

Prosthetic Rehabilitation of Amputated Thumb: A Simplified Approach

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Abstract This case report presents a case of prosthetic rehabilitation of an amputated thumb. It emphasizes that prosthetic replacement is a better option for aesthetic and psychological improvement, particularly in cases where the victim is unwilling to undergo complicated surgical procedures for reconstruction of thumb or where functioning of thumb cannot be restored even by multiple surgeries. In the present case, a 20 years old female patient, with missing thumb of her right hand was rehabilitated aesthetically by a non-invasive and cost effective prosthetic procedure by using heat temperature vulcanizing silicone material. The prosthesis (the thumb) was attached using medical adhesives. On 3 months recall appointment, no complications were observed. The prosthesis was in good shape and required no further intervention. The prosthetic thumb lacks the sensation of a normal or reconstructed thumb, although it does not require the multiple procedures of surgical reconstruction and the accompanying loss of time for rehabilitation and healing.

Keywords Adhesive · Amputation · Grip

Introduction

From a functional point of view, the thumb constitutes at least 50 % of the hand. The thumb is essential for precision and power grip. Loss of this necessary counter pressure to maintain a grip on objects diminishes power grip.

Missing thumb can be reconstructed surgically or through prosthetic approach. Most require multiple surgical procedures in order to achieve the desired end result. Because of this disadvantage, most of the thumb amputees tend to shy away from the tedious, time-consuming reconstructive surgical procedures and adapt themselves to live with their deformity and function.

Few articles cite the prosthetic rehabilitation following digit amputations [1–3] but recent literature has scanty references to prosthetic rehabilitation following thumb amputation. In this case report, we present a case of a female patient with thumb amputation who was successfully rehabilitated with highly cosmetic silicone thumb prosthesis.

Case Report

A 20 years old female patient was referred from Department of Surgery to the Department of Prosthodontics with the complaint of missing thumb of right hand soon after birth (Fig. 1). Her history revealed that her right thumb was amputated 1 week after birth due to gangrene resulting from infection due to blood transfusion through the vein over the right thumb when she was undergoing treatment for neonatal jaundice. She was depressed not due to her disability to perform certain tasks but due to aesthetic disfigurement of hand.

The physical examination and radiographs-antero-posterior and oblique views of right thumb region revealed that her right thumb was amputated through proximal phalanx (Fig. 2). The rehabilitation of her thumb was quite challenging due to site and level of amputation.

Both possible treatment options-surgical reconstruction and prosthetic rehabilitation were offered to the patient.

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Fig. 1 Pretreatment photograph showing amputated thumb of right hand



Fig. 2 a Antero-posterior view of amputated thumb. b Lateral oblique view of amputated thumb

The patient refused to undergo any surgical procedure, so, it was planned to fabricate thumb prosthesis for the patient.

Next area of concern was retention of the thumb prosthesis as residual thumb stump was not of sufficient length to aid in retention of glove like thumb prosthesis. For this, again two options were put forth. First option was implant retained thumb prosthesis [4–6] and second option was using adjunctive retentive modalities like Velcro or plastic strap or medical adhesives. The patient was unwilling for any surgery and as the mechanical devices such as Velcro strap were quite discernible, the patient agreed to use medical adhesives for retention of thumb prosthesis. Patient was informed about the procedure and her consent was obtained.

An impression of the right hand with remaining thumb stump was made using the irreversible hydrocolloid impression material (Alginate, Aramex Trading Co., Lucknow, India) and poured with Type-III dental stone

(Kalstone, Kalabhai Pvt. Ltd., Mumbai, India) to obtain the working cast (Fig. 3a). Another impression of patient's left thumb along with the index finger flexed slightly was made using the irreversible hydrocolloid material and molten modeling wax (Link dental modelling wax no. 2, MDM Corporation, Delhi, India) was poured into the impression to duplicate the lost thumb (Fig. 3b).

This wax pattern was then, adapted to the remaining thumb stump on the stone cast of patient's right hand with the borders merged with the area adjacent to the defect site (Fig. 4a). The anatomic lines and crease lines were accentuated to improve the esthetics and provide a more natural appearance. Then, the wax pattern was tried on the patient's thumb stump (Fig. 4b). The fit, emergence, orientation and borders of the pattern were evaluated along with shape and size of the pattern.

The pattern was then invested in flasks. Two piece moulds were made using type III dental stone. After dewaxing, the thumb stump was reduced by ~1 mm all around to provide snug-fit to the elastic silicone prosthesis. Tin foil substitute was applied on the dewaxed moulds.

