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ENHANCING FINGER PROSTHESIS STABILITY WITH TAILORED CAST RINGS-A CLINICAL CASE SERIES

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Abstract:

Background: Traditional suction or adhesive-retained finger prostheses often fail in cases of very short or irregularly shaped residual stumps, compromising retention, function, and patient satisfaction.

Aim: To present an innovative technique for retaining finger prostheses using custom-cast rings with integrated mesh, specifically designed to address retention challenges in patients with anatomically compromised finger stumps.

Methodology: This case series reports on the prosthetic rehabilitation of patients with missing fingers and short/irregular stumps using castable ring-retained prostheses. Castable rings with integrated mesh were fabricated to fit securely over the stump, incorporating inner and outer finish lines for optimal silicone merging. A flexible wax pattern was utilized to sculpt the prosthesis, followed by silicone processing. In cases with extremely short stumps, buddy rings were connected to adjacent fingers without impeding natural movement, enhancing retention. The castable ring design facilitated superior prosthesis retention, ease of insertion/removal, and prevented fraying of the silicone edges, thereby extending prosthesis longevity. The buddy ring adaptation enabled prosthetic use in minimal-stump scenarios while maintaining tissue compatibility and joint mobility.

Conclusion: Castable ring-retained prostheses offer a practical, durable, and patient-friendly alternative for restoring form and function in cases where conventional retention methods are unsuitable. This approach significantly improves prosthesis stability, aesthetics, and wearer comfort, especially in challenging anatomical conditions.

Key words: finger prosthesis, castable ring, short stump, mesh retention, silicone prosthesis, buddy ring, prosthetic rehabilitation, irregular finger amputation

Introduction

Congenital or trauma induced defects are commonly seen in the form or missing fingers/ toes. Rehabilitation of such defects by a prosthesis is not common in India due to unawareness amongst the general population, accessibility to treatment and cost of the treatment.

Surgical reconstruction of amputated digits is often not recommended for many patients due to potential postoperative complications and the

unpredictability of esthetic outcomes.[1,2] In these patients a passive prosthesis is advocated.[1] Passive finger prosthesis can be fabricated in acrylic or silicone material. Though acrylic has more durability as compared to silicone prosthesis made of silicone material has more lifelike appearance, function and feel.

Retention for silicone finger prosthesis can be achieved by positive fit of retention sleeves, using implants and adhesives.[3] Artificial jewellery like finger rings, wrist bands or bangles can be used to gain additional retention for the finger or hand prosthesis. They are also used to mask the seam/ junction between the prosthesis and the finger or hand. The most common problem encountered with finger rings is the difficulty to get the exact size which will fit the stump and the prosthesis. This happens because the stump is irregularly shaped most of the times with the terminal part of stump being broader than the base of finger. Hence a broader ring is required which will pass over the enlarged part of the stump but such a ring has a loose fit at the bottom part of the stump. This leads to the movement of prosthesis over the stump. Castable rings are a plausible solution for this wherein the ring can be customized to have a fit as close as possible to the irregularly shaped stump. In situations where no stump is present retention is achieved by either implants or adhesives or by using adjacent finger. Use of customized rings in such situations is extremely useful as not only do they provide retention, but can be designed in such a way as to provide support to silicone material too.

Clinical Report 1

A patient presented with index finger of the left hand amputated at proximal phalange of the left hand. The patient had lost her finger due to trauma. Though the patient was able to function with the partially amputated finger it was not esthetically pleasing. It was decided that a silicone finger prosthesis should be fabricated for the patient retained with a castable ring.

Impression and Model:

Two impressions of the fingers of the left hand along with the stump of the index finger were made using irreversible hydrocolloid (Tropicalgin – Zhermack) impression material. The patient was advised to keep fingers relaxed while the material set. Once the material set, the patient was asked to wriggle fingers a little and pull the hand out. A similar impression of the right hand was also made to help during modeling of the pattern of finger. The impressions were evaluated for any porosities or tears and dental

