Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Silicone finger prosthesis for a partially amputed index finger -A Case Report

Dr.Asha Rathod

Professor and PG Guide, Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry, Navi Mumbai

Dr. Maithile Hoskalle

Lecturer, Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry , Navi Mumbai

Dr.Ankita Chitnis

Lecturer, Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry , Navi Mumbai

Dr. Anoopa Nataraj

PG Student,Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry , Navi Mumbai

Dr. Vidhi Karia

PG Student, Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry , Navi Mumbai

Dr. Yash Gujar

PG Students , Department of Prosthodontics, D.Y. Patil Deemed to be University , School of Dentistry , Navi Mumbai

Abstract:

Finger and partial finger amputations are some of the most frequently encountered forms of partial hand loss. This renders an amputee incapable of leading a relatively normal life. Partial-finger amputations not only affect the function of the hand but also the psychology of patients. Amputation can be caused by traumatic injuries, congenital defects, or malformations. Patients will benefit aesthetically as well as functionally when a finger prosthesis is uniquely sculpted for each patient. Silicone finger prosthesis provides life-like natural appearance of the prosthesis, alleviating psychological problems and thus improving function and quality of life. This paper presents a case report of prosthetic rehabilitation of partially amputed index finger with custom made silicone prosthesis.

Key words: Partial finger amputation, Prosthetic finger, Silicone finger prosthesis

Introduction:

A finger is a type of digit, an organ of manipulation and sensation found in the hands of humans and other primates[1] Fingers enable us to interact with our environment and help in many day-to-day functions. The index finger, generally known as the forefinger is a great precision performer[2]. Amputation causes immediate loss of grasp, strength and security and absence of a finger may cause marked psychological trauma[3,4.]

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Finger and partial finger amputations are some of the most frequently encountered forms of partial hand loss. The most common causes of these amputations are trauma, congenital absence and malformations[5].

Currently, many injuries and traumatic amputations of fingers can be rehabilitated by microsurgery through re-implantations. However, in a few patients, surgical reconstruction is contraindicated or unaffordable. In such situations prosthetic rehabilitation with aesthetic silicone finger prosthesis is considered as an alternative.

The fabrication of a prosthesis is as much an art as it is a science. Prosthesis form, coloration and texture must be as indiscernible as possible from the surrounding natural tissues. The ideally constructed prosthesis must duplicate the missing parts so precisely that the casual observer notices nothing that would draw attention to the prosthetic reconstruction. Rehabilitation efforts can only be successful when the patient can appear in public without fear of attracting unwanted attention[6]. The construction of a prosthesis consists of six stages and each requires extraordinary attention to detail: (i) Impression and working cast, (ii) sculpturing and formation of the pattern, (iii) mould fabrication, (iv) stump fabrication, (v) processing of the prosthesis material with intrinsic and extrinsic coloration[6]. This paper presents the prosthetic rehabilitation of a partially amputated index finger with a custom-made prosthesis fabricated using silicone elastomers, which provides adequate function, is comfortable to use and aesthetically acceptable to the patient.

Case report:

A 65-year-old female patient reported to the department of Prosthodontics at D Y Patil University, School of Dentistry, Navi Mumbai with a chief complaint of partially missing index finger of her right hand due to a traumatic injury. The amputation was partial involving the junction of 2nd and 3rd phalange (Fig. 1). The wound was completely healed and the surrounding skin showed no signs of inflammation and infection. The patient had no history of previous prosthesis. After thorough diagnosis it was decided to fabricate a silicone finger prosthesis. An informed consent was obtained from the patient for the fabrication of the prosthesis under ethical standards and the patient was informed about the limitations of the prosthesis.

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Technique for fabrication of silicone finger prosthesis:

Impression making:

The patient was asked to thoroughly wash his hands under a plain antiseptic soap solution following which his hands were lubricated with a thin layer of petroleum jelly to prevent adherence of impression material to the skin and hair. An irreversible hydrocolloid impression material (Zhermack Tropicalgin) was used to make an impression of the amputated finger (Fig. 2) and the donor finger (Fig. 3). This technique also allows the hand to be removed from the impression with the fingers in flexion. The patient was instructed to keep the hand in the normal resting position without stretching while impression making.

