Comprehensive Rehabilitation of Partially Amputated Index Finger with Silicone Prosthesis: A Case Report with 3 years of Follow Up

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Go to:

Abstract

The loss of all or part of a finger following traumatic amputation may have a negative impact on physical and psychological well-being. An esthetic prosthesis can offer psychological, functional, and rehabilitative advantages. One of the major problems associated with somato-prosthetic replacement of partially amputated finger is inadequate retention of the prosthesis. This may stem from the weight of the prosthesis, inadequate tissue support, and/or the particular area of the finger to be replaced. A number of means have been employed to enhance retention. Among the more common are adhesives, adhesive tape, magnets and implants. The purpose of this article is to describe a technique which eliminates the need for adhesive materials and utilizes copper wire to fabricate a finger ring as a primary means of retention. This technique can be utilized whenever the prosthesis encompasses more than 180° of the affected area. This clinical report presents a case of rehabilitation of a partially amputated index finger defect and describes a method of retention for the same with a copper ring.

Keywords: Finger prosthesis, Finger amputation, Silicone prosthesis

Go to:

Introduction

Extra-oral defects involving the ear, eye, nose and finger are routinely seen, amongst which finger amputation is one of the most frequently encountered forms of partial hand loss. Such malfunctions might be due to surgical excision for neoplastic disorders, congenital disorders such as amniotic band syndrome or traumatic injuries [1, 2]. The missing partial or complete finger has tremendous physical and emotional influence, and it may affect the social well-being of an individual. A high quality aesthetic prosthesis with passive function can be helpful to the patient. Although microsurgical reconstruction by re-implantation or transplantation can be attempted to restore function of many finger defects, it may not be possible in crush and severe injuries or financial constraints. Prosthetic rehabilitation as an alternative could be considered in these situations to restore the digit with a functional prosthesis with a matching form, color, and texture to enhance the patient's acceptance and confidence in the society [3, 4].

The ideally constructed finger prosthesis must meet the following preconditions: the prosthesis must assist in grip and absorbing and transferring forces to the hand; the prosthesis should look natural, allowing expression of gestures. This case report presents the use of copper wire to fabricate finger ring for the retention of finger prostheses. It offers a real alternative for the reconstruction of fingers in cases where other techniques are not applicable.

Go to:

Case Report

This report describes the case of a 21 years old female patient whose left hand index finger was partially lost, 3 years back as a result of occupational trauma. The patient had suffered a long period of psychological depression immediately after the injury. Post-surgery, the patient had also observed difficulty in holding large-sized objects. Medical history was non-contributory except she was taking anti-depressants for many years. Clinical examination of the affected hand revealed that remaining part of the index finger was approximately

20 mm in length (Figs. 1, ,2).2). There was no evidence of hard and soft tissue undercuts. The surrounding area appeared to be normal with no signs of any infection over the digit. After having informed consent from the patient, to ensure her willingness and co-operation the treatment was initiated.

Fig. 1
Partially amputated left index finger

Fig. 2
Dorsal view of the index finger

Before making impression, a thin layer of petroleum jelly was applied on patient's amputated finger and the adjacent area for preventing adherence of impression material to the skin and hair. An impression of the remaining stump was made using irreversible hydrocolloid (Alginate, Zelgan plus, Dentsply, India) mixed with 50 % more water than normal water in powder ratio to produce thin consistency leading to satisfactory and optimum impression without any undue pressure over the tissue bed. The patient was instructed to keep the hand in the normal resting position without stretching. When the material was set the impression was retrieved. The impression was poured in type-III gypsum product (Kalstone, Kalabhai, Mumbai: India). At the same appointment another impression was made of patient's right hand index finger in a combination of light body and putty (Express, 3MESPE, India) and wax was poured in the negative mould for duplication of the lost finger. The wax pattern was then adjusted by sculpting and adapted on the working cast. The pattern was then tried on the stump and checked for the approximate length, angulation and shape at all aspects of the index finger.

A copper wire was adapted on the working cast out of which one end of the wire was modified in the shape of the finger ring while the other end was inserted into the wax pattern to ensure the sufficient retention (Fig. 3). Test of retention and stability between the wax pattern and finger was performed during the try-in procedure. At the same time nail bed was prepared in the wax pattern and an appropriate size and shade of the pre-fabricated artificial acrylic finger nail (Konad, Sravi Enterprises) was selected for the prosthesis to look more versatile (Diagram 1a). Beneath the cuticle margin an undercut was created to retain the acrylic resin nail within the prosthesis. Finally the anatomic lines were also incorporated to improve aesthetics.

