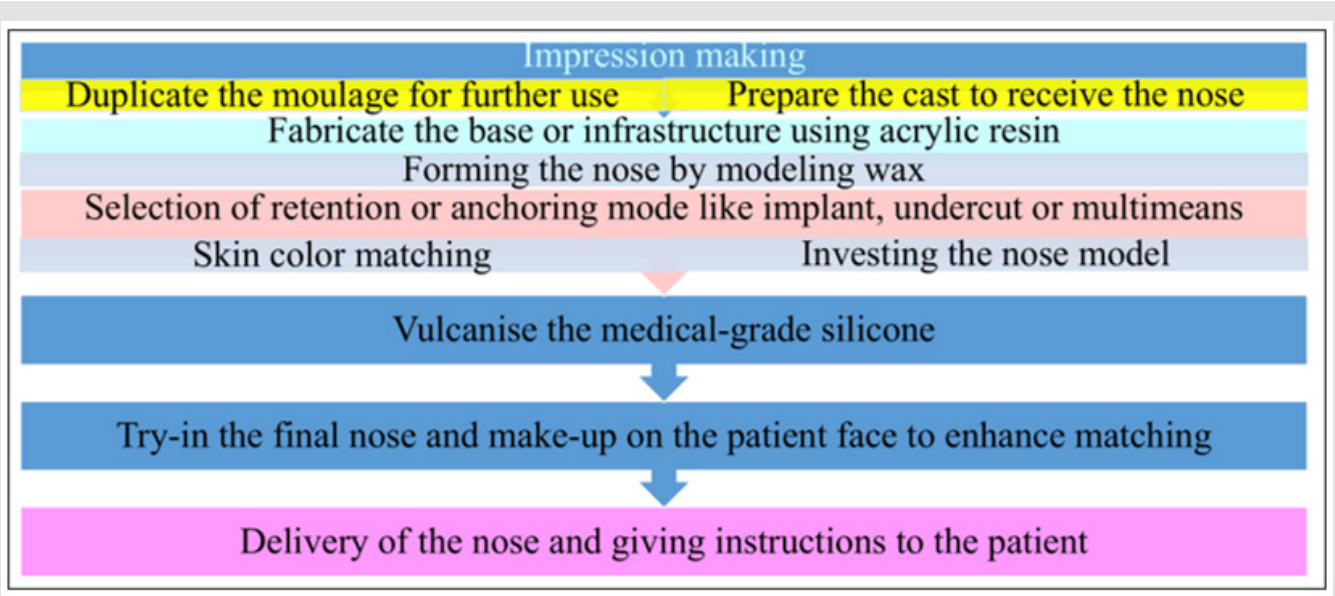

Figure 3: The order in which the various nose parts were processed.

The First Case Management: Replacement of the Left Ala of the Nose

A Chinese woman in her fifties wanted a prosthetic replacement for her left ala (Figure 4), which had been surgically removed. The mole, or nevus, was excised by a dermatologist since it was large and worrisome. An examination of the surgical site revealed an irregularly shaped residual base. A cartilage remnant, like a little ball at the bottom margin of the left nostril, suggested the use of undercut and adhesive (Figure 5). This would be necessary if the retention fails to securely hold the medical-grade silicone piece in place. The midface replica was created using irreversible hydrocolloid (Kromopan Alginate) after covering the nostrils with two thin pieces of gauze coated with Vaseline (petroleum jelly) and connecting them with dental floss or a similar thread to avoid any deep push inside the nasal cavity. The area was surrounded with enough height to offer sufficient thickness for the alginate and a layer of gypsum product (Dental plaster, type II) using boxing wax (Hygienic boxing wax).

