Case Report

Osseo integrated finger prosthesis with a custom abutment

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Abstract

One of the most regularly encountered forms of partial hand loss causing physical, psychosocial and financial burden to an individual is the finger amputation followed by trauma. The prosthetic rehabilitation of amputated finger is a good treatment option, when compared to all other means of complex and unaffordable options. Osseointegrated implant retained silicone finger prosthesis with innovative prosthetic designs can provide the patient a life changing experience.

Key Words: Finger prosthesis, implant retained, osseointegration

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INTRODUCTION

The loss of one or more fingers of the hand may occur as a result of trauma, disease or a congenital abnormality which causes functional deficiencies and social isolation for the individual. The incidences of such cases are high in industrialized countries, and due to road traffic accidents. In India, the occurrence of such cases is on the rise due to negligence in the use of personal protective measures among factory workers. The volume of residual tissue, the number of fingers involved and condition of the remaining bone have to be assessed when choosing appropriate treatment options. At present, there are several reconstructive techniques existing, starting from vacuum retained finger prosthesis and surgeries to transplant toe finger to the area of interest and the latest one being the bionic hand and fingers.[1,2] The above mentioned techniques are either uncomfortable or involves financial burden to the patient.

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A two-stage reconstruction aimed at fixation of thumb prosthesis to the first metacarpal bone through an osseointegrated titanium fixture was described by Lundborg *et al.* in 1996.[3] Since then the use of osseous-integrated implants and various designs of abutments have been used to anchor digital prosthesis. Many case reports with regular follow-up have concluded that this method is a suitable alternative for the replacement of an amputated finger/s.[4-6]

CASE REPORT

A 22-year-old male patient reported to the prosthodontic department with a defective right hand finger which was amputated in an industrial accident 3 years back. Since surgical reconstruction was not possible, the site was covered with a skin flap at that time and the healing was uneventful [Figure 1]. As the patient was a dental assistant, his job mainly involved the use of the right hand, especially

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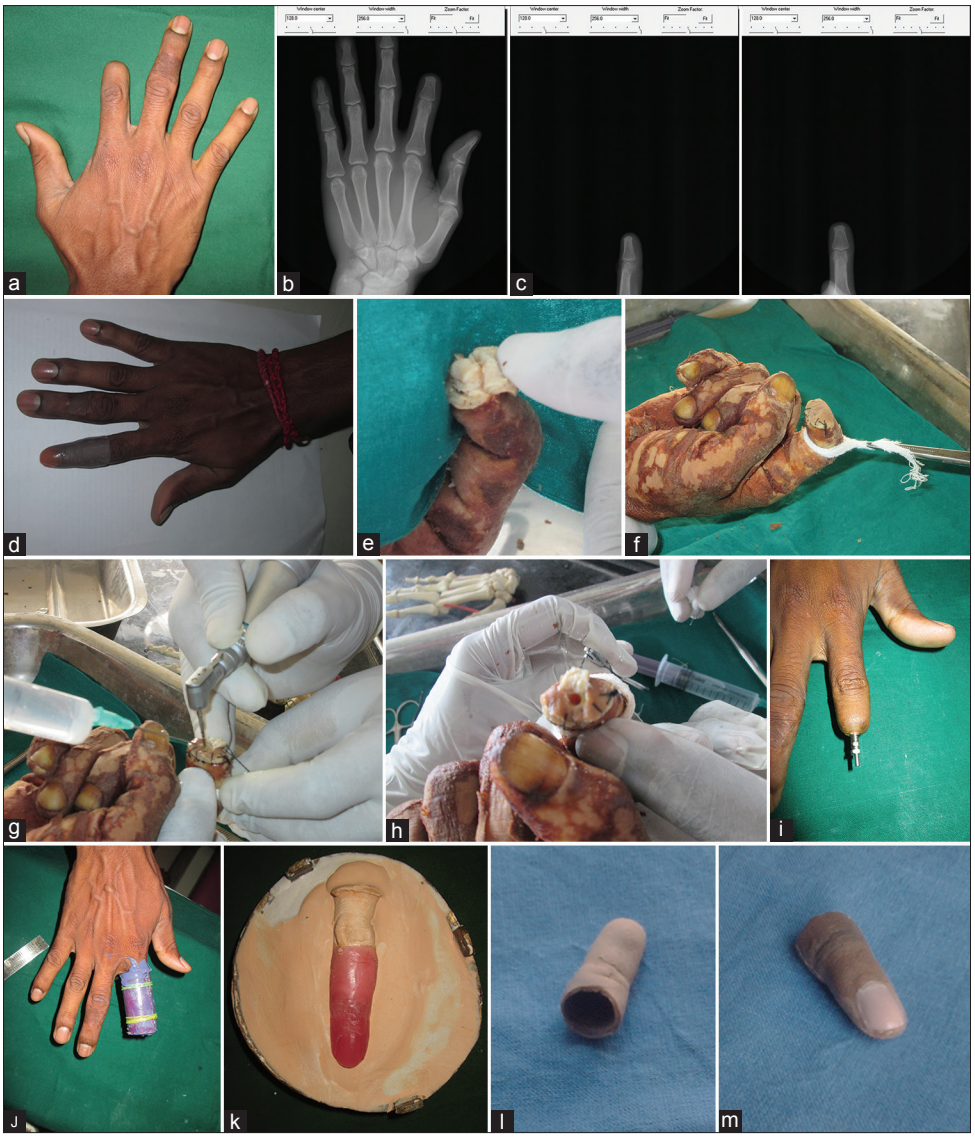