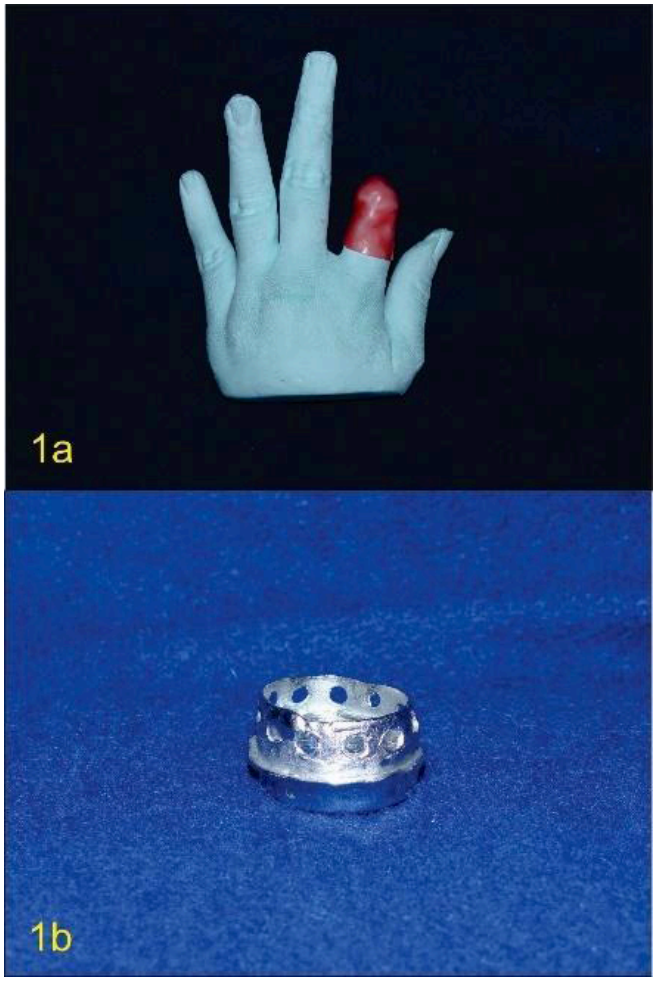

Figure 1-a: Spacer adapted for silicone material
Figure 1- b: Casted metal ring with extension

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stone (Kalstone – Kalabhai) was poured into the impressions of left and right hand to make models. The second left hand impression was poured in industrially available tin silicone (Tin Cure RTV Liquid Silicone Rubber – Asia Silicone Chemicals Co.) to make a flexible mold.

Making of custom made casted ring:

Outline was marked to decide the position of the ring. Trimming of the model in the outlined portion by 1mm was done with a tungsten carbide bur to ensure an active fit of the ring, hence rendering it more retentive. A single layer of baseplate wax was added on the stump, from above the upper border of the ring, to make space for the silicone material and achieve an internal finish line in the casting (Fig. 1a).

The stump with the wax was duplicated to make a refractory cast. Wax pattern was then fabricated on the refractory cast. Around 2 to 3 mm of width was kept for the ring and an extension of around 3 to 4 mm was given in the area where there was baseplate wax, for retention of the silicone material. Holes were made in the extension large enough for silicone to flow through. The pattern was then casted in chrome cobalt alloy, and finished (Fig. 1b). It was tried on the patient's finger to check for fit and comfort (Fig. 2a).

Making of Wax Pattern of the Finger:

The flexible model of stump was used to fabricate the silicone part of prosthesis as the ring would not fit on a rigid model since it was made on a smaller model. The casted ring was placed on the model and evaluated for the fit whether it was exactly same as that on patient's finger.

Base plate wax was used to make the pattern of the finger. The model of the other hand was used for guidance while carving the pattern to replicate the size, form and patterns of the finger. It was ensured that the wax flowed through the holes made in the ring. After trying the pattern on the patient's finger, it was relined from inside using fluid wax to record all the fine details of the stump (Fig. 2b). This helped to improve the adaptation of the prosthesis to the finger stump. The pattern was then processed.

Processing:

Dental stone was flowed in the pattern on the tissue side and allowed to set. The pattern along with the stone was then flasked in the conventional manner and dewaxed. The silicone material (Technovent Silicone Rubber) was then