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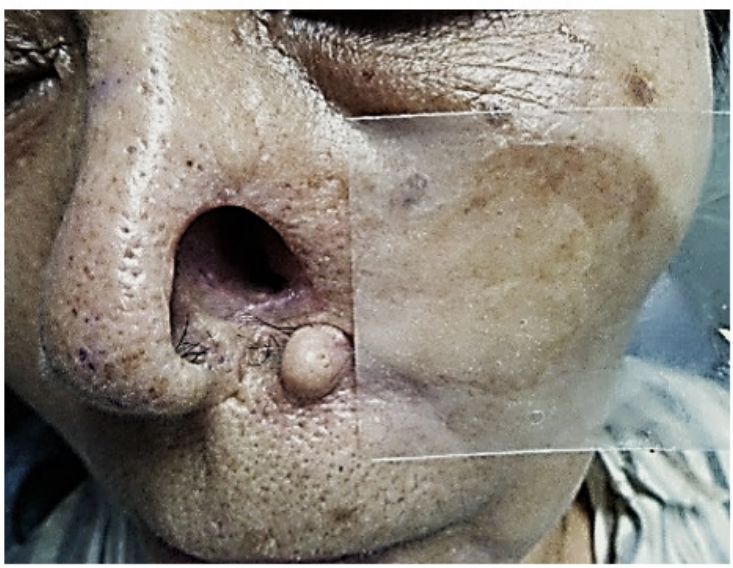

Figure 4: The defect size and skin color matching.

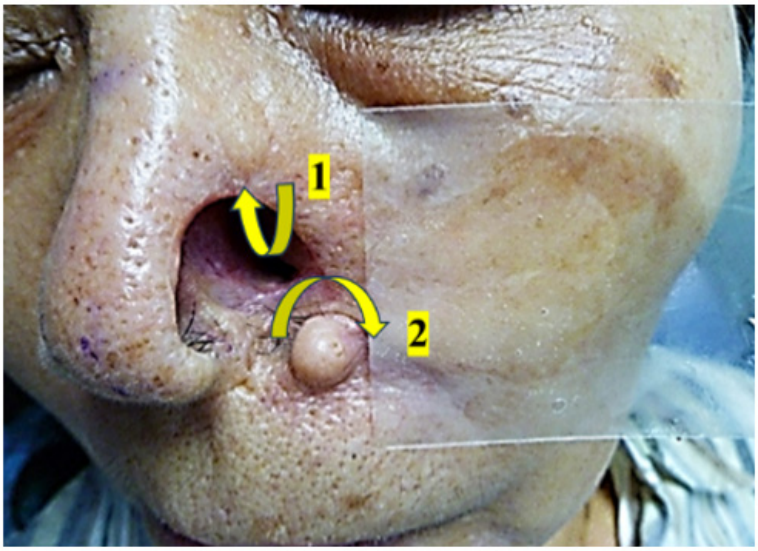

Figure 5: The use of undercut areas (1, 2 locations).

The impression was poured with stone (Dental hard stone, type IV) to create the working moulage. The ala of the nose was created and shaped using modeling wax (Pyrax modelling wax), considering the need for undercut area shaving to enhance retention after the silicone processing. The model was tried on the patient's nose, and any deficiency was corrected to the normal shape and similarity to the original one using the right side as a reference and a recent photo of the patient. The wax model was refined on the moulage, and the periphery thickness was well formed and trimmed around the defect area to prevent tearing of the silicone during continuous use. The wax model was put into a flask, opened, and isolated for medical-grade silicone (Cosmesil) packing. The silicone color was selected and vulcanized using the room temperature overnight method. The flask was opened, and the piece was retrieved, trimmed, and prepared for delivery to the patient (Figure 6). Upon successfully fitting the piece on the patient (Figure 7), external painting and makeup were used

to improve skin color matching and texture, followed by the glazing process. The patient received the completed replacement piece and was very pleased with its retention, as well as the matching of skin hue and consistency (Figure 8). The outcome was extremely satisfactory for both the prosthodontist and the patient. This simple case exemplifies how thoughtful design and execution in prosthodontics can profoundly enhance quality of life, reinforcing the significance of personalization in dental care.

