Case Report

Nasal Reconstruction in a Patient with Basal Cell Carcinoma Using Digital Technology: A Case Report

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Abstract

Introduction: Basal cell carcinoma (BCC) is the most common type of skin cancer, with significant clinical consequences. It predominantly affects areas exposed to sunlight, such as the nose, necessitating effective management strategies due to its cosmetic and functional importance. This case report describes nasal reconstruction in a patient with BCC by using digital technology.

Case Presentation: A 65-year-old female patient underwent total rhinectomy due to BCC and was subsequently rehabilitated using a silicone nasal prosthesis. The digital scanning technology was utilized to fabricate a customized prosthesis according to a 3D scan of the patient's daughter, enhancing both fit and esthetics.

Conclusion: Successful nasal reconstruction by using digital technology presents a promising approach for management of defects following surgical removal of BCC lesions. This case report emphasizes on the benefits of digital technology in achieving functionally and esthetically pleasant prostheses with improved patient satisfaction.

Key Words: Basal Cell Carcinoma, Nasal Reconstruction, Silicone Prostheses, Digital Technology, 3D Scanning

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Received: 16 July 2024
Accepted: 20 Sept 2024

➢ **Cite this article as:** Mazaheri Tehrani A, Zarbakhsh A, Nazarnejad F, Rastin V, Safari S, Mangoli HR. Nasal Reconstruction in a Patient with Basal Cell Carcinoma Using Digital Technology: A Case Report. J Iran Dent Assoc. 2024; 36(3-4):84-90.

Introduction

Basal cell carcinoma (BCC) is a slow-growing malignant tumor and is the most common malignancy in humans (1), accounting for approximately 80% of all non-melanoma skin cancers (2). It originates from the epidermal basal cell layer or follicular structures (3). It usually affects sun-exposed skin of older patients with a higher affinity to the facial area. The nose is the area most frequently affected (4). The prevalence of BCC is increasing in developing countries, compared to industrialized countries, due to reasons such as increased exposure to UV light, ozone depletion, increased surveillance, and changes in lifestyle habits, such as smoking, dressing, and sedentary lifestyle (5).

Facial prosthesis, as a non-surgical form of reconstruction of facial defects, has been well accepted. In addition to achieving esthetics, nasal prostheses can reinstate the anatomical contour in presence of midface defects (6). Reconstruction of the nose presents unique challenges due to its intricate anatomy and the necessity to restore both its structural integrity and esthetic features. The traditional surgical techniques for nasal reconstruction, such as grafts, local flaps, or free tissue transfer flaps, have been employed to achieve these goals. While these methods can provide satisfactory outcomes in some certain cases, they also have limitations, including prolonged surgical time, variable success rates, and the potential for significant donor site morbidity (7). Achieving esthetically pleasant and functional results often become increasingly complex, especially in cases with extensive tissue loss, such as after excision of a BCC lesion (8). The materials used for nasal prostheses are based on polymethylmethacrylate and silicone, which are biocompatible (9). Silicone elastomeric material has some advantages such as high stability and optimal marginal adaptation. A major drawback of silicone material is its degradation, and decomposition of its constituents over time due to exposure to high temperatures, UV light, sunlight, and moisture, necessitating its replacement (9).

Recently, the integration of digital technology has transformed reconstructive surgery, particularly in complex areas like the face and nose. The development of digital technology has significantly enhanced the possibility of nasal reconstruction. Digital technology can be employed in all phases of nasal reconstruction, including the preoperative, intraoperative, and postoperative stages and can significantly improve the outcome (10). Tools such as 3D printing, computer-aided design, and 3D imaging are now used to enhance surgical precision, facilitate preoperative planning, and improve overall outcomes. Hilger et al, (11) in 1983 were the first to use computer image technology for morphological assessment and structural analysis of rhinoplasty. After the advent of 3D printing technology, it soon gained increasing popularity as an effective strategy for preoperative simulations and fabrication of customized prostheses. This technology was later used for nasal reconstruction. Accordingly, a personalized and highly precise nasal reconstruction may be achieved by using digital technology (10). Digital scanning technology allows for the creation of highly accurate models of the patients' anatomy, enabling tailored solutions that align closely with individual patients' functional and esthetic needs. The shift toward digital methods represents a significant advancement, allowing for enhanced customization and reduced human errors in prosthetic rehabilitation (12).

Considering the existing challenges in prosthetic reconstruction of the nose in reconstructive surgery, employment of digital technology can significantly enhance this process, and serve as a novel alternative to the existing techniques. Concerning the novelty of digital technology in Iran and its applications in dentistry, reports regarding its application for nasal reconstruction in Iran are scarce. Accordingly, this case report describes nasal reconstruction in a patient with BCC by using digital technology. The significance of this case is that it shows how digital technology can effectively address the challenges faced during nasal reconstruction following excision of a nasal BCC lesion. Unlike the conventional methods, the authors utilized a 3D scan from a family member to craft a personalized prosthesis, offering a tailored approach to enhance both esthetics and function.