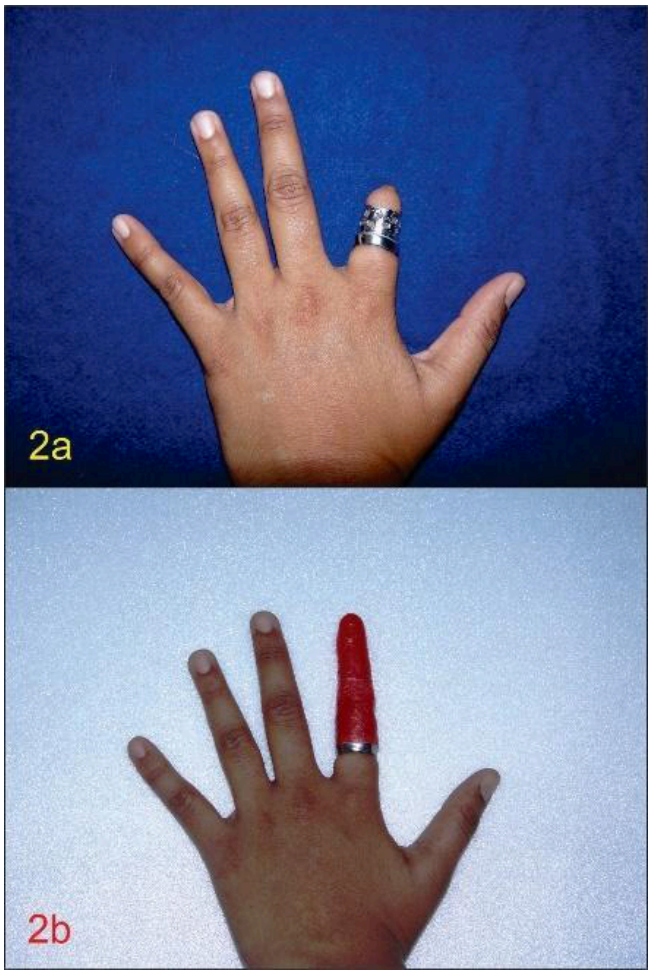

Figure 2 a: Try in of casted ring
b: Try in of waxed up prosthesis after relining with fluid wax

packed in the obtained mould. Intrinsic stains were used before packing to achieve a basic shade of the finger. The silicone was allowed to cure for 24 hours at room temperature.

Fabrication of artificial nail

After the wax pattern was completed and before it was processed the artificial nail was fabricated. The nail bed was carved in the wax pattern and a mould of the wax pattern was made in putty elastomer. A cast of the same was made on which a wax pattern of the nail was fabricated and finished. The wax pattern along with the cast was flasked and nail was fabricated using compression molded technique. Shade matching was done while mixing the heat cure resin at the time of packing. To replicate the colour of the nail tooth coloured, clear and pink acrylic was mixed in varying proportions. After processing the nail, it was finished and polished.

Finishing and Delivery:

On retrieval of the prosthesis, excess was trimmed with scissors and silicone trimming burs. The prosthesis was then tried on the patient. This was followed by extrinsic staining to improve the match of the shade with adjacent fingers. The extrinsic stains were sealed with a sealer. After the sealer hardened, the artificial nail was attached in the prepared nailbed using polyacrylate cement. The prosthesis was then delivered to the patient (Fig 3). The patient was given instructions about post insertion care of prosthesis.

Figure 3: Final prosthesis

Clinical report 2

A patient presented with almost completely amputed little finger of left hand. The patient had lost her finger to trauma which had also resulted in formation of scar tissue covering lateral side of hand. Due to the size and shape of the stump

Figure 4 a: Try in of ring made with pattern resin
b: Casted buddy rings
c: Casted buddy ring with acrylic substructure placed on flexible mould

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it was not possible to make a conventional silicone prosthesis taking support from stump or a castable ring supported prosthesis placed on the stump. It was therefore decided to take support from the adjacent ring finger by making a castable ring with extension for little finger prosthesis. Impressions were made as previously described.

Making of casted ring

After trimming of cast (to compensate for compressibility of tissues) resin pattern was adapted in the shape of a ring. This was then tried on the patient (Fig. 4a). The accurate fit of the resin ring confirmed that the cast was trimming was adequate.

Figure 5 a: Silicone prosthesis with artificial nail
b: Insertion of final prosthesis

This trimmed cast was then duplicated to make the refractory cast. On the refractory cast, wax pattern was made in the form of ring on ring finger. A slightly smaller ring (double/buddy ring) was fabricated on stump which was connected to the ring on adjacent finger. Metal extensions in the form of mesh were made on superior and inferior border of ring made on stump. Casting was done with cobalt chromium alloy (Fig. 4b). The finished and polished rings were tried on patient.

Fabrication of acrylic substructure

To reduce the weight of prosthesis, it was decided to make the prosthesis hollow by making an acrylic substructure. To determine the size of acrylic substructure, wax up of the little finger was done. After making putty index of the finger, the wax pattern was removed and pattern for substructure was made which engaged the superior mesh of the ring on the stump. This pattern was checked with putty index on finger to evaluate its position and size. It was then processed with clear heat cure acrylic resin. This substructure was kept hollow to reduce its weight (Fig. 4c).

Fabrication of wax pattern

The ring with acrylic substructure was placed on flexible model and wax pattern was fabricated. The pattern was processed and silicone prosthesis was fabricated as stated above (Fig. 5a).