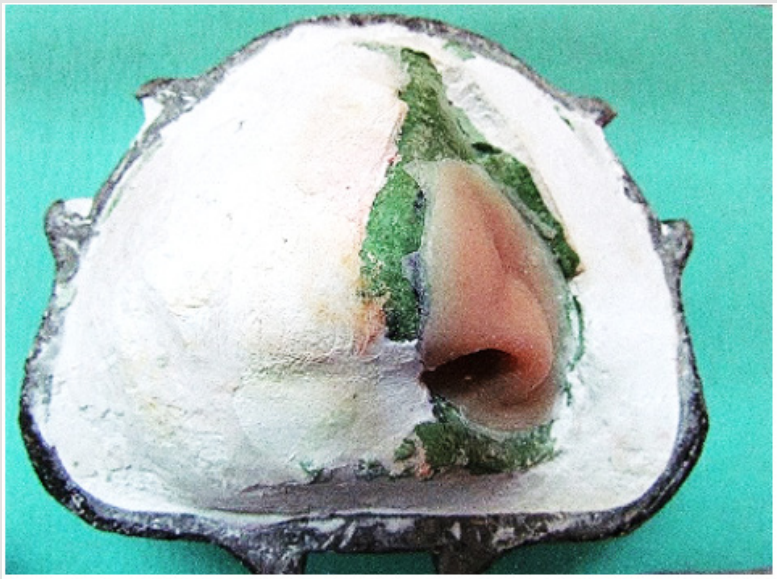

Figure 6: The finished medical-grade silicone.

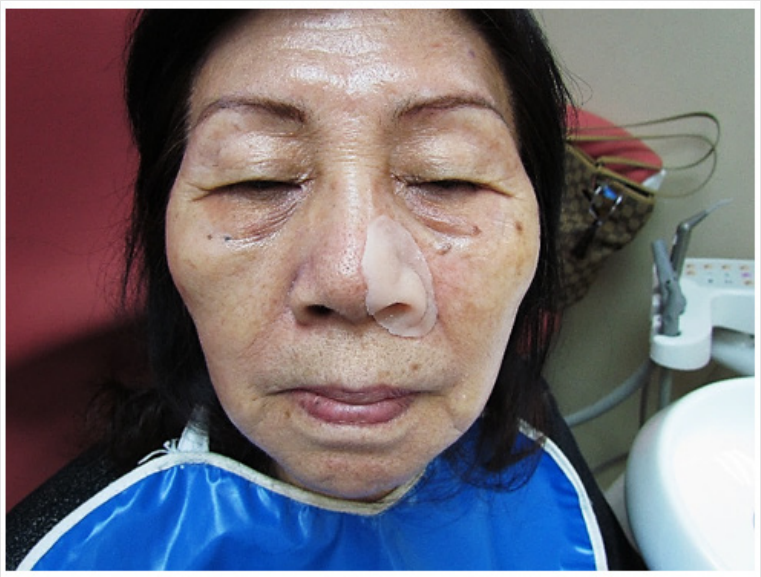

Figure 7: The try-in step of the finished piece.

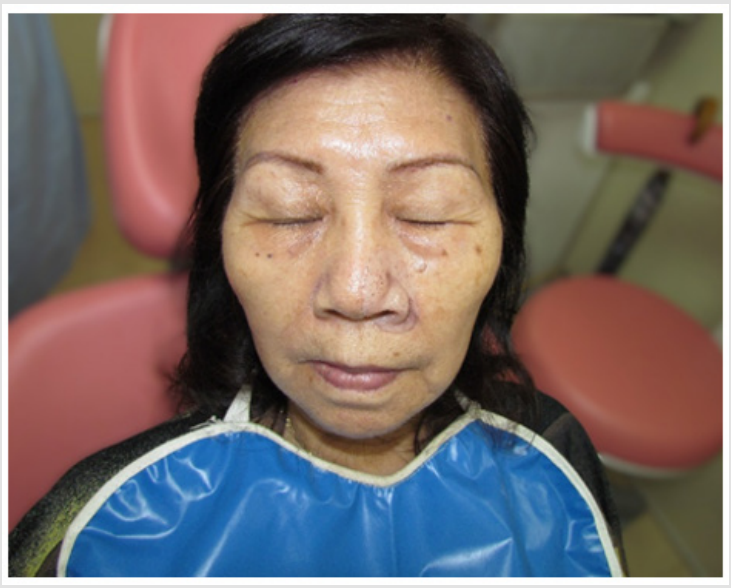

Figure 8: The nose after make-up.

The Second Case Management: Replace Part (Half) of the Nose

A middle-aged Malay teacher went to the faculty maxillofacial clinic to have his postoperative right half nasal deformity corrected. The lesion was diagnosed as squamous cell carcinoma (SSC), requiring the removal of a considerable portion of the affected nose area. No general condition anomalies or extra post-surgical treatment of the lesion were mentioned, and the patient was declared medically fit. The deformity was found to be restricted to the nose alone, with no communication with the maxillary arch, according to the extraoral and intraoral examination. The cartilage of the remaining lower nose, however, was deformed and collapsed (Figure 9). An impression was made of the face, excluding the mandible, using the same technique and materials for making facial moulage (alginate supported by plaster of Paris) after boxing the desired area and isolating the skin and protecting the defect area with gauze impregnated with petroleum jelly. The respiration was kept without interference by fixing simple plastic tubes through the mouth opening.

