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Restoring Touch - The Evolution of Finger Prosthesis - A Case Report

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Abstract

Finger prostheses in prosthodontics play a crucial role in the rehabilitation of patients who have lost fingers due to trauma, disease, or congenital conditions. The digital defects in an individual result in a diminished and degraded function as well as a threat to the integrity of one's self-esteem. An appropriately matched and well-fitting finger prosthesis might help a patient feel like they are not limited by their condition. In this article we describe the technique for creating customized silicone elastomer prosthesis which would increase the fit and retention to improve the durability, functionality. The life-like appearance of prosthetic fingers, offering new hope and improved quality of life for patients in need of these specialized devices.

Keywords: Finger Prosthesis, Maxillofacial prosthesis, Hand prosthesis, Silicone, Amputated partial fingers.

Introduction

''Amputation'', derived from the Latin word ''amputare'' (to excise, to cut out) has been defined as

the ‘‘removal of part or all of a body part enclosed by skin’’ [1]. The important part of our body is our hand that helps us perform our daily functions, and fingers are also integral part. Hands without fingers are non-functional, just like mouth without teeth!

It helps us perform various daily functions and gives us an aesthetic appearance. Loss or absence of the finger or part of the finger could be congenital, acquired deformity (traumatic/accidental), or surgical amputation [2].

For many individuals, digital amputation is a significant psychological problem. Beasley and de Bese have been keen to highlight the unusually rigorous nature of the esthetic requirements for digital prosthesis, which are subject to critical comparison with the adjacent normal digits [3]. The aesthetic function of the hand is as important as its active function. In conditions of digital amputations, the loss of form and cosmetic look of the hand can have such an impact on psychological state that active function of the hand is impeded.[4]

Advances in surgical sciences, such as microvascular reimplantations, have helped rescue several seriously wounded and traumatically amputed fingers. However, in the majority of cases, microvascular reconstruction is either unacceptable, inaccessible, or unsuccessful. In this group of patients, a prosthesis can be provided and may offer tremendous benefit like facing psychosocial difficulties. [5]

The process used in this case study can be described as a traditional method of fabricating prosthetic fingers. Missing fingers can be replaced using several ways, including titanium implants, osteointegration abutments, and silicone elastomers [7]. Fabricating the prosthetic finger takes highly experienced specialists and hard work, as opposed to Computer Aided Designs (CAD) for rapid prototyping and 3D printing. However, this contemporary technology is less inexpensive for the general people. [6]

This case report presents the prosthetic rehabilitation of amputated fingers with a custom-made prosthesis fabricated using silicone elastomers, which had adequate suspension, function, is comfortable to use and aesthetically acceptable to the patient.

Case Presentation

A 59-year-old male patient reported to the Department of Prosthodontics crown & bridge and Implantology, Bhopal, Madhya Pradesh, India, for the fabrication of complete denture prosthesis. On a general examination, we discovered that the patient had lost his middle finger of the dominant right arm due to injuries in a thresher machine.

Amputations were carried out through the distal portion of the middle inter phalanx of the middle finger years back. (Fig. 1)

Fig. 1

The amputated fingers showed thickened end. The surrounding area appeared to be normal with no signs of any infection over the digits.

The patient was informed of the procedure, which included the construction of an artificial silicon finger prosthesis. The patient eagerly accepted the treatment. Counseling was done to make the patient comfortable during the therapy, and he was advised about the limitations of the prosthesis.

Technique

1) The patient’s right hand was lubricated with a thin layer of petroleum jelly to prevent adherence of

impression material to the skin and hair. The area around the hand was boxed and impression material, irreversible hydrocolloid (Alginate, Gelmak, Brulon International, India) was placed over the palmar side first and then the dorsal side to prevent tearing and distortion of the material. This technique also allows the hand to be removed from the impression with the fingers in flexion. (8)

2) The patient was asked to slowly move his fingers and try to pull his hand outside to obtain the impression. The impression was poured in dental stone (Gemstone, Shruti Products) and a positive replica of the hand was made.

3) A wax pattern of the resected finger was made. For this purpose, we used right hand of same person as size and shape of the hand matches with that of the patient's right side and poured in wax (Modelling wax, Pyrax Polymars).

4) On solidification, it was retrieved, modified, and adapted onto the positive replica of the amputated finger. It was to give a life-like appearance in natural resting conditions. We further customized to mimic the skin folds and wrinkles to it. A glove type wax pattern was made from the donor wax model. After that, the fit of the wax pattern was checked. (fig 2)

Fig 2

5) Since the prostheses were meant to be a 'glove'-like construction, it was essential to ensure a snug fit of the silicone to the tissue. In order to provide a snug prosthetics, fit, the stump was reduced accurately by around 0.5–1 mm and a thin ring was added, so that silicone stretches and flexes over the stumps as prostheses were fit. (fig 3)

Fig. 3

6) Only the wax pattern along the ring placed on the amputated finger cast was flasked, dewaxed, and packed with the characterized heat cure acrylic resin as a maxillofacial material. (fig 4)