Figure 1: a) Preoperative image of right hand. b) Preoperative radiograph of right hand. c) Preoperative radiograph side and PA view. d) The acrylic prosthesis fabricated for patient. e) Cadavar study - creating the defect. f) Cadavar study -simulated defect. g) Cadavar study - osteotomy in progress. h) Cadavar study - completed osteotomy. i) Open tray transfer coping attached for impression. j) Custom impression tray made of plastic cylinder split in middle. k) Wax pattern invested in dental flask. l) Final prosthesis -intaglio surface. m) Final prosthesis -dorsal view

the index finger which was used for writing and handling dental materials and so wanted to rehabilitate the defect with a retentive prosthesis.

Physical examination of the hand showed that the patient's index finger was amputated at the level of the distal phalange, but the joint was preserved and functional.

Conventional acrylic resin finger prosthesis was fabricated for knowing the acceptance and adaptability level of the patient to an artificial prosthesis. The acceptance was satisfactory, but patient was disappointed with the poor retention of the same. Multiple treatment options were discussed with the patient and patient showed willingness toward the osseointegrated finger prosthesis fabrication.

A radiographic analysis of the residual finger was done, palmar, and lateral views were made to evaluate the skeleton's bone density and dimensions. Routine blood investigations were carried out. The case was discussed with relevant medical specialty surgeons and oral and maxillofacial surgeon.

Since the case was done for the first time by the surgeon and prosthodontist, a cadaver study was planned and carried out successfully.

An implant retained finger prosthesis was finalized and it was decided to be done using a two stage surgery technique which is considered as the standard protocol.[7,8] An informed consent was obtained from the patient. Prophylactic antibiotics were prescribed.

The surgical procedures were performed in the dental implant operatory of the department, under strict asepsis.

Routine presurgical scrubbing was carried out and the area was isolated. Then, the Right index finger's digital nerve was anaesthetized with 2% lignocaine without epinephrine and hemostasis was obtained using a tourniquet at 250 mmHg. The right hand was kept on a flat platform. Skin incision was made at the implant site and a skin flap was elevated. The osteotomy was started with a 2 mm pilot drill, the position and the angulation of the osteotomy was guided by radiovisiography (RVG) [Figure 2]. The bone density was observed as Type IV according to Lekholm and Zarb classification.[9] Sequential drilling was done to insert a 3.5 mm (diameter) × 11.5 mm (length) Adin Touareg dental implant (Afula, Israel). The osteotomy site was irrigated with copious amount of saline and betadine. The implant was manually inserted using a hand wrench with 30 N torque. A cover screw was placed and the flap was repositioned using nylon sutures [Figure 3]. RVG was taken from various angles to verify the position of the implant and a pressure dressing was given and was changed once in 3 days. The patient was also asked to care for the wound. The healing was uneventful and on the 10th day the sutures were removed. The superficial skin layer was found to be necrotized and the color of the skin had darkened, careful debridement was carried out and the issue was resolved.