Figure 9: The defect area and nose collapse.

The resulted impression was poured into a stone cast (Figure 10). The anchoring method was reviewed with the patient, along with the relevant therapy options and costs. The decision was to employ the available undercuts alone or, for further security, with a spectacle frame. On the face cast, the periphery of the defect was shaved to ensure sufficient thickness for the future silicone, which would create a better seal with the skin and improve resistance to tearing. The infrastructure was previously created using heat-cured acrylic resin and tested to evaluate the engagement of the accessible undercut without causing discomfort to the patient. A wax model of the missing half-nose and its surroundings was then created to match the patient's nose using a profile and front photos before the surgery, in addition to filling the shaved border of the problem area. A simple modification to allow the support of the spectacle bridge was done on the wax model during the tray-in phase (Figure 11). Inside the flaw, tinfoil was formed into a low-profile nose, leaving enough space for the air to pass during inhalation.

Figure 10: The infrastructure acrylic resin.

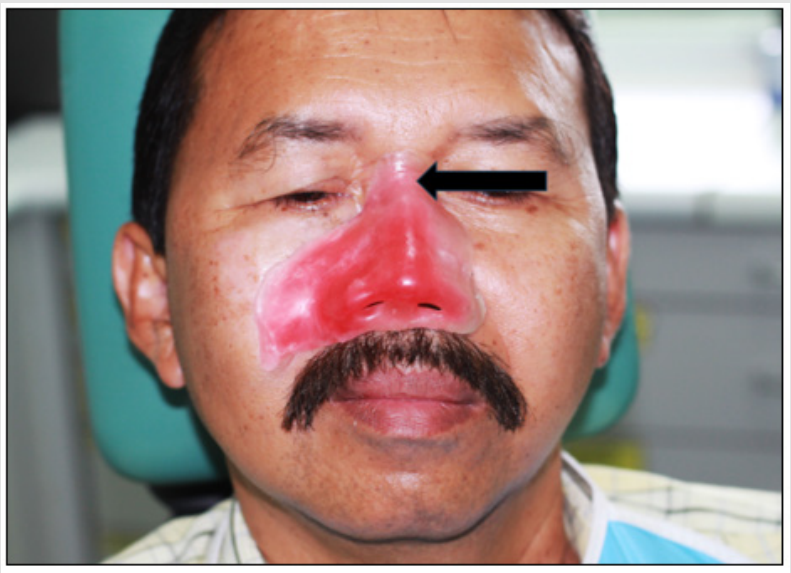

Figure 11: The trial nose with the spectacle stopper (in black).

This phase can be substituted with any material that can be easily removed without damaging the nose model during try-in processes or when connecting to the undercut engagement component. Tinfoil was placed layer by layer to provide enough space for the airflow except for the middle part of the connection to the infrastructure. On the inside of the wax form, a small piece of small-pore stainless-steel mesh was fixed to protect the patient from foreign objects during normal use and breathing. The waxed form was tried on the patient, and the morphology, border thickness, and margins were refined and finished. The mesh is lubricated on its free part only to ensure easy cleaning after processing of the silicone. Skin color matching was performed using the method and skin shade described by Dr. Humam in 2010 (Figure 12) [8-10]. The silicone production techniques considered both mesh fixing (Figure 13) and infrastructure attachment. The result was satisfying for both the patient and practitioner (Figure 14).