Model preparation:

The impressions were poured with type III dental stone (Gold stone, Asian Chemical, Rajkot, Gujarat, India) and a positive replica was retrieved.

Wax pattern fabrication:

A putty (Zhermack Zetaplus Impression Material) index of the donor site finger was made from the positive replica into which molten modelling wax (Fig. 4) (Maark, Shiva Products, Mumbai, India) was poured and retrieved. The wax pattern was then hollowed from the inside by sculpting (Fig. 5). The wax pattern was then placed on the cast and modifications in sculpting were carried out to resemble the index finger of the other hand.

Stump model preparation:

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 prosthetic fit, the stump was reduced accurately by around 0.5–1 mm, so that silicone stretches and flexes over the stumps as prostheses were fit (Fig. 6 and 7).

Try-In:

The wax pattern was tried on the patient’s hand and the length and shape were verified (Fig. 8 and 9).

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Investment technique:

The wax pattern was invested in type III dental stone till the junction of dorsal and ventral surfaces making sure to apply a layer of separating medium between the two pours. Adequate keys and escape channels were prepared to ensure proper re-orientation and wax burnout respectively (Fig. 10). This mould facilitates easy packing of silicone and separate colour matching for dorsal and ventral surfaces. This mould was dewaxed by immersing in a boiling water bath (Fig. 11). After the mould was carefully opened separating medium was applied between the two pours before silicone packing.

Colour matching and packing:

The Silicone (Cosmesil HTV silicone with 10:1 ratio of part A and part B) and pigments were mixed intrinsically to match patient's skin. Colour matching of the dorsal and ventral surface was done separately in natural light (Fig. 12). After getting the desired shade the silicone material was packed into the mould and light pressure was applied to remove excess material. Curing was done as per manufacturer's instructions. After polymerization, the prosthesis was carefully retrieved from the mould (Fig. 13), extrinsic staining was done and the prosthesis was finished (Fig. 14). An acrylic nail was attached to the prosthesis with a cyanoacrylate adhesive.

Final prosthesis:

A wide ring over the margin of a finger prosthesis ending at the metacarpal-phalangeal joint was placed using a cyanoacrylate adhesive to disguise the junction line. This also helped in retention of the finger prosthesis. The final prosthesis was inserted on the residual stump and the fit and colour matching was evaluated (Fig. 15, 16, 17 and 18). The patient was demonstrated about the use and instructions were given about maintenance of the prosthesis.

Discussion:

With recent advances, severely injured and traumatically amputated digits can be saved by microsurgical replantation. When surgical intervention is contraindicated, unsuccessful or unavailable, prosthesis can provide and offer great psychological help[7]. A precisely fitting prosthesis can improve function by restoring normal length, providing opposition for the

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remaining digits, maintaining sensitivity through a thin lamina, protecting a sensitive stump, and transmitting pressure and position sense for activities such as writing or typing[8].

Over time various materials have been developed and used for fabricating finger prosthesis. Wood, leather, polyurethane and polyvinyl chloride have been used to produce aesthetic prosthesis, but silicone rubber has proved to be the most promising in achieving the desired lifelike effects[9]. The overall durability and stain resistance of silicone is far superior to any other material currently available for finger restorations. Almost all stains, including ballpoint ink, newsprint, clothing dyes, and food colourings can be removed easily with water and soap[10].

Leow et al studied optimal circumference reduction of finger models for a good prosthetic fit of a thimble-type prosthesis for distal finger amputations and found out that 5–7% circumference reduction in the finger was shown to be best among 1–3% and 8–9% of reduction[11].

Finger prostheses are generally retained by a vacuum effect on the stump[9] use medical grade adhesives[12] and placement of finger ring[12].

For the patient presented here, a full-length finger prosthesis ending at the metacarpal-phalangeal joint were fabricated as the morphology and residual length was inadequate for gaining retention only by suction method. A wide ring was placed over the margin of a finger prosthesis ending at the metacarpal-phalangeal joint to aid in retention and to make the changing colour of the hand less noticeable.