At 5th month follow-up, the radiographs revealed a fine degree of osseous integration of the implant and the absence of infection and other complications.

A second stage surgery was planned after 5 months. The soft tissue covering the implant was measured and was found to be 5 mm, hence to obtain an ideal soft tissue cover the sub mucosal tissue was scooped out using a tissue curette. By reducing the distance between the implant platform and the prosthesis the leverage forces on the implant fixture can be reduced. The possibilities of secondary infections can also be controlled by limiting the excessive soft tissue thickness around the abutment.[10] A healing collar (3 mm) was attached to the implant and sutures were given [Figure 4]. The patient was recalled for the impression procedures after 2 weeks. The healing collar was replaced with an open tray impression coping. The impression was made using polyether impression material (Impregum, 3M, St. Paul, USA) by using a custom impression tray which was earlier fabricated using a cylindrical measuring jar. A cast was obtained with type 4 die stone with a soft tissue simulator at the collar region.

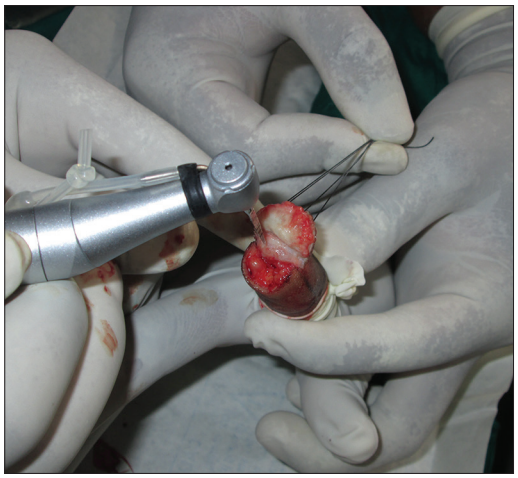

Figure 2: Flap elevated and osteotomy in progress

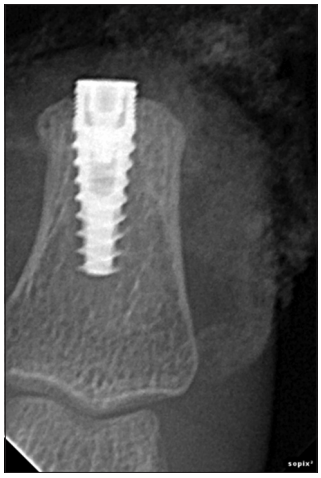

Figure 3: Postoperative radiograph of implant in position

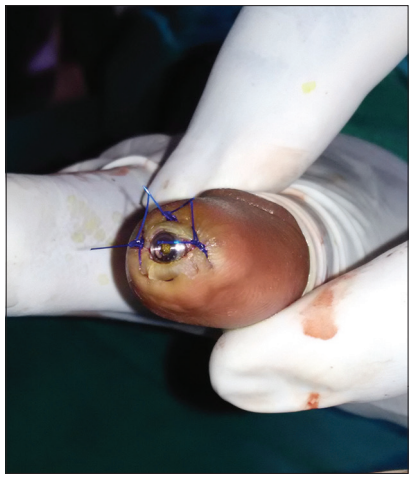

Figure 4: Healing collar attached after second stage surgery

The open tray transfer coping was modified to be used as a custom abutment. Self-cure clear acrylic was molded into a ribbed form along the sides of the coping converting it to a retentive abutment for the silicone prosthesis [Figure 5].