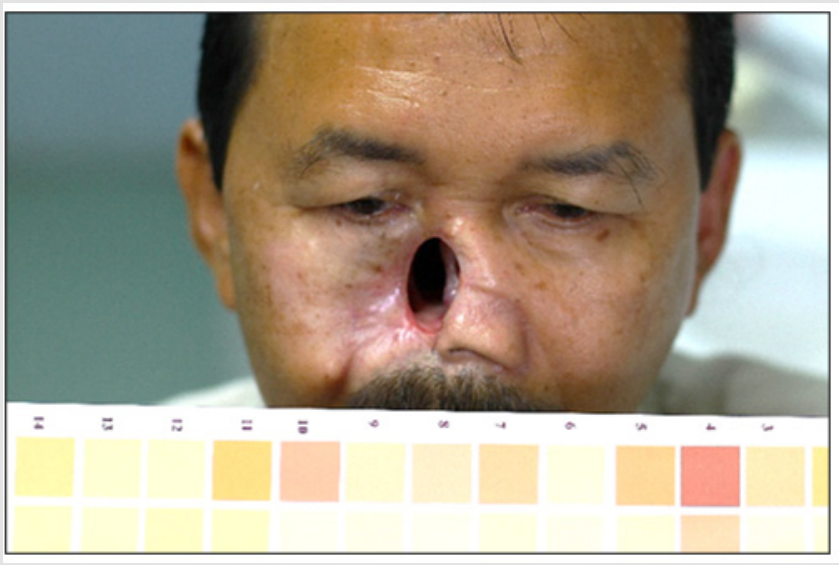

Figure 12: Selection of skin color.

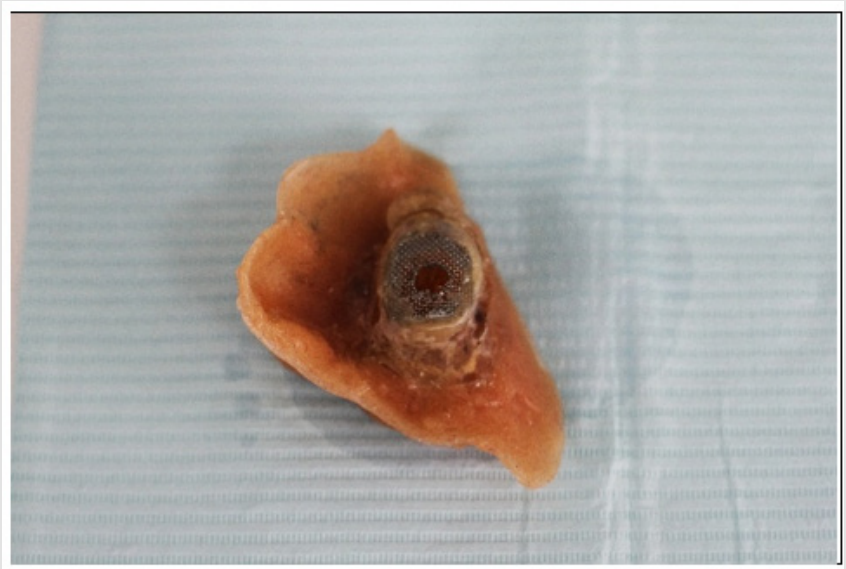

Figure 13: The mesh location inside the nose.

Figure 14: The finished nose with extra support by the spectacle frame.

The Third Case Management: Use of Implant-Bar System

A Chinese male in his thirties, a cook, attended the prosthetic department for nose replacement. The examination revealed the excision of the whole nose and the anterior part of the maxillary bones, leaving the posterior palate and the right and left tuberosities with the first and second molars in place. The cause of excision was the removal of a squamous cell carcinoma (SCC) tumor of the nose that extended to involve part of the maxillae and the hard palate. Extraorally, the upper lip in the middle was corrected, and two ordinary endosseous implants were placed across the middle of the nose and connected by a Dolder bar (Figure 15). This case demonstrates the advantage of separating the external nose from the internal obturator. This system has numerous advantages over the coupling of internal and exterior prostheses. The most important feature is the ability to use the external prosthesis (the nose) when the obturator is removed for cleaning or maintenance, for example.

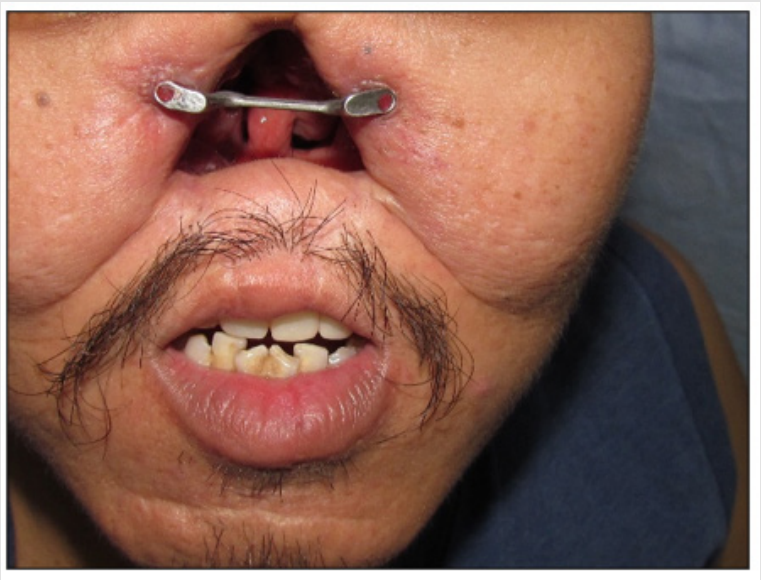

Figure 15: The implant-bar system.