Case Presentation

A 65-year-old female patient was referred to the Department of Prosthodontics, School of Dentistry, Azad University, Tehran, Iran, complaining of her huge nasal defect. Informed consent was obtained from the patient to use the photos for publication. She was highly dissatisfied with her facial appearance. The patient had undergone total rhinectomy about 1 year earlier, followed by several sessions of radiotherapy (Figure 1).

A treatment plan was designed according to her age, general condition, site, size, and etiology of the defect, and patient's demand, and discussed with the patient. The designed treatment plane included the following steps. Written informed consent was obtained from the patient.

Figure 1. Patient's facial appearance and her midface defect

Figure 2. Impression step: (A, B) An impression was made with addition polyvinyl siloxane light body impression material (C) the cast was poured with dental stone

Step 1: Impression:
The patient was positioned semi-upright to minimize tissue distortion. The surrounding areas of the nose were boxed and restricted by using wax strips and then a moist gauze was packed in the nasal cavity defect to prevent material entrapment in the underlying tissue. Additional polyvinyl siloxane light-body impression material (Charmflex, South Korea) was then injected to fill the defect (Figure 2). To enhance retention of the plaster, three pins were inserted, and plaster of Paris (Well Mix G30; Asia Shimi Teb, Tehran, Iran) was poured to cover the impression material. The impression was removed, boxed, and poured with type III dental stone (Dentsply Sirona, USA) (Figure 2).
Step 2: Fabricating the pattern:
To prepare the nose pattern, A 3D face scanner (Shining 3D Dental Face Scanner, Hangzhou, China) was used to obtain a 3D face scan from her daughter's face and two other relatives whose facial musculoskeletal pattern was similar to that of the patient. The Exocad software was used to superimpose the nasal scan files on the patient's facial photograph to decide which nose is suitable for the patient (Figure 3). The eyes and cheek points were also used for maximum alignment. Finally, her daughter's nasal scan was found suitable, and selected.
An impression was made from her daughter's nose to serve as an index. It was then waxed to create a wax pattern. An airway should also be included in nasal prostheses to improve respiratory function and comfort. The wax pattern was tried-in to ensure its optimal adaptation to the face especially at the borders. The adaptation of the wax with the surrounding tissues was also checked ((Figure 4).
Step 3: Investment and fabrication of the mold:
The wax prosthesis was sealed to the cast. An ejector-type (three-piece) flask (OT Flask A5705; Italy) was used to facilitate prosthesis removal after processing of silicone. Plaster mix was poured in the bottom half of the flask, and the wax pattern and cast were placed in the upper half. The separating medium was applied on the plaster. The middle section of the flask

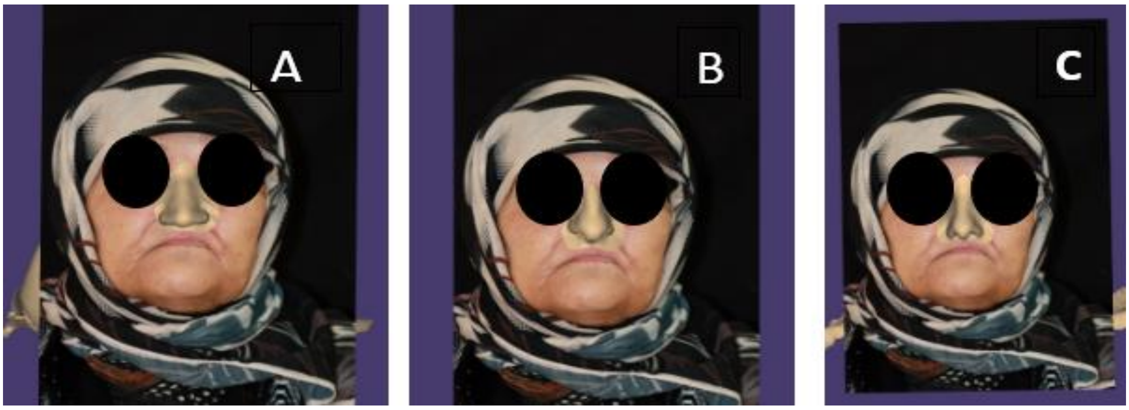

Figure 3. (A, B) Trying different wax patterns; (C) the suitable one according to her daughter's facial scan

was added, and the wax pattern undercuts were filled with dental stone. The base of the wax pattern and cast had to be flush with the drag of the flask to prevent possible breakage of the two halves of the flask.

