

**Rehabilitation of an amputated finger using custom-made acrylic prosthesis: A clinical report**

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**Abstract**

Rehabilitation of complete/partial loss of one or more fingers due to traumatic amputation is of utmost importance to regain the patient's confidence by improving function and appearance. However, it presents as a complex scenario with several factors, such as, level of amputation, morphology of residual stump, patients' functional and esthetic expectations, their social and financial profile, dictating the course of treatment. A well-fitting prosthesis with adequate retention, ease of patient handling, and optimal esthetics can be effective in

rehabilitating these patients when microsurgical techniques are not feasible. This clinical report presents a simple technique to rehabilitate a partially amputated index finger defect using heat cure acrylic resin prosthesis with a wrought wire framework as the mode of retention to enhance the overall fit, comfort and eliminating the need for adhesives.

**Keywords:** amputation, finger prosthesis, finger amputation, partial finger amputation, acrylic resin prosthesis

## **Introduction**

Amputation, derived from Latin word 'Amputare', is defined as the intentional surgical removal of a limb or body part.<sup>1</sup> It is performed to remove diseased tissue or relieve pain<sup>1</sup> secondary to trauma (most common cause), metabolic diseases (diabetes mellitus), congenital anomalies, peripheral vascular diseases, burns, cancer etc.<sup>2</sup> Loss/deficiency of a limb or part of it can have a drastic influence on physical and psychological well-being of an individual<sup>3</sup> due to serious functional deficits and compromised esthetics.<sup>4</sup> Therefore, reconstruction of an amputated limb/finger plays an important role in restoring natural appearance, reducing functional damage by restoring normal length, providing opposition for the 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<sup>5,6</sup>, and returning the patient to normal life enhancing their overall well-being.

Advance surgical techniques, such as, microsurgical replantation or transplantation are now considered as the most effective method to replace a severely injured digit. In some patients, however, reconstruction is contraindicated or unsuccessful.<sup>7</sup> In such cases, prosthetic rehabilitation of the lost digit with a functional prosthesis can offer a suitable alternative.

Prosthetics is the art and science of supplying artificial replacements for missing parts of the human body.<sup>8</sup> Reconstruction depends on various factors like amount of tissue and bone involved, level of amputation, involvement of other fingers<sup>9</sup> and anatomy of the affected area.<sup>10</sup> An ideal prosthesis must be of high quality, both technically and aesthetically, should be biocompatible, life-like with realistic surface detailing, strong and stable with incorporation of characterization like fingernails.<sup>11</sup> Fixation of the prosthesis must be secure, comfortable,

and simple. It is also necessary to determine the patient's motivation for obtaining a prosthesis and whether he has a realistic understanding of the advantages and disadvantages.<sup>12</sup>

This case report describes a simple and cost-effective technique to fabricate a custom-made acrylic finger prosthesis using a wrought wire ring for retention.

## **Case Report**

A 26-year-old male patient was referred to the Department of Prosthodontics, with the chief complaint of a partially missing index finger of his left hand. He revealed a history of having lost a part of his index finger in a traumatic injury when he was 5 years old. On inspection, the defect was seen at the mid-level of the middle phalanx of the left index finger. Residual stump was light brown in colour measuring approximately 3cm. On physical examination, patient reported no pain on palpation and the surrounding skin showed no signs of inflammation or infection. Palpation revealed no bony undercuts or subcutaneous nodules. The patient had no history of a previous prosthesis.

The objective of the treatment was to replace the amputated digit with a firmly attached prosthesis which would restore the aesthetics as well as function and permit easy removal and replacement by the patient. Treatment options included implant supported fixed finger prosthesis and conventional removable finger prosthesis. The patient opted for the latter due to apprehension towards a surgical procedure. Conventional prosthesis can be fabricated using silicone rubber or polymethyl methacrylate resin material. The patient was explained the advantages and limitations of both materials, and polymethyl methacrylate acrylic resin was selected as the material of choice due to patient's affordability. As a part of protocol, an informed consent was taken from the patient before initiating the treatment to ensure his willingness and cooperation.