It also reduced or eliminated discomfort and sensitivity caused by the exterior part's continual pressure and friction with the fragile, sensitive tissues under the epithesis limits when the obturator moved during oral activities. Additionally, the combined-type restoration allows for the simple repair of one element at a time, and if a failure occurs, only one part is easily and quickly replaced, saving the patient time, functionality, and comfort. An impression was made of the middle of the face using a common technique after protecting the deep part of the defect area with gauze impregnated with petroleum jelly and ensuring the adequate respiration of the patient through his mouth. Before the impression making, the analogue copings were inserted inside the implant structure, and the area was boxed by a frame of modeling wax. The impression was taken with alginate and supported by a plaster of Paris layer. It was poured with hard stone to produce the moulage. The bar was waxed and cast into metal alloy and tried on the patient for fitness. An infrastructure base was waxed and checked on the patient with the housing of the bar (Figures 16 & 17).

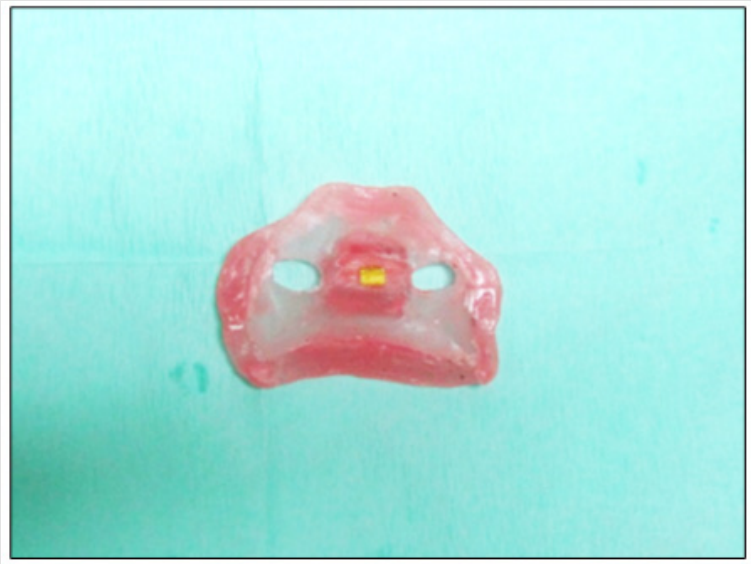

Figure 16: The waxed infrastructure with the housing.

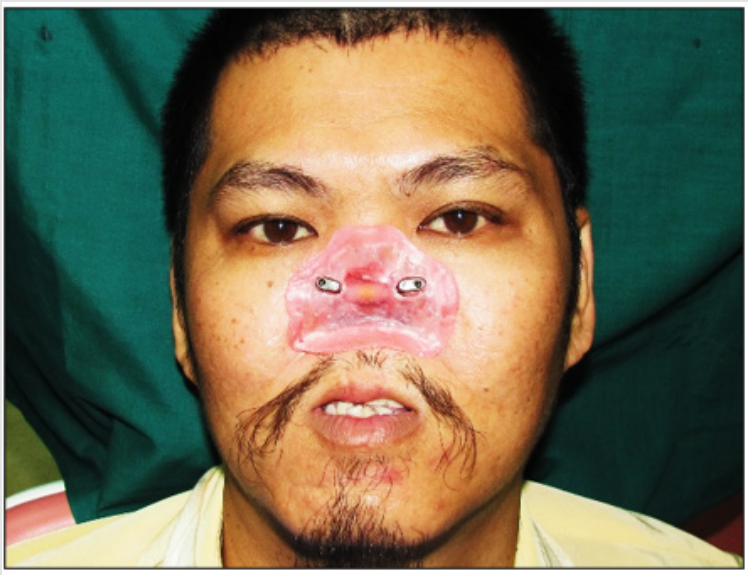

Figure 17: The infrastructure waxed form.

