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Implant Retained Silicone Finger Prosthesis With Customized Abutment And A Telescopic Attachment: A Case Report.

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Abstract:
Traumatic finger amputations are the most commonly encountered forms of partial hand loss. The prosthetic rehabilitation of an amputated finger is considered when micro-surgical reconstruction is contraindicated, unaffordable or failed. An aesthetic and functional prosthesis can offer distinct psychological and rehabilitative advantages to the patient. This article presents rehabilitation of a young male patient with amputated right ring finger by fabrication of an aesthetic silicone finger prosthesis retained by a dental implant, osseointegrated over a period of four months. The type of attachment was a custom designed ball abutment attached to a telescopic housing carrying an O-ring. An antirotation notch was incorporated to achieve stability. The prosthesis provided functionality such as counter support while writing and grasping objects. The aesthetic outcome and customized color met the patient's desire for inconspicuousness.

Keywords: *Abutment Design; Amputation; Dental Implant; Finger Prosthesis; Surgical Flap*

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I. Introduction

Fingers as organs of manipulation have an indispensable role in function and aesthetics. The wide range of hand movements and functions are apparent from its position, movements and actions. The active function of the hand is represented by its prehensile activities in grip, grasp and transferring, and absorbing forces. Hands also have an aesthetic impact as they can emphasize the beauty of a gesture or the grace of a movement.[1–3] Hands can be affected by an umpteen number of conditions such as congenital malformations and systemic diseases (diabetes mellitus), but traumatic amputations continue to be the most common cause leading to partial or total digit loss.[3–5] Amputation of finger causes devastating physical, psychosocial and economic damage to an individual. The feeling of physical impairment can bring apathy towards life due to the social stigma. Thus, the artificial substitutes play an immense role in making the patient more socially acceptable.[4,5] Many surgical and microsurgical replantation techniques are available and used to save severely injured and traumatically amputated fingers. However, such reconstructions are either contraindicated or unsuccessful. Hence, it is in this group of patients that an aesthetic and functional prosthesis can be of great help.[1]

Standard finger prosthesis is retained by a vacuum effect on the stump. Prosthetic replacement of the fingers can be satisfactory in patients who have at least 1.5cm of residual stump. However, patients performing more vigorous activities like swimming, knitting, gardening, cooking are often concerned about retention and fear of detachment leading to public embarrassment. As retention is the primary determinant factor in the success of prosthesis, osseointegrated digit prosthesis presents a viable and affirmative treatment modality to rehabilitate patients with finger amputations.[1,6]

The implant supported finger prosthesis is securely attached by means of an implant placed inside the intramedullary canal of residual bone, by a phenomenon known as “osseointegration” which is defined as a direct structural and functional connection between ordered , living bone and surface of a load carrying implant.[7] Osseointegrated extraoral implants are a reliable alternative in the management of orbital, ear, and nose defects and the success has revolutionized the field of implant supported maxillofacial prosthesis.[1,8]

Furthermore, the osseointegrated finger prosthesis provide some degree of tactile sensation and this special concept where osseointegrated fixtures identify tactile thresholds transmitted through their prostheses is well documented as “osseoperception”.[9,10] This clinical case report describes the fabrication of silicone finger prosthesis secured by using dental implants with customized abutments to rehabilitate a young male patient presented with a traumatic amputation of right ring finger. Also, the patient is a navy crew member

involved in various vigorous activities like swimming which makes the need for osseointegrated prosthesis even more desirable.

II. Clinical Report

A 25-year-old male patient presented with a traumatic amputation of his right ring finger, which he had lost in a road traffic accident 3 months before and desired rehabilitation of the same. The traumatic amputation was at the level of middle of intermediate phalanx along with moderate soft tissue loss (Figure 1). After removal of the gangrenous part, the underlying phalanx was exposed. It was covered using neurocutaneous Litler flap harvested from medial surface of middle finger. All the joints apart from one which is injured were tested for mobility, tendon repair and physiotherapy was undertaken before further procedures. Upon complete healing the affected hand was radiographically evaluated. As the length of the remaining stump was 15mm and the width of the inner cortex was 5mm an Implant retained finger prosthesis was planned (Figure 1).