Fig. 3
Wax pattern with copper wire

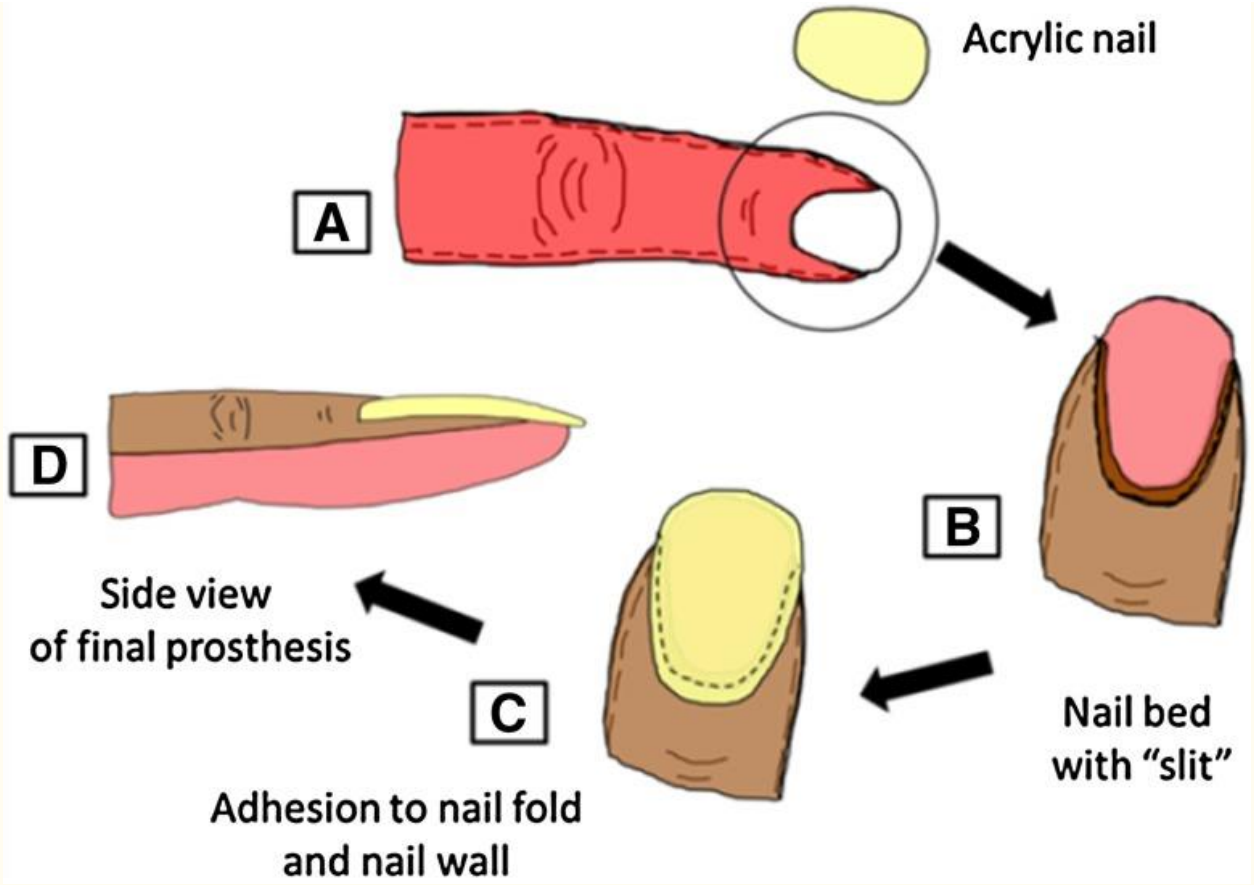

Diagram 1

a Selection of appropriate size artificial acrylic nail; **b** a "slit" is made at nail bed for nail fixation; **c** acrylic nail adhered to the "nail fold" and "nail wall"; **d** final prosthesis