Fig. 4

7) On the day of packing, Appropriate shade matching was done during day light. Silicone material (Silicone for Prosthesis, MP Sai Enterprise) was packed in two parts (dorsal and ventral surfaces), the separate colour were added to the corresponding areas of the mould surfaces. (fig 5)

Different shades were selected for characterization of ventral and dorsal surfaces of the hand and intrinsic staining was done. (fig 6)

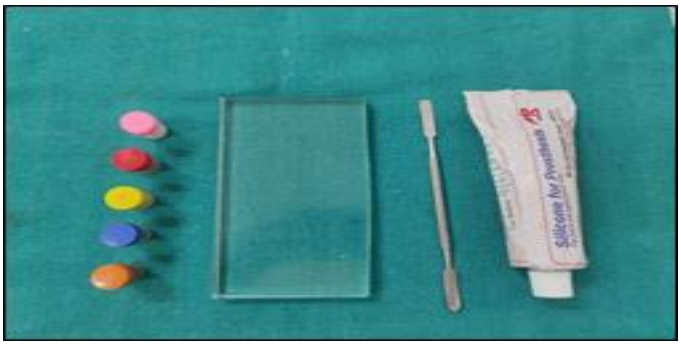

Fig. 5

7) After attaining the closest possible match on colour of the material, both halves of the mould were closed, placed under bench press and cured overnight.

Fig 6 (a).

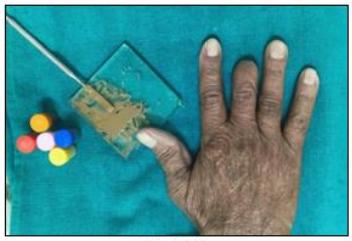

Fig 6 (b)

8) Once the final prosthesis was retrieved, the flash was trimmed using a sharp blade and final finishing was accomplished using a silicone burs. To complete the prosthesis, an artificial nail was fabricated with cold cure clear acrylic resin layered on a pink cold cure acrylic resin (Pyrax, Rapid Repair). The nail was carefully fashioned to match those of the corresponding normal hand.

A cynoacrylate adhesive was then applied on the under surface of the nail for bonding with silicone surface to achieve a realistic appearance. The patient was happy and satisfied with the prosthesis. (fig 7)

Fig. 7

10). Patient was asked to follow the post-op instructions regarding the prosthesis: -

- Wash the prosthesis with antibacterial soap and brush.
- Remove the prosthesis during sleep.

Discussion

Replantation of the digits to reassemble the fingers is possible if the patient arrives at the surgical clinic within 4 to 6 hours following the damage. The artificial finger is planned in conditions where surgical replantation or reconstruction is impossible, such as severe infection or delayed consultation with surgeons, where the amputated finger is not preserved as per the recommended protocol, and accidental loss of the finger cannot be tracked. [9]

Ware suggests that persons who have had a finger or thumb amputated often begin rehabilitation immediately after surgery. Although there are various ways to medically and surgically manage digital amputations, the goals of rehabilitation remain the same: preserve the functional length, preserve useful sensitivity, prevent symptomatic neuromas, prevent adjacent joint contractures, achieve short-duration morbidity, and enable the patient to perform daily tasks as quickly as possible. [10]

The psychological impact of a high-quality prosthesis has received little attention. A high-quality cosmetic effect can be achieved using modern materials, enhanced fabrication methods, and attention to detail [11]. Customized silicone prostheses are widely accepted due to their better comfort, durability, and stain resistance compared to any other existing extraoral maxillofacial materials [12]. In this case, a silicone elastomer was chosen due to its superior aesthetics, flexibility, elasticity, and lifelike look. It enhances the moisture of the skin's stratum corneum [13].

Medical grade silicone, often known as grade II, is the most commonly utilized for the construction of maxillofacial prostheses. Due to the expensive expense of silicone materials, prosthodontists may propose acrylic prosthesis for finger prostheses for low-income patients. [14] Colors for specific extrinsic skin hues are acrylic-based paints combined with monomer or chloroform-based solvents. Intrinsic stains often utilized include rayon flocking or fibres, dry earth pigments, and more [9].

Recent improvements have allowed modern prosthetic hands to closely resemble the original limb in both form and function. Despite being lauded as a triumph of engineering expertise, the bionic hand is still an inferior replacement for the real thing, and as a result, there are a number of obstacles to its adoption among the upper limb amputee population. These impede the prosthetic hand from accomplishing the ultimate goal of any prosthesis: 100% acceptance by its users [15]. Cabibihan has successfully worked on manufacturing described fingers that can reproduce their function utilizing patients' Computer Tomography (CT) data remotely. However, due to its high cost, the use of this technique to create hands or fingers remains limited [16].

Conclusion

For the vast majority of patients, a severed finger's physical glance is more important than its usefulness. With advances in talent, technology, and material availability, rehabilitating a severed finger is no longer visibly challenging. When fabricated with immense care, they can be made life- like. A well-made, aesthetically appealing prosthesis can help patients get psychological support.

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