

# Use of Dental Implants to Retain Finger Prostheses: A Case Report

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## Abstract

Fingers as organs of manipulation have an important role in function and aesthetics. Moreover, for the majority of patients, the loss of the finger can lead to psychological problems. This case report presents the use of osseointegrated dental implants for the retention of finger prostheses. The possibility of using osseointegrated implant-retained prostheses offers a real alternative for the reconstruction of fingers in cases where other techniques are not applicable.

*Key Words: Finger Prosthesis, Dental Implant*

## Introduction

Absence of hands or fingers may be caused by congenital abnormalities, trauma or diseases. Whatever the reason, the complete or partial amputation of a finger causes functional deficiencies and aesthetic problems. Psychological problems may also be caused by the poor appearance after the loss of fingers [1,2].

The amount of tissue lost, the current condition of the bone, and involvement of the other fingers are some of the factors that have to be considered when choosing a suitable treatment option [1,3]. There are several microsurgical techniques for the reconstruction of amputated fingers [3]. In case of any contra-indications or failure of these surgical methods, an aesthetic finger prosthesis is an option for the restoration of the handicap [4]. Furthermore, the psychological trauma that such patients live with may be eliminated after the placement of prosthetic fingers. These prostheses can also improve function by restoring the normal shape and length of the finger, protecting the stump, and transferring sensations such as pressure [3].

Osseointegration biotechnology has revolutionised the retention of dental and maxillofacial prostheses, and the benefits of osseointegrated reconstruction have been well documented [3]. Osseointegrated dental implants have been used to retain prostheses and to avoid the problem of insta-

bility [2,5,6]. Osseointegrated implants provide firm retention for prostheses [4]. It is generally agreed that such retention is more secure than the retention obtained by using conventional glues or undercuts. Today, the use of bone-anchored implants for anchoring silicone prostheses provides an alternative technique to reconstruct lost or absent fingers [2,5-7]. An implant placed in the intramedullary canal of the residual bone of the amputated digit offers additional advantages, because the technique enables short stumps, where a traditional prosthesis is not successful, to be restored and provides for tactile sensation by transferring stimuli to the bone through implant [2].

Both dental implants and implants that are specifically designed for use in fingers are made of titanium with threaded surfaces but they may differ in design and insertion procedure. In the case report that follows, the replacement of two traumatically amputated digits using osseointegrated standard dental implant-retained prostheses is presented.

## Case Report

A 30-year-old male whose fourth and fifth fingers of his right hand were lost at the level of the distal interphalangeal joint as a result of an accident during carpentry presented to our clinic (*Figure 1*). Physical examination of the hand showed that the patient's second finger was also amputated at the

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distal phalanx in the same accident but the joint was preserved and functional. He gave no other relevant medical history.



**Figure 1.** Pre-operative appearance of the right hand. The fourth and fifth fingers were lost in an accident at the distal inter-phalangeal joint.

The patient stated that he did not want any treatment to his second finger. It was decided to use implant-retained prostheses for the restoration of the digits and a schedule for the treatment was planned. The lengths and widths of the dental implants were selected after a computerised tomography scan using a radiographic template.