The artificial nail was attached and prosthesis was given to the patient (Fig. 5b).

Discussion

The challenges faced while fabricating finger

prosthesis mainly pertains to retention of the prosthesis. The property of retention is as important as esthetics for finger prosthesis. Various techniques are used to ensure retention of prosthesis. In silicone prosthesis, vacuum is commonly used to retain prosthesis. Since silicone is an elastic material it can be stretched over the stump to create negative pressure. To ensure that the demarcation between the prosthesis and thumb is obliterated, the margin of the prosthesis is thinned. The repeated wear and removal cause this thin margin of prosthesis to fray and tear. Prolonged use of such silicone prosthesis which retain by suspension method may lead to atrophy of tissues[4]. In situations where short stump is tapering, suspension method cannot be effectively used.[5] Alternate methods of retention are adhesives for silicone prostheses. Adhesives are preferred over plain surfaces rather than curved surfaces like that of finger stump. Also placing prosthesis with adhesive is difficult as the thin margins may fold or distort while placement. It is important that the adhesive is thoroughly cleaned from the stump and prosthesis to maintain health of tissues. So adhesives are not preferred means of retention for finger prosthesis. Newer methods include suspension socket which create suction between stump and socket.[4,6] The inner diameter of socket is smaller than the stump which helps in creating the suction.[7] The socket is lined form outside with silicone material to attain the required the contour. Such type of suspension prostheses may cause soft tissue atrophy of the residuum after prolonged use.[7] Other method of achieving retention is the use of finger rings. The primary advantage of employing finger rings is that they help to obscure the junction between the prosthesis and the stump while maintaining tissue health, as retention is not solely dependent on suction. In cases where the prosthesis is slightly loose the ring helps in securing the prosthesis to the stump. Finger rings available locally can be used for the same. Challenge lies in finding a finger ring which will fit the stump since the stump is unlike the normal finger. The stumps are usually irregularly shaped especially due to irregular scar tissue formed post trauma.

Considering the above factors, in these patients we decided to use a ring to enhance the retention of the prosthesis while maintaining the health of the residuum. After the impressions were made and models were obtained the patients were asked to get a ring which would fit the stump. But the rings available in the market did not precisely fit the stump and were either loose or too tight to pass through the stump. Hence it was decided that a ring has to be casted which will fit the stump precisely. After the ring with extension was casted it was tried out on the patient. The extension was in the form of mesh all along the circumference of ring. Such extensions provide better support to silicone as compared to extensions made with wires and loops.[6] Proper fit was obtained by compressing the tissues sufficiently to get good retention. The casted ring had inner and outer finish line on the extension with holes in the extension. The finish lines ensured that silicone ends on a butt joint with ring giving a life like appearance. This also ensured uniform thickness of silicone at border which will prevent fraying of material at the border. The holes were made in the extension for mechanical interlocking of silicone with ring. To precisely duplicate the fit of the ring on finger stump a flexible model of the stump was made using industrial grade silicone. This not only allowed the ring to seat in the correct position but also gave the most true form and contour of the stump for fabricating the silicone prosthesis. (Though it is not possible to exactly duplicate the compressibility of stump). There are problems encountered with double/buddy rings like compromised stability of prosthesis with repeated flexion and extension of hand and fingers.[5] In this case the stump was too short to cause any hindrance to the stability of prosthesis. Artificial nail for the finger was fabricated using

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heat cure resin as mentioned before. Even though prefabricated nails are available it becomes difficult to match the colour with the remaining nails. The shape and contour of nail can be manipulated as desired which becomes difficult with prefabricated nails. The prosthesis requires six monthly recall check up to maintain the health of residuum and the prosthesis can be changed after 3-4 years depending upon the colour and flexibility of silicone.

Conclusion

Employing a castable ring for retention in finger prostheses provides multiple clinical and functional advantages. The primary advantage is the predictability of retention after the insertion of prosthesis. As the prosthesis does not depend on flexibility of silicone for retention, the amount of retention remains constant throughout its life. The common problem of frayed border of silicone prosthesis with use is eliminated as the silicone ends on ring rather than directly on tissue and the ring is easier to handle rather than silicone directly while placement and removal of prosthesis. The casted finger ring also maintains the health of residuum which is compromised in other methods of retention like the suspension socket. Considering all these points ring should be preferred means of retention for finger prosthesis when the stump is small or support from adjacent finger is required.

Conflict of Interest

The authors declare no conflict of interest. Written informed consent was obtained from the patients for publication of case details and clinical photographs.

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