Figure 5: Custom abutment with retentive features on working model

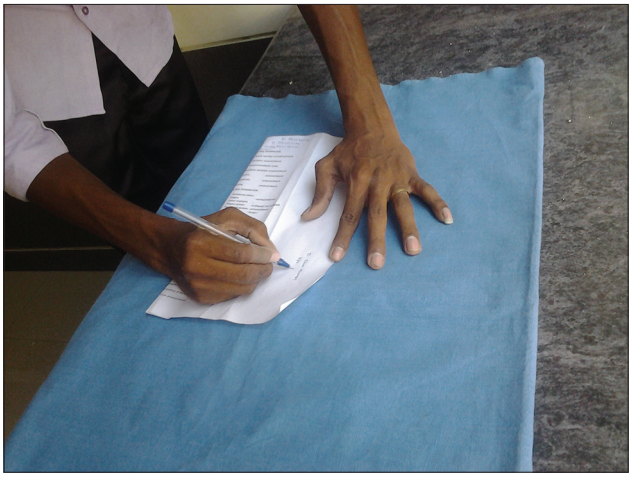

Figure 6: The osseointegrated finger prosthesis in function

A full anatomy index finger was sculpted using modeling wax and a wax trial was carried out to ensure the angulations and appearance was life-like. The pattern was invested in a dental flask and kept in a dewaxing unit to eliminate the wax. The mold space was then filled with medical grade silicone with intrinsic stains (M72 Full Prosthetics Starter Kit, Technovent Ltd., South Wales, UK) to simulate the exact color of the patient's skin. The silicone was cured at room temperature according to the manufacturer's instructions. An acrylic nail was fabricated using self-cure acrylic resin, by incorporating intrinsic stains. The nail was attached to the prosthesis using adhesive primer (G611 Platinum Primer-Technovent Ltd, South Wales, UK). The finished and polished prosthesis was gently pushed over the ribbed area of the custom abutment and it exhibited good retentive ability. The insertion and removal of the prosthesis was easy and patient was satisfied with the function of the prosthesis. The patient could hold a pen and write immediately after insertion [Figure 6]. Instructions were given on the maintenance of the prosthesis as well as the peri implant area.

Patient was asked to wash the area with Luke warm water and clean the area with a soft dental brush. Since the prosthesis is subjected to wear and tear, it has to be reviewed regularly and if needed to be refabricated. The mold was retained in the dental flask for further remaking.

Patient reported for review after 1 month and the site was examined in detail, no postoperative infections were observed and the bone loss was within the acceptable limits. The patient was able to do his day today work and social activities with confidence.

DISCUSSION

Surgical procedures required for finger reconstruction are often complex and unaffordable. The functional recovery of the missing finger may be achieved by various surgical means, regardless of its compromised esthetic results. The surgically reconstructed fingers are often in compromised shape and size with unpleasant patient acceptance. The osseointegrated implant retained finger prosthesis provides an aesthetic and cost effective treatment for the patient.

The two stage surgical procedure which is considered as the standard protocol offers better result as we can analyze the soft tissue thickness during the stage two surgery and modify it accordingly. The two-stage technique has low risk of infection with better soft tissue management. However, two-stage surgery needs multiple surgical procedures, periodic reviews, and delayed prosthesis delivery.[11]

In case of single stage surgery, there are disadvantages such as exposure of the healing collar after primary surgery and difficulties of caring during the healing phase, by the patient. As it is the finger, there can be forces which cannot be prevented from falling directly on the exposed healing collar or screw during the primary healing phase and as known, osseointergation needs an undisturbed environment.

A dental implant is not an ideal choice for an extra oral situation as the environment and the microorganism it deals with is totally different. To create a permanent skin seal at the implant-skin interface, it was hypothesized that a porous coated subdermal attachment incorporated onto an endo-prosthetic implant would prevent infection by

immediately gripping the skin tissue at the implant exit site, and subsequently providing scaffolding for skin ingrowth and attachment. This could establish a physiological barrier to bacteria.[12] An extra-oral implant with these features are under research and can be expected to arrive soon into the market.

The implant retained finger prosthesis allows a partial recovery of the osseo perception as a result of the transfer of tactile stimuli to inter-osseous nerves via the osseointegrated implant, which allows the patient to do highly precise activities like writing on paper with pen, typing on the mobile, holding or grabbing small objects.

CONCLUSION

Rehabilitation of defective finger by means of conventional and implant retained artificial prosthesis improves patient's confidence level to a great extent by improving the esthetic outcome. However, an implant retained prosthesis showed more retentive and functional outcome in addition to esthetics. Whenever the residual bone quality and quantity is satisfactory its preferred to proceed with an osseointegrated prosthesis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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