Stage I surgical phase was done under complete aseptic protocol. After administering a wrist block, a local flap was raised, tissue dissection was done and a bone exposure of around 4mm was obtained from all sides. The initial osteotomy was begun with a pilot drill of 2mm followed by sequential drilling. Final osteotomy site was prepared using bone expander and special thumb screws (Figure 2). An intraoral implant (ADIN Dental Implant Systems Ltd, Touareg™-OS) of dimension 3.3mm x 10 mm was placed longitudinally into the medullary canal, cover screw was placed, the surgical site was sutured and surgical dressing was given.

Implant was left unloaded for four months to allow for osseointegration (Figure 3). At stage II, the healing cap was placed with a flapless procedure (Figure 4) and 3 week time was given for the formation of tissue collar around healing cap (Figure 4). A special tray was fabricated for an open tray impression procedure. Impression post was screwed onto the implant fixture (Figure 5) and impression was made using a double mix technique with light and medium bodied pol vinyl siloxane impression material (Aquasil, Dentsply, India). Once the material got polymerized the impression was carefully retrieved and laboratory analogue was attached (Figure 6). The impression was poured in ADA type IV dental stone (Elite Master, Zhermack) to produce the final cast.

Since the prefabricated ball attachments would have cause rotational effect thus putting the stability of finger prostheses into jeopardy, special customized attachments were designed to gain frictional fit as well as to achieve maximum stability. The technique of fabrication was similar to that used to fabricate implant superstructure and telescopic attachments. In the present case, plastic caps were used as wax patterns and cast using cobalt-chromium alloys. The male component in the attachment assembly was a customised ball attachment with an antirotation notch (Figure 7) whereas the female component is a telescopic attachment with an O-ring in its inner surface and multiple small beadings on the outer surface to achieve mechanical retention for the superstructure (Figure 7). The attachments were tried onto the implant fixture to check for precise fit and proper orientation similar to that in the cast. An acrylic superstructure was made onto the female component from autopolymerizing acrylic resin (Lucitone Fas-Por+ Liquid, Dentsply, International).

Impression was made of the unaffected contra lateral hand with irreversible hydrocolloid impression material (Neocolloid, Zhermack) and wax was poured into the moulds to obtain wax pattern. The wax pattern was tried onto the finger as well as on the cast. The, size, shape and contours were evaluated. The details of nail bed and joint knuckles were sculptured in the wax pattern. The nail was then made from autopolymerizing resin and extrinsic staining was done for better aesthetics. It was later trimmed, polished and checked onto the wax pattern. Wax pattern with the cast was then invested and stone mould was fabricated using the lost wax technique.

The acrylic resin superstructure was cleaned and silicone bonding primer was applied. The silicone material (RTV KIT, Factor II) was mixed in correct base and catalyst proportions and appropriate intrinsic colours were incorporated to simulate every detail and it was then layered onto the mould using brush of sequential sizes. The mould was filled with the mix, tightened gently and cured overnight for the polymerization to be completed. The finger prosthesis was then retrieved, trimmed and polished. The nail was attached with primer and the complete finger prostheses was tried and checked for proper fit and aesthetics (Figure 8 and 9). The function was evaluated for holding, writing and grasping positions. The prosthesis was functionally effective, aesthetically pleasing and satisfactory retention was also attained. Patient was instructed for proper home care use for the maintenance of the prosthesis. Upon review after one week, it was revealed that due to the vacuum fit of the prosthesis an anaerobic infection has developed. As a remedial measure Metrogyl ointment was prescribed. Appropriate post insertion instructions such as frequent prosthesis removal and lubrication were given to the patient, the issue resolved in a period of one week.

After 3 months of follow up the healing was found to be satisfactory and no tissue reaction was observed on the skin around the implant.

III. Discussion

According to Pilley M.J, when surgical reconstruction of lost finger is contraindicated, unsuccessful or unavailable, prosthesis can provide and offer great psychological help. A precisely fitting prosthesis can improve function 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 [1,2].