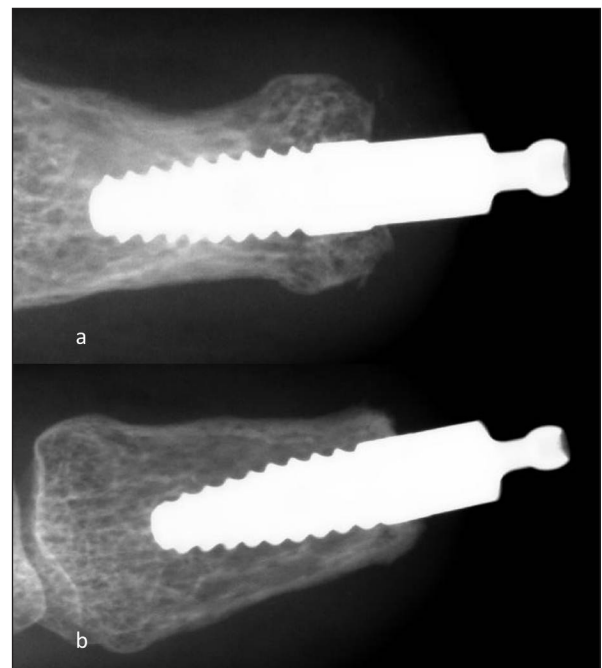
The first stage of the surgical procedure was to raise an ellipsoid flap on the stumps under local anaesthesia (digital block) and an ischemic tourniquet. The residual bone of the distal phalanges and the articular cartilage tissues of the joint were debrided. Drill holes were prepared longitudinally, in appropriate dimensions for the implants, in the medullar canals of the middle phalanges of both digits. Two dental implants (Laser-Lok collar with RBT body, internal hex; BioHorizons, Birmingham, AL, USA) with the dimensions of 4.6 mm x 12 mm and 3.8 mm x 10 mm were placed in the prepared holes in the middle phalanges of the fourth and fifth fingers, respectively (*Figure 2*). The first surgical procedure was finished when the flaps were sutured in place. Clinical and radiographic reviews were performed after three months. Radiographically, no evidence of infection or other complications were observed and an optimal degree of osseointegration was seen (*Figure 3*).

At the second surgical operation, the skin was reopened with an ellipsoid flap, cover screws on the implants were removed, and healing caps were attached to the implant fixtures. The flaps were

then sutured back into place. At the end of a 15-day healing period, impressions were taken using silicone impression material (Zetaplus; Zhermack SpA, Badia Polesine, Italy) after attaching impression caps (close tray) in place. Once the impression material had set, the impressions were carefully removed and implant analogues were attached to the impression caps that were removed from the fingers. Working casts were produced using Type-V dental stone (Die-Keen; Heraeus Kulzer, Armonk, NY, USA). The models were trimmed with a bur to have undersized sleeves so that the sleeves had a vacuum effect on the stumps.



**Figure 2.** Intra-operative appearance of the dental implants.



**Figure 3.** Radiographic images of the dental implants after three months of follow-up.  
(a) Fourth finger; (b) Fifth finger

Impressions of the same fingers of the other hand were made with an irreversible hydrocolloid impression material (Hydrogum Soft; Zhermack SpA) and wax was poured into the negative moulds to duplicate the lost fingers. The wax patterns were adapted on the stump cast with analogues and definitive ball attachments. The female parts of the ball attachments were embedded into the wax patterns. The patterns were then tried on the stumps and checked for the size and shape at all aspects of both fingers. Necessary modifications were made to the patterns for a better cosmetic result (*Figure 4*).



**Figure 4.** Photographs of wax prototype fingers.

The patterns were seated in flasks into which dental stone was poured. Markings were made on the casts to locate the stumps correctly and undercuts were formed to fix them. After making indices and applying separating medium to the moulds, the flasks were closed and underwent a de-waxing procedure.

Appropriate shades were chosen and the colours were added to the mould in the related areas. The base colour silicone and further applications of localised swatch colour were applied for the best colour match possible. The moulds were closed following this step and the curing process was performed according to the manufacturer's instructions. The prostheses were removed gently after the moulds had been opened and they were trimmed and finished.

Once the nails had been fabricated, using a transparent self-polymerising acrylic resin (Akribel; Atlas-Enta AS, Izmir, Turkey), on the casts of the nail beds, they were placed into the nail beds, which had previously been prepared on the

prostheses. After the necessary adjustments had been made, the nails were attached to the beds with a silicone sealant. The prostheses were inserted and evaluated for fit and aesthetics. Instructions for home care were given to the patient, including the debridement of the skin and cleaning of the removable prostheses with a soft toothbrush and soap under flowing warm water.

After three months, further clinical and radiographic reviews were performed and no complications were found. The skin was healthy and the retention of the attachments was unchanged. The patient said that he had not encountered any problems or unwanted detachments and he was happy with the results (*Figure 5*). A final follow-up session was carried out 13 months after the second surgical procedure and it was seen that the skin around the attachments was healthy, the prostheses were in good shape, and there was no need for any repairs.