It was invested into flask and processed into acrylic resin. After retrieving from the flask, it was checked on the bar that fixed on the implants on the patient face. The external shape of the nose was sculpted and refined to match the original patient nose using a personal manual forming technique and photos (front and profile of the face) before the surgical operation. Before attaching the nose to its infrastructure two opening were created inside the infrastructure; one above the metal housing and the other below the housing and connected to each other through a plastic channel to form an air intake opening through the final artificial nose. These vents were covered by a stainless-steel mesh to prevent foreign bodies from entering the respiratory system (Figure 18). The waxed nose was checked on the patient face and refined, finished until complete patient satisfaction. The sealing, border thickness, and margins continuity were verified and corrected when necessary. The skin color matching was done using the direct method described before [8-10]. The nose was invested, and the flask opened, the mold cleaned. Medical-grade silicone was prepared with the selected internal color and vulcanized following the classical process. The flask was opened and the nose was retrieved, cleaned from debris, and the excess silicone was cut. The prosthesis was examined for any flaws or porosity. The patient was called for delivery. The prosthesis was evaluated for shape symmetry and harmony with facial morphology, retention, border sealing and continuity with skin creases, and breathing comfort. The skin colour matching was examined, then makeup with external silicone paints was applied in bright light until the best result was achieved. The patient was given two replicas of the nose: one with closed vents for swimming and one with vents for everyday activities (Figures 19 & 20). The patient expressed considerable happiness with the results. The clips were dropped after nearly six months and fixed appropriately.

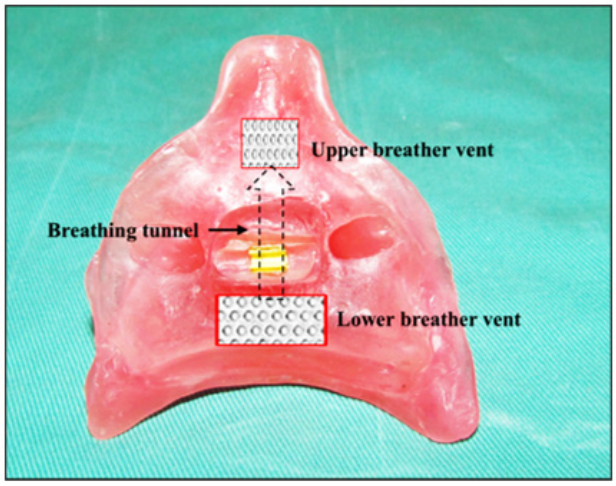

Figure18: The inner face of the infrastructure and the filtering mesh and breathing tunnel.

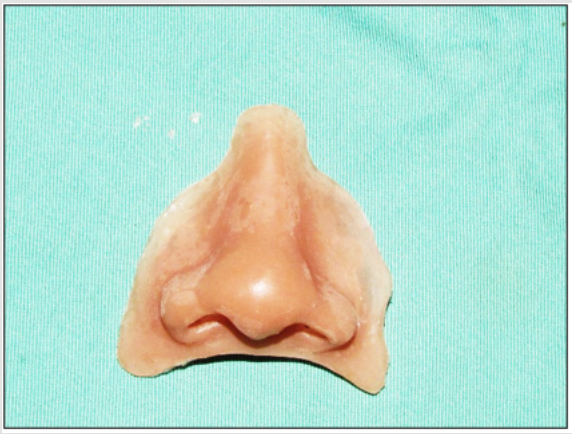

Figure 19: The finished nose.

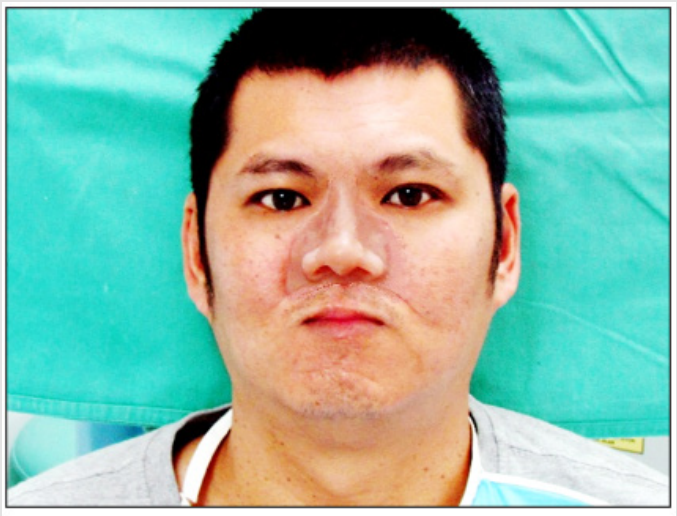

Figure 20: The nose in place.