Retention in finger prosthesis is generally achieved by a vacuum effect on the stump, use of medical grade adhesives, and placement of finger ring. Recently, osseointegrated implants are used to retain the finger prostheses. In the suction- fitted prosthesis, the elastic and nonporous silicone rubber allows an airtight "cupping" of the residuum such that an incipient slippage of the prosthesis is immediately followed by an internal vacuum effect that checks further displacement.[1,11,12]

Buckner H et al, stated that the acceptance rate of individually sculpted custom-made silicone prosthesis has been much higher.**[13]** The artificial digit is made of a silicone elastomer .These silicones can be rendered to match the skin colour of the patient and give a more lifelike appearance. Most of silicones used for this purpose are Room Temperature Vulcanizing Silicones (RTV) as they offer chemical inertness, flexibility and elasticity.[14]

The implant retained finger prosthesis offers several benefits over conventional prosthesis such as better control over prosthesis, weightless feeling, no perspiration, pain and tissue breakdown from the socket, partial recovery of tactile sensation by transferring stimuli to the bone through implant because of direct pressure of implant on the bone and most importantly an enhanced retention giving psychological support to the patient. While the disadvantages of osseointegrated prosthesis are additional surgical procedure, relatively long rehabilitation period and a risk of anaerobic infection.[15] The psychological and functional effects of the prosthesis enhance rehabilitation by helping patients to adjust to their loss and by permitting more normal professional life.[2]

IV. Conclusion

With the ever-advancing technology and revolutionary innovations, the prosthetic rehabilitation of amputated finger has become successful over complex surgical procedures. This article presents a case report where a young male patient who presented with a traumatic amputation of right ring finger is rehabilitated with an implant retained silicone finger prosthesis with customised attachment. The prosthesis was very cost effective and offered satisfactory retention and stability with well healed peri-implant skin. It also restored near normal function and overall aesthetic appearance of the patient.

Protocol we put forward is:

1. Step 1: Wound debridement
2. Step 2: Neurocutaneous flap to improve sensation, tendon reconstruction and joint surgery followed by Physiotherapy.
3. Step 3: Implant placement
4. Step 4: Prosthetic phase
5. Step 5: Follow up

V. limitations

The primary limitation surfaced was the development of the anaerobic infection around the implant. Secondary limitation is that the protocol followed is on the pilot case only, but we intend to extend our study enrolling 20-25 patients with 2 year follow up.

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Figure Legends And Figures

Figure_1: Pre Operative View And Pre Operative Radiograph

Figure_2: Stage I Surgery – Implant Placement.

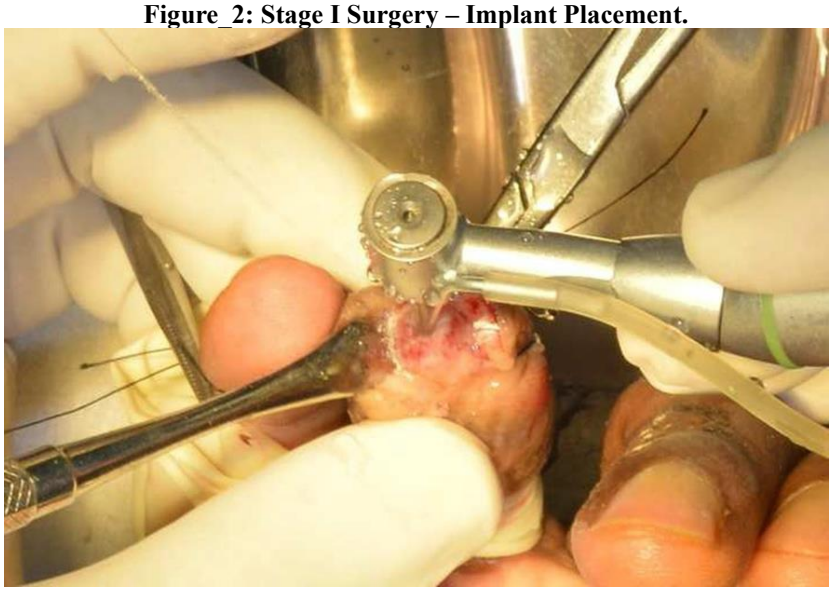

Figure_3: Post Operative Radiograph 4 Months After Surgery.