Appropriate shades were chosen and the intrinsically pigmented colours were added to the mould according to the skin color of the patient. Colour matching of the palmer surface was done first as this tends to be lighter than the top surface. The base colour HTV silicone (Cosmesil, Cosmedica Ltd., Cardiff, UK) and further applications of localized swatch colour were applied for the best colour match possible. The moulds were closed and the curing process was performed according to the manufacturer's instructions (Fig. 5). After curing, the prostheses were removed gently and trimmed and finished.

The shade was evaluated and extrinsic coloring was done to match the exact color of the patient. Careful coloration is crucial for maximal patient acceptance as rehabilitation efforts can only be successful when the patient

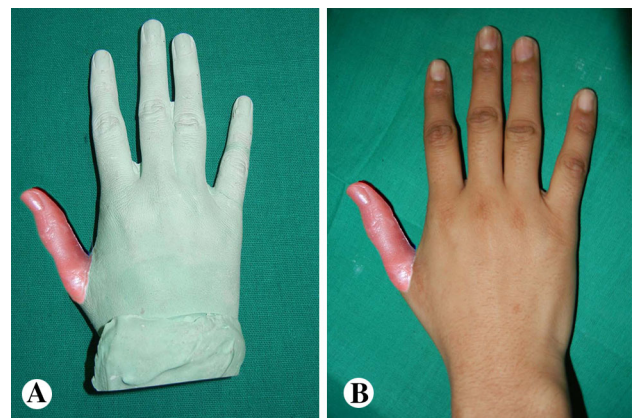


Fig. 3 a Stone model of right hand with remaining thumb stump. b Stone model of thumb of left hand

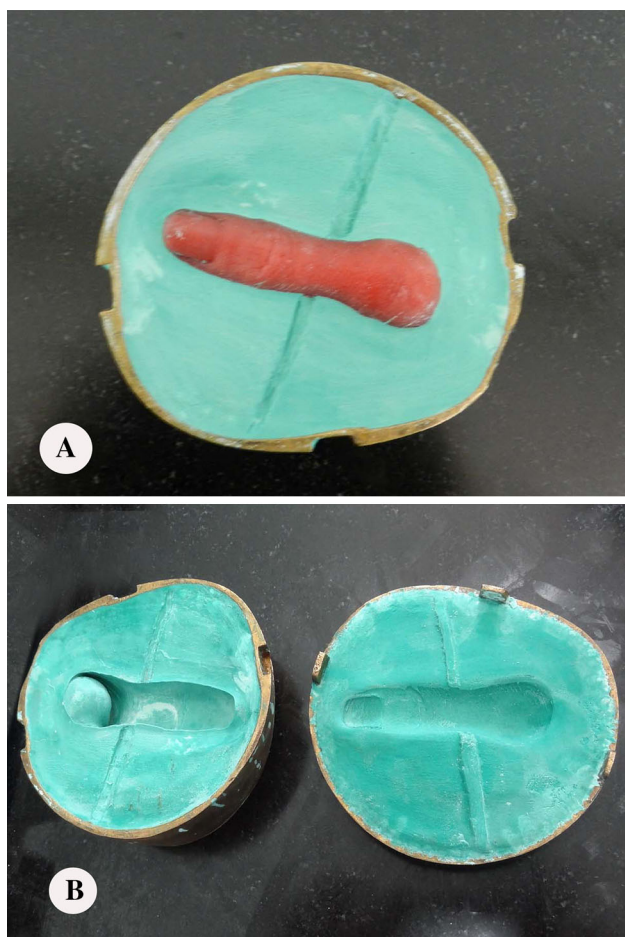


Fig. 4 a Stump model with wax pattern. b Wax pattern try-in



Fig. 5 Manipulation, colouration of HTV silicone material and packing into mould

can appear in public without fear of attracting unwanted attention [7].

The nail was fabricated, using transparent and pink self-polymerizing acrylic resin. To achieve an enhanced realistic appearance, the nail and nail bed were shaped with trimmer according to the nails of the natural fingers and it was placed into the nail bed. After making the necessary adjustments, the nail was attached to the prosthesis with a silicone sealant.

The prosthesis was inserted and retained with use of medical adhesive (Original Tacky Gel Adhesive Cartridge G511) supplied by the manufacturer along with silicone material and evaluated for fit, aesthetics, emergence as well as its emergence with the remaining stump (Fig. 6a, b). Instructions for home care were given to the patient, including the debridement of the skin and prosthesis maintenance. As the silicone material is susceptible to discoloration on exposure to UV rays and chemicals, so patient was advised not to expose it to excessive sunlight and strong chemicals. The patient was informed that the prosthesis may require replacement as the elastomer and its color additives undergo changes [8].