After achieving the satisfactory results, the pattern was flasked. The first pour was done until the junction of dorsal and ventral surface. Separating medium was applied and a second pour was done to cover the entire wax pattern so that dorsal and ventral halves of the finger was obtained in separate flask parts to achieve better characterization with different shades of silicone. It also eliminated the formation of unsightly voids in the prosthesis commonly seen while using silicone, as it is more viscous and does not flow easily into inaccessible areas. Dewaxing was carried out routinely and the flask was allowed to cool. Medical grade silicone RTV (Multisil-Epithetik, Bredent, Germany) was dispensed in a ratio of 1:1 for base and catalyst paste and thickener (Multisil-Epithetik thickener, Bredent, Germany) was added to thicken the material and to reduce the problem of air entrapment. The base color of the prosthesis was matched with the ventral and dorsal surface of the hand and

pigments (powdered stains of different colors—red, brown, yellow, black, and white) were mixed intrinsically to match the patient's skin to achieve required shade. The shade matching was carried out in natural light between 11:00 a.m. and 1:00 p.m. The base shade selected was lighter than the highest skin tone of the patient since prosthesis darkens with color. Color matching of the dorsal and ventral surface was done separately. Silicone was layered into the mould and both the materials were packed simultaneously. The moulds were closed with light pressure applied to remove excess material. Silicone was processed at room temperature and allowed to bench cure for overnight.

Once the final prosthesis was retrieved, the flash was trimmed using a sharp blade and final finishing was accomplished using a silicone burs (Fig. 4). A slit was made along the crease on the nail bed area, where artificial acrylic nail is to be inserted (Diagram 1b). The acrylic nail was larger than the nail bed by 2 mm proximally (edge-to edge), reducing on the lateral borders to matching the size distally. The excess nail portion was inserted into the slit. After the size and position of the acrylic nail was established, the acrylic nail was un-mounted and the nail bed area was cleaned with high pressure air to remove the debris. The nail bed was treated with primer (Multisil-Primer, Bredent, Germany) as per the manufacturer's guidelines to enhance the optimal bonding between silicone prosthesis and artificial acrylic nail (Diagram 1c, d). Cyanoacrylate adhesive (Nail Glue, Hunan Magic Power Industrial Co. Ltd.) was applied on the undersurface of the nail and it was positioned such that the edges of the nail were fit inside the "slit" made along the crease of nail bed area to achieve adequate mechanical retention (Figs. 5, ,6).6). Nail polish was applied to make the prosthesis more esthetic. The prostheses was inserted into the patient's amputated index finger and evaluated for fit [5, 6]. Instructions for home care were given to the patient, including the debridement of the skin and cleaning of the removable prostheses. After 3 months, further clinical reviews were performed and no complications were found. The skin was healthy and the retention of the finger attachment was unchanged (Figs. 7, ,8).8). The dynamic ability of the stump was determined for some basic functions as restoring normal length, providing opposition for the remaining digits,

protecting a sensitive stump, and transmitting pressure and position sense for activities such as writing or typing [7, 8].

Fig. 4
Ventral surface of index finger

Fig. 5
Pre-fabricated finger nails

Fig. 6
Dorsal surface of index finger with artificial nail

Fig. 7
Patient with artificial index finger

Fig. 8
Dorsal surface of the hand with prosthesis

Go to:

Discussion

Fingers as organs of manipulation have an important role in function and aesthetics. Moreover, for the majority of patients, the loss of the finger can lead to psychological problems. The success of a finger prosthetic restoration primarily depends on its retention. The most common methods of retaining a digital prosthesis are by vacuum effect on the stump, use of a ring at the junction of prosthesis and stump, and the use of osseointegrated implants with customized attachments [9–11]. In this case report, retention of the prosthesis was achieved by a vacuum effect on the stump associated to a mechanical adaptation with adequate shape to provide enough stability and a finger ring made of copper wire and attached to the prosthesis. The patient could reproduce the movements of the stump with success without displacement of the prosthesis. The patient was highly appreciative of the social acceptance after she started wearing the finger prosthesis. The prosthesis provided passive functionality such as counter-support when grasping objects. The natural appearance and customized color design meet the patient's desire for inconspicuousness. The vacuum effect keeps the prosthesis securely on the residual limb without annoying closures. Thin, tapered edges additionally improve wearer comfort. The prosthesis is also easy to clean with water and soap; made of material that is pleasant to wear and good fixation; prevents pressure sores, easy application and removal of the prosthesis and enhance counter-support for existing fingers and improved gripping function.

Go to:

Conclusion

Restoration of both form and function are essential requirements for the fabrication of finger prosthesis. The custom-made prosthesis is

esthetically acceptable, partially restores some degree of function, and is comfortable for patient resulting in psychological improvement with personality development. The patient was well satisfied with the prosthesis and was using it regularly.