## **Procedure**

The patient's hand was lubricated with a thin layer of petroleum jelly to prevent adherence of the irreversible hydrocolloid impression material to the surgical site and the tissue surface. Following this, area around the index and middle finger was boxed. Alginate impression material (Coltoprint NCR) was mixed as per manufacturer's instructions and poured to completely cover the plantar and dorsal surfaces of both the fingers until adequate thickness was achieved. This was covered by moist gauze and quick-setting plaster to support the impression material. During the impression making procedure, the patient was instructed to keep the hand in normal relaxed state without stretching. An impression of the contralateral side was made in the similar manner. An additional impression of the contralateral index finger was made using addition silicone impression material to aid in fabrication of the wax pattern.

To create a positive replica of the amputated finger, the impressions were carefully poured with ADA type IV die stone (Kalrock Type IV Stone). The models were retrieved and analysed for any voids or discrepancies.

Modelling wax was melted and poured into the negative mold of the contralateral finger created using rubber-based impression material. The working wax pattern thus obtained was hollowed out from inside in order to reduce the weight of the prosthesis. It was carefully removed from the model to avoid distortion. When placed over the stump model, necessary modifications in thickness and anatomy were done. Surface characterization (like skin folds and wrinkles) was also incorporated by carving the wax using the contralateral model as a reference.

Wax pattern trial was done on the patient. The fit and alignment with respect to adjacent fingers were checked.

Shade matching was carried out under the natural daylight and the patient's approval and consent was gained regarding the same.

After satisfactory trial, stump was sectioned from the rest of the model using a die-saw. Final wax up was completed and the pattern was flaked using two pour technique, making sure to avoid undercuts for the counter flaking. The pattern was flaked to enhance the accuracy at the stage of shade matching such that the dorsal and the ventral aspects of the finger were separable. Separating medium was applied between the two pours. Dewaxing was done and a mold was obtained.

The finger stump was carefully separated without breaking the mold and separating media was applied into mold and on prepared stump. A retentive framework comprising of a ring fabricated using 0.6mm wrought stainless steel wire with a looped extension that ran along the length of the finger from the ring was added at this stage. This metal frame ring assembly was used as an auxiliary retention aid. The heat cure acrylic resin (Trevalon clear acrylic resin) was mixed and pigments (M.P. Sai Enterprises) were added to match patient's skin colour on the dorsal and ventral portion of the finger. After getting the desired shade, the material was packed into the mold and pressure was applied to remove excess material. Following acrylization, deflasking was done, and the finger prosthesis was carefully retrieved from stump. The prosthesis was inspected for any surface irregularities and finishing and polishing procedure was completed.

To complete the prosthesis an appropriately sized artificial nail was used with proper shape, size and shade and was secured in place with the help of cold cure acrylic resin.

In the final step a snugly fitting resin prosthesis was placed on the patient's hand. The fit and shade of the finger prosthesis were evaluated. A stock ring was used to hide the prosthesis-hand junction. Patient was instructed

and demonstrated about the use and maintenance of the prosthesis. The patient was recalled after 1 week for check-up and was advised a half yearly recall appointment.

### **Discussion**

Partial-hand losses are mostly encountered as finger and partial-finger amputations. Although the impact is sometimes minimized, loss of even one finger produces significant functional deficiencies and marked psychological trauma with social dysfunction for the patient.<sup>13</sup> Allen's classification<sup>14</sup> describes the level of amputation for a digit. Type I injuries involve pulp only. Type II injuries involves injury to the pulp as well as nail bed. Type III injuries consist of distal phalangeal fracture with associated pulp and nail loss. Type IV injuries include the lunula, distal phalanx, pulp and nail loss.