As the patient's thumb was amputated at the level of metacarpal, motion at this joint was not possible. With prosthetic thumb, patient was able to achieve opposition through carpo-metacarpal joint. The range of this motion was assessed by Kapandji's rule of 10 (1992) [9], for which patient was asked to touch the thumb tip to the ten specified areas of 4 fingers. Patient was able to touch all ten areas indicating total thumb opposition to fingers.

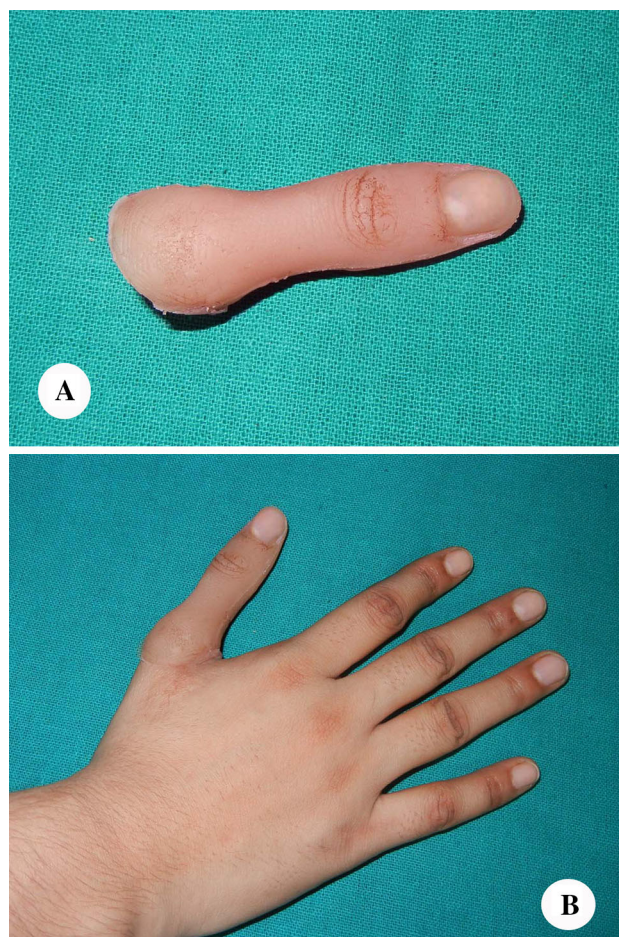


Fig. 6 a Thumb prosthesis. b Prosthesis in lieu of amputated thumb

Tip pinch grip score [10] which provide a good indication of thumb function was also measured. To measure grip strength, calibrated pinch gauge was used. The patient was instructed to place the thumb beneath the gauge with dial facing up and the pulp of the index finger on the top to form an O shape whilst the other fingers were flexed. Tip pinch grip score was found to be only 5 % as compared to the contra-lateral thumb.

Discussion

The traumatic amputation of thumb is a serious malformation, which brings considerable functional and esthetic disappointment. For majority of patients, the psychological impact of the amputation may seem disproportionate to the extent of the lesion. For these reasons, considerable attention has been dedicated to researching surgical and prosthetic solutions that give an acceptable cosmetic and functional result.

There is little doubt that the earlier the prosthesis is applied, the better are the results in terms of functional capacity and psychological adaptation [11]. The first objective of the prosthesis is to eliminate the psychological consequences of amputation. It should restore the appearance sufficiently close to normal to reduce the stigma associated with disfigurement.

The treatment outcome for each patient is dependent upon the level, extent and site of amputation, the expressed preference for either function or cosmesis and quality of treatment provided. In some cases, the particular nature of stumps resulting from phalangeal, thumb and hand amputations make them unsuitable for being fitted with a prosthesis by traditional methods, so alternative methods such as surgical reconstitution or implant retained prosthesis are required [12]. However, not all patients agree for surgical procedures, so for these amputees who would otherwise shun the more complicated and time-consuming surgical replacement procedures, prosthetic replacement has a definite edge as it is non-invasive, less expensive and more predictable than the surgical reconstruction.

Conclusions

Although the prosthetic pollicization lacks the sensation of a normal or reconstructed thumb, it does provide a myriad of functions unattainable with no thumb at all. It also fulfill the esthetic and psychological needs of amputees to look like everybody else, with two hands, and be able to use them in public without embarrassment.

Conflict of interest There are no conflict of interest to disclose.

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