Figure 4. (A) Wax model, (B) trying the wax model on the patient's face

Step 4: Coloring:

Due to significance of color matching of silicone, both intrinsic and extrinsic staining were performed. Intrinsic colorants were used according to the skin tone of the patient, and were added to the previously prepared uncolored silicone using the liquid catalyst. Additional colorants were mixed with small amounts of the base shade to generate a variety of intrinsic staining colorants. External staining of the surface of the prosthesis was also performed with a paintbrush to further simulate natural skin in terms of presence of freckles, moles, blood vessels, and even sunburned areas. The silicone and all materials used for extrinsic and intrinsic staining were from Cosmosil (Figure 5).

Figure 5. Nasal silicon prosthesis

Step 5: Delivery:

The prosthesis was tried on the patient's face. The patient was instructed on how to use skin adhesive and place the prosthesis on her face. To maximize retention, eyeglasses were recommended. Also, she received necessary instructions on how to care for the prosthesis and keep it clean (Figure 6). She was recalled 1 month after the delivery for the follow-up and expressed her satisfaction with the prosthesis.

Figure 6. Delivered nasal prosthesis with eyeglasses

Discussion

This case report described the use of digital technology for nasal reconstruction in a 65-year-old female patient who had undergone total rhinectomy due to BCC. Nasal reconstruction was accomplished successfully utilizing a silicone prosthesis fabricated by digital technology, which significantly improved the patient's facial appearance and self-esteem, and met patient satisfaction. Digital technology, including a 3D facial scan of her daughter's face, played a crucial role in achieving a highly customized and well-fitted nasal prosthesis in this case.

Reconstruction of maxillofacial defects with silicone prostheses has some advantages such as optimal esthetics, non-invasiveness, biocompatibility with the surrounding tissues, low cost, easy fabrication, and easy cleaning (13). In comparison with the conventional nasal reconstruction techniques, such as grafts and hand-sculpted prostheses, the digital approach offers notable advantages. The traditional methods often struggle with achieving symmetry and details, which can lead to patient dissatisfaction. In contrast, the use of digital tools allows for precise customization aligned closely to the patient's unique anatomy, enhancing both function and esthetics (12). Digital methods enable real-time adjustments and feedback, addressing common challenges of the traditional techniques and reducing the time required for the adjustments (14).The use of 3D facial scan and CAD software in the present case significantly improved precision in prosthesis alignment and shape, and enhanced the esthetic outcome. With the help of digital technology i.e., 3D facial scanning, the facial scan of the patient's daughter was used to shape the anatomy of the nasal prosthesis. At present, 3D reconstruction/imaging technology, 3D printing technology, and computer-aided surgical navigation are increasingly used in nasal reconstructions worldwide (10). Furthermore, the 4D technology and artificial intelligence have also been tested for preliminary clinical applications (15). Application of digital technology in rhinoplasty and nasal reconstruction can enhance meeting the esthetic goals, precision, and individualization, and maximize patient satisfaction (10).

Despite the advantages, the digital techniques have some limitations in nasal reconstruction as well. The common challenges include the high cost of digital equipment and the need for advanced training to effectively utilize these tools. Additionally, there may be a learning curve associated with adopting new technologies and software programs, which can impede their widespread use (15). Furthermore, while digital techniques offer many benefits, cases with more complex defects may still present significant challenges, particularly concerning functional aspects such as nasal breathing (16).

Literature supports the evolving role of digital techniques in facial prostheses, with several studies reporting successful outcomes in similar cases , consistent with the management of the present case (17-19). In the present study, similar to some other studies , the prosthesis was fabricated after surgery and completion of the recovery period (17, 18). However, some other studies fabricated the prosthesis preoperatively using the digital technology for immediate delivery after the procedure and improving patient satisfaction (20,21). Innovations in the field, driven by advancements in digital technology, continue to support the notion that personalized prostheses can significantly enhance the quality of care for patients undergoing facial rehabilitation (17, 18).

The implications of this case extend beyond BCC rehabilitation. Digital techniques offer a broader clinical application in maxillofacial reconstruction. With continued advancements in technology, there is potential for implementing these methods for various facial structures or in diverse patient populations, including those with other types of cancer (22). The ability to customize treatment plans through digital tools can lead to improvements in patient outcomes, which may pave the way for these techniques to become standard practice in the field (23).

In the present case, the patient reported high levels of satisfaction with her nasal prosthesis, noting significant improvements in her quality of life and self-esteem. The prosthesis served effectively in her daily activities, demonstrating a positive impact on her overall well-being. Looking toward the future, every 3-month follow-ups will be essential for assessing the durability of the prosthesis and determining any necessary adjustments to maximize its lifespan.

Conclusion

In conclusion, this case underscores the pivotal role of digital technology in achieving successful nasal reconstruction for patients with BCC post-surgery. The ability to obtain a personalized and precisely-fitting prosthesis highlights the advancements in digital tools that enhance surgical outcomes and patient satisfaction. Future research should focus on refining digital techniques and exploring their applications across larger-scale studies in facial prostheses, ultimately driving innovation and improving standards of care in reconstructive surgery.

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