Discussion

The prosthetic repair of a missing nose is nothing new. It is recommended to correct facial disfiguration and restore normal psychology and life to such people when corrective or plastic surgery fails to provide a remedy. In addition to the numerous benefits, this restoring method has many restrictions and drawbacks. For example, medical-grade silicone has a limited life expectancy and requires frequent replacement and repair due to degradation mechanisms over time. Maxillofacial prostheses often require replacement within 1-3 years due to degradation [11]. The most common form of degradation is increased surface hardness and reduced flexibility. Color degradation and yellowing are common indicators of aging. Prolonged exposure to heat and oxygen causes silicone to harden, lose flexibility, and suffer from reduced tensile strength. Long-term environmental exposure can cause surface loss of gloss, staining, and holes. In medical applications, medical-grade silicone can be degraded by microorganisms (bacteria and yeast), which can grow just below the surface, causing deformation and failure [12].

Exposure to UV or sunlight, humidity, and skin fluid contamination in maxillofacial prosthetists are main cause of degradation and the need for replacement [13]. Implants are an excellent anchoring means due to retention providing quality and longevity if maintained well, however, the cost, aggressivity during surgical intervention and post-operative discomfort and daily maintenance reduce their acceptance by the patients. The nose replication using silicone material is simple procedure especially the practitioner stored the previously used mold. To get the maximum life span and the quality of processed silicone some saving procedures should be done to reduce the use and environment impacts. The patients were given post-delivery instructions; cleaning and hygiene of the prosthesis are key steps for keeping the silicone in functional condition for an extended period. To eliminate skin oils, sweat, and dust, clean the prosthesis once a day with warm water and a mild soap. Abrasive brushes and scrubs should never be used because they create a rough surface that encourages bacteria growth. Handle with care and store in a cool, dry, non-airtight container. Use a sturdy container, keep it out of children's reach, and keep it out of the sun and heat to prevent damage. Before going to bed, take off the prosthesis to allow the skin to breathe and avoid pressure-related skin irritation or prosthetic deterioration. Cigarette smoke can stain and yellow silicone; thus, patients should stay away from it. Avoiding swimming with the primary prosthesis is advised because it may result in colour loss, particularly in saltwater or chlorinated pools. Rinse it right away with fresh water if it's exposed. Avoid applying cosmetics and makeup since both can cause discoloration.

For an implant-retained nose, clean the metal pillars (abutments) and surrounding skin on a regular basis using a soft toothbrush and light soap, or a 50:50 mixture of water and hydrogen peroxide. Professional cleaning, polishing to eliminate buildup, and colour touch-ups should be done every 6 to 12 months, or whenever a problem emerges with the prosthesis. People who use these tactics can extend the life of their silicone prosthesis, make it more comfortable, and improve its appearance. Face transplantation is another surgical developing option for severe face deformities caused by many factors, including severe burns, massive trauma, or tumors. Even though roughly 44 cases have been transplanted worldwide since 2005, it is still in the trial stage due to several dangerous side effects. The transplants were performed on 39 men and 9 women. The median follow-up period was 8.9 years. During the follow-up period, six transplants were lost, and two patients were retransplanted. There were ten patients who died; two of them had lost their transplants. The 5- and 10-year transplant survival rates were 85% [14]. At the end of the day, medical-grade silicone is a temporary fix for maxillofacial and other irregularities. As

a result, all disciplines of biology and medical sciences should strive to develop biointegrated materials to a point where they promote and accept the growth of living tissues and can be easily customized by anaplastologists to match missing structures without rejection or side effects [15].

Conclusion

Prosthetic nose replacement with medical-grade silicone is an acceptable and desirable treatment for those in need due to its positive cosmetic results, cost, and ability to be used in ordinary as well as medically restricted circumstances, except for an allergic reaction to silicone itself. To provide professional-level care, the discipline requires more improvement in skill, biomaterials, and training.

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