Non-surgical rehabilitation of the amputated digit offers a viable treatment alternative in situations where microsurgery through re-implantation is not advisable<sup>15</sup> or not possible due to factors like financial issues, technical difficulties, non-feasibility or unavailability.<sup>3,7</sup> Prosthetic rehabilitation is may be challenging owing to the artificial feel of prosthesis and limited functional gain. Basic goals of prosthetic rehabilitation include preservation of the functional length, useful sensitivity, adjacent joint contractures, achieving short duration of morbidity and enabling the patient to perform tasks of daily life as quickly as possible.<sup>16</sup>

Several materials (wood, leather, polyurethane, polyvinyl chloride) have been used for the prosthetic replacement of a missing finger.<sup>9</sup> Acrylic resin and silicone elastomer are the most common materials used in fabricating the maxillofacial prosthesis. Although prosthesis fabricated using silicone elastomer provides a much higher acceptance rate<sup>17</sup> owing to more life-like prosthesis, resin materials are also widely used due to their numerous

advantages, such as, widespread availability, ease of natural shade replication, great strength, compatibility with adhesives, ease of repair and replacement and cost effectiveness.<sup>18</sup> In the current case the patient also preferred heat cure acrylic material.

A method of scoring the model, as described by Michael and Buckner<sup>19</sup>, to obtain a snugly fitted prosthesis utilises the compressibility of tissues on the residual stump. However, in this case, scoring was not utilized due to position of the defect resulting in minimally compressible tissues and bony prominence in the area.

The purpose of this case report is to describe a simpler technique to fabricate acrylic resin finger prosthesis restoring the shape and length of the finger. The ring-wire substructure ensured adequate retention and fit by means of mechanical interlocking of the resin in the loops. Several authors<sup>3,9,20</sup> followed similar techniques.

Prosthesis delivery and subsequent check-up appointments revealed that the patient was able to remove and replace the prosthesis comfortably. Due to the limited possibility of injuring the patient's fingers by damaged retention rings, strict instructions regarding orientation, insertion, removal and prosthesis care were given to the patient including removal of prosthesis at night and application of lubricant during while inserting the prosthesis.

### **Conclusion**

Rehabilitation of loss digit with a maxillofacial prosthesis presents as a challenging scenario to the clinician. In addition to restoring function and esthetics, such prosthesis often has a great positive psychological impact on the individual. If fabricated with care, it can be made into a life-like prosthesis which will be accepted both functionally and esthetically by the patient. The finger prosthesis with a wrought wire retentive substructure is a simple effective way of rehabilitating the lost digit. In

spite of display of the metallic ring on the index finger, the patient was highly satisfied with the prosthesis.

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Legend Figures

Images/Illustrations



Figure 1: Partially amputated left index finger

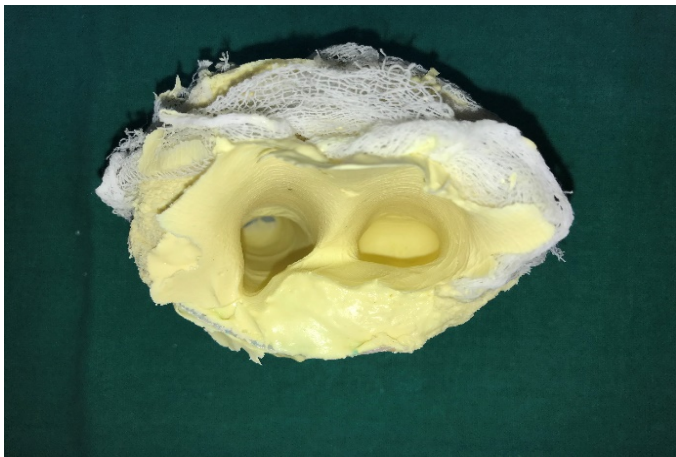


Figure 2: Impression of the affected area using Irreversible Impression Material



Figure 3: Working model of the residual stump (in Type IV Die Stone)



Figure 4: Wax pattern Fabrication using contralateral finger as guide



Figure 5: Final Prosthesis with wrought wire framework (before nail attachment)



Figure 6: Final Prosthesis