Conclusion:

Finger and partial finger amputations are some of the most frequently encountered forms of partial hand loss. The loss of a single finger has a profound effect upon the amputee's body image, self-esteem, and psychological status. In these cases, the restoration of form and aesthetics becomes of utmost importance. When surgical reconstruction is contraindicated, unsuccessful, or unaffordable, a high-quality aesthetic prosthesis with passive function can assists the amputee's rehabilitation and return to society, socially as well as psychologically.

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ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Figures:

Fig.1 Pre op view of Stump

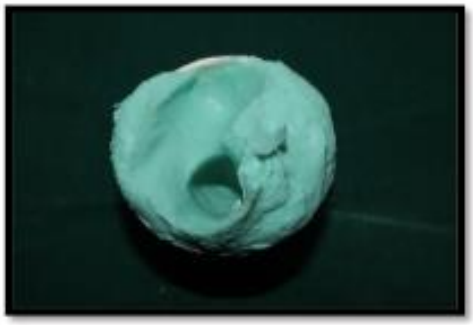

Fig. 2 Impression of stump

Fig. 3 Impression of donor finger

Fig. 4 Wax fill of impression

Fig. 5 Stump and wax donor finger

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

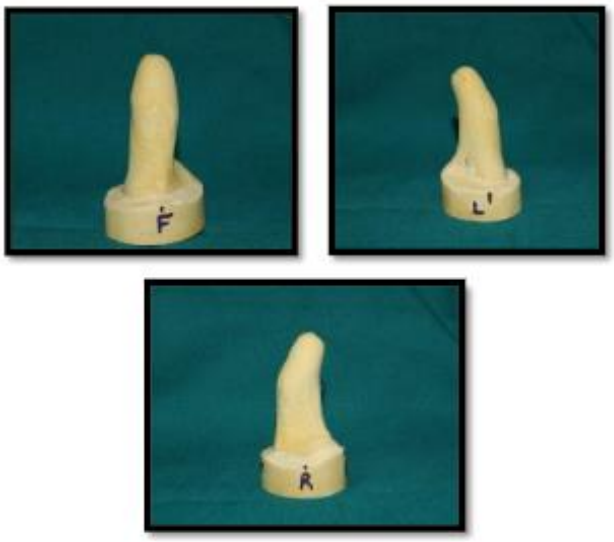