Figure_4: Stage Ii Surgery - Exposure Of Implant Head And Placement Of Healing Cap

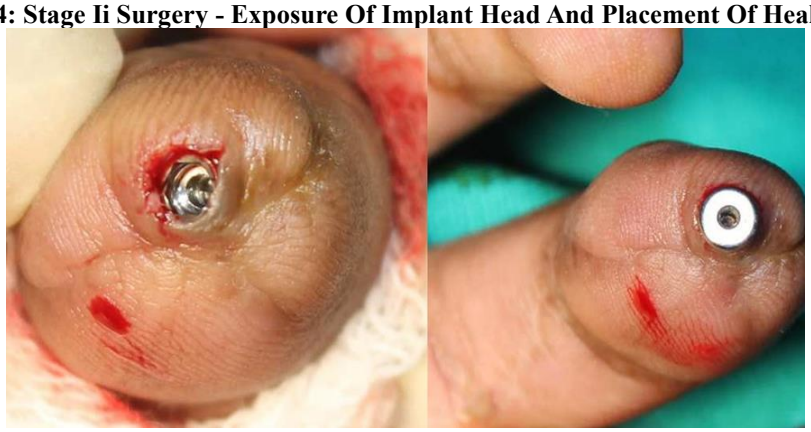

Figure_5: Open Tray Post Attached Onto The Implant Head.

Figure_6: Attachment Of Implant Analogue On The Impression.

Figure_7: Customized Ball Attachment With Antirotation Notch And Customized Retentive Attachment With Telescopic Coping.

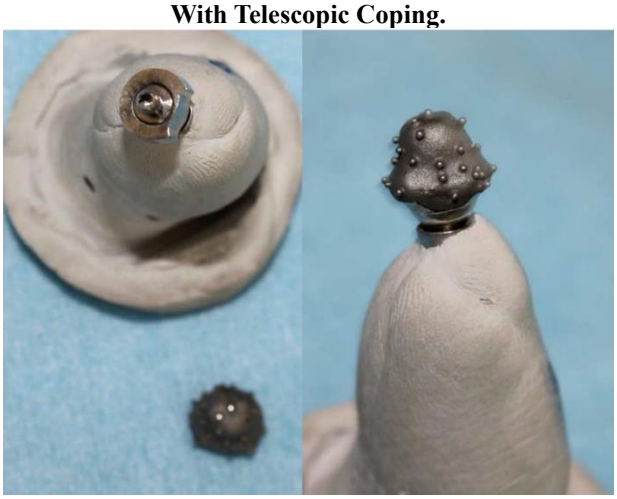

Figure_8: Finger Prosthesis In Position – Dorsal View

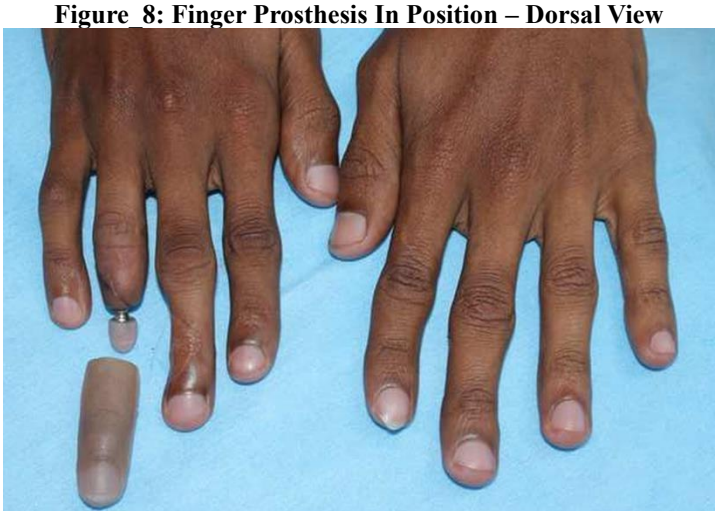

Figure_9: Finger Prosthesis In Position – Ventral View.