**Figure 5.** Post-treatment view of replaced digits.

### Discussion

Loss of a finger has both functional and psychological consequences. Even if the stump is adequate for daily functions, poor appearance remains the main concern for the patient. Beasley (1987) has noted that individuals who keep their hands hidden inside pockets due to embarrassment over appearance are as functionally disabled as a forequarter (scapulothoracic) amputee [1,8].

Several reconstruction techniques have been described, such as toe-to-finger transfers, pollicisation, lengthening procedures and osteo-cutaneous flaps [2]. Reconstruction of an amputated finger



may be achieved by surgical procedures but despite good functional results, cosmetic outcomes may be unsatisfactory.

However, using a digital prosthesis fulfils all aesthetic requirements and provides some functional gains, as well as restoring grabbing movement for the patient and protecting the stump [9]. Traditional silicone digital prostheses have been used extensively for years but not without problems, such as weak retention, instability, and lack of sensibility [2]. Retention is the key factor for the success of a finger prosthesis. It can be improved by different methods including the use of rings at the restoration–skin junction and modification of the stump mould for a better vacuum effect [1]. More recently, bone anchoring has offered a better alternative.

As well as an excellent cosmetic result, osseointegrated implant-supported restorations provide several advantages, such as stable fixation of the prosthesis to the skeleton and restoration of some sensory feedback (osseoperception) [10]. The term “osseoperception” was suggested by Lundborg *et al.* (1997) [7] to describe the vibration and position sensations acquired with osseointegration of the implant. Rydevik *et al.* (2005) [11] proposed that this occurs as a result of the transfer of tactile stimuli to inter-osseous nerves via the osseointegrated implant and Enkling (2010) [12] reported that the “active tactile sensibility” of dental implants with antagonistic natural teeth is similar to that of teeth. Osseoperception is a finding that has been reported in all published papers on this subject and it was also observed in the current case.

Originally, the use of this osseointegrated implant technique was limited to a few very select cases. Lundborg *et al.* (1997) [7] suggested that for grip function and strength, a level comparable to the one measured for the uninjured hand was reached whereas Manurangsee *et al.* (2000) [5] reported that the strength level was almost half of the contra-lateral hand. In the studies of Manurangsee *et al.* (2000) [5] and Sierakowski *et al.* (2011) [9], patients scored highly in the Jebsen Hand Function Test, with results close to the contra-lateral hand. Sierakowski *et al.* (2011) [9] also reported that the three patients in their study experienced some kind

of pain, described as night pain, cold intolerance, or pain on activity, but this situation did not prevent them using the prostheses. Despite all these advantages and gains, the total experience with osseointegrated prostheses for amputated digits is still very limited [2-7,9]. The longest follow-up recorded in these papers is four years except for one case presented by Sierakowski *et al.* (2001) [9], which was for 13 years. Thus, at present, there is little evidence of possible long-term problems that a patient may encounter and of management issues such as the repair needs of the prostheses and the condition of implants and bone. Aydin *et al.* (2007) [3] reported the use of osseointegrated dental implants with custom-designed attachments for retention of digital prostheses. In the current case, standard dental implants and attachments were used and no customisation was performed.

So far, the patient uses his prosthesis during his day-to-day work and social activities without any problems and he is happy with the appearance.

### Conclusions

The use of osseointegrated dental implants to retain finger prostheses seems to be a viable method for restoring amputated fingers as it provides comfort, stability of function, and generally excellent cosmetic results.

### Contributions of each author

- AO designed the study, collected data, and wrote the paper.
- BS assisted in the literature review and took the photographs.
- CED contributed to the introduction and edited the paper.
- HAU wrote the paper and reviewed the manuscript.
- RE drafted the study and contributed to the conclusions.
- All authors read and approved the final manuscript.

### Statement of conflict of interest

The authors declare that there are no conflicts of interest

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