Fig. 6 Stump of affected finger

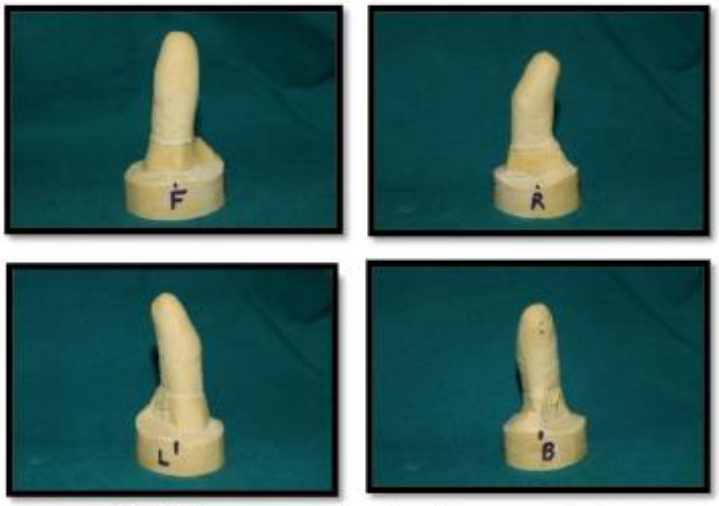

Fig. 7 Stump preparation for silicone prosthesis

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Fig. 8 Wax trial

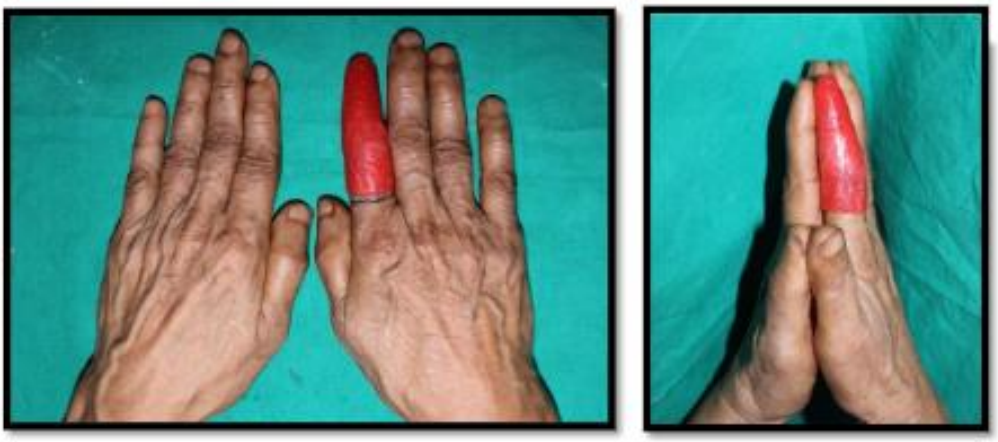

Fig. 9 Wax trial of prosthesis compared to contra lateral finger

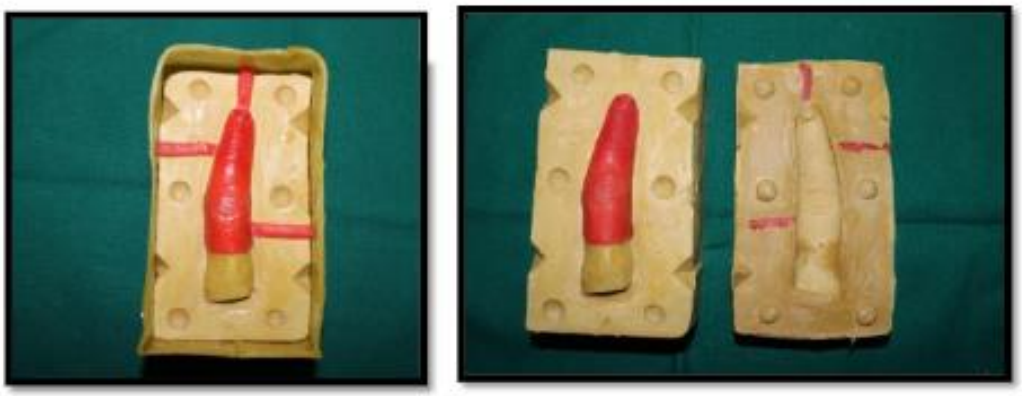

Fig. 10 Investing of wax pattern

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Fig. 11 Dewaxing

Fig. 12 Shade matching

Fig. 13 Silicone prosthesis after deflasking

Fig. 14 Silicone prosthesis on stump

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Fig. 15 Trial of silicone prosthesis

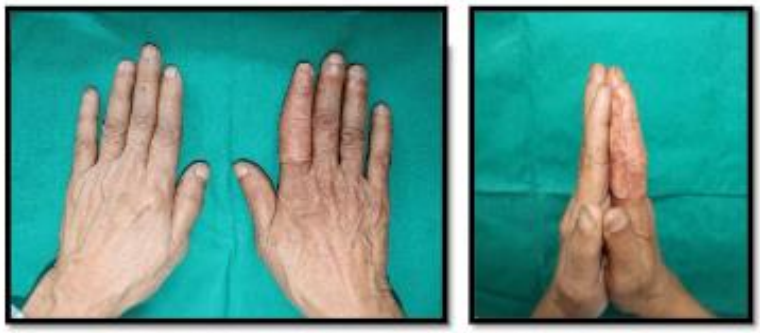

Fig. 16 Dimensions with respect to contralateral finger

Fig. 17 Silicone prosthesis after extrinsic staining

ISSN: 0975-3583, 0976-2833 VOL12, ISSUE04, 2021

Fig. 18 Finger prosthesis with respect to contra lateral finger

Fig. 19 Pre and Post Op Results