Short Communication

The Use of Dental Implants to Retain Thumb Prostheses: A Short-term Evaluation of 2 Cases

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This article presents the use of dental implants for the retention of thumb prostheses. Two patients with traumatic amputation of the thumb were rehabilitated with implant-supported digital prostheses. A dental implant was placed in the residual bone of the thumb. After a 3-month osseointegration period, retentive attachment and silicone prostheses were fabricated. Osseointegration of the implant, peri-implant skin health, and prosthesis function were assessed every 6 months. The follow-up period was 18 months for patient 1 and 21 months for patient 2. Osseointegration was achieved, and there were no skin problems. Some degree of tactile sensation was observed, and the patients were satisfied with the esthetic result. *Int J Prosthodont 2008;21:138–140.*

Traumatic amputation of the fingers results in a serious impairment of hand function and affects psychologic status.[1,2] Currently, many traumatically amputated digits can be saved by microsurgical replantation. In some cases, however, reconstruction is contraindicated or unsuccessful. In these cases, a socially acceptable prosthesis can restore both form and function of the hand. Standard digital prostheses are retained by a vacuum effect on the stump. Prosthetic replacement of the fingers can be satisfactory in patients who have at least 1.5 cm of residual stump.[3] The osseointegrated digital prosthesis is an alternative technique for patients with short stumps on which a standard digital prosthesis will not fit properly. The prosthesis attaches securely by means of an osseointegrated implant placed within the intramedullary canal of the residual bone of the amputated digit. Furthermore, the osseointegrated digital prosthesis can provide some tactile sensation. It is hypothesized that this phenomenon is based on the transfer of tactile stimuli from the digit to intraosseous nerves via the osseointegrated implant.[1,3]

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In the present study, dental implants were used in 2 cases of traumatic thumb amputation for retention of thumb prostheses.

Materials and Methods

Two patients with traumatic amputation of the thumb at the metacarpophalangeal joint level presented for treatment. Prior to surgery, the affected hand was evaluated radiographically. The surgery was performed according to the principles described for implant placement in the maxillofacial region.[4] In the first stage of surgery, an implant (Standard implants, Straumann) was placed longitudinally into the medullary canal of the first metacarpal bone (Fig 1a). The implant was left unloaded for 3 months to allow osseointegration. At stage 2, an abutment was attached to the implant. After a 2-week healing period, an impression was made of the abutment and stump using silicone impression material, and a master cast was fabricated.

Retentive attachment was custom designed on the implant analog and abutment to provide both retention by frictional forces and rigid support for the silicone finger prosthesis as described in a previous report (Fig 1b).[5] A plastic coping (no. 048.229, Straumann) for the burnout technique was used as a wax pattern for the attachment in the casting procedure. A flat surface was created on the cylindric attachment to provide stability against rotational forces. A coping was designed on the attachment to provide retention. The inner surface of the coping was closely adapted to the cylindric attachment. The outer surface of the coping had retentive elements for an acrylic resin substructure of

Fig 1a Radiographic appearance of an osseointegrated implant with custom-designed retentive attachment (case 1).

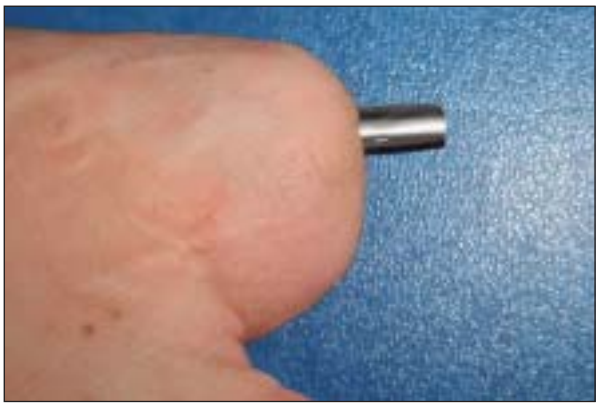

Fig 1b Skin-penetrating retentive attachment on the abutment (case 2).

Fig 2a Silicone thumb prosthesis in place (case 1).

Fig 2b Grasping function of the implant-retained silicone thumb prosthesis (case 2).

the silicone prosthesis. The pattern of the coping was directly waxed to the attachment and cast. An autopolymerizing acrylic resin substructure was incorporated onto the surface of the coping. The wax pattern of the thumb prosthesis was adapted on the stump cast with the implant analog and attachment. The acrylic resin substructure that incorporated the coping was embedded into the wax pattern. The size, shape, and contour of the wax pattern were evaluated on the patient. The thumb prosthesis was fabricated from silicone (Multisil, Bredent) (Figs 2a and 2b).

The prosthesis was inserted, and the patient was instructed in home care and prosthesis maintenance. Home care included mechanical debridement of the skin around the abutment with a toothbrush, water, and soap. After delivery of the prosthesis, implant mobility, health of peri-implant skin, and the patient's opinion of appearance and function were assessed every 6 months.

Case Reports

Case 1

A 21-year-old right-handed man lost his right thumb in an accident. A dental implant (3.3 mm in diameter and 12 mm in length) was inserted in the stump, and a prosthesis was placed. The length of follow-up was 18 months. The patient could move the finger via the remaining joint and perform daily activities with the prosthesis. No soft tissue problems were recorded. The patient experienced loosening of the retentive attachment 8 months after prosthesis placement. The screw of the attachment was tightened.

Case 2

A 15-year-old right-handed girl lost her right thumb in an accident 5 years prior to presentation. An implant (4.1 mm in diameter and 10 mm in length) was placed into the residual bone. She quickly learned to use her thumb prosthesis and achieved useful perception of tactile stimuli (Fig 2b). She was a student and had no problems with writing or other activities. She was very happy with the appearance of the prosthesis. Implant osseointegration was achieved. The retentive attachment was in function and no peri-implant soft tissue problems were noted during the follow-up period. Color fade of the silicone prosthesis was observed 21 months after placement. A replacement prosthesis was provided.

Discussion and Conclusion

An osseointegrated implant-retained prosthesis offers an alternative technique for finger reconstruction. This technique was used in previous studies with different prosthetic designs. In a study by Manurangsee et al,[2] acrylic resin prostheses were fabricated and firmly attached to the abutments using a hexagonal magnetic suprastructure system. Lundborg et al[1] rehabilitated 3 patients with traumatic thumb amputation with implant-retained silicone thumb prostheses. The retentive system was locked in position using a transverse screw device. In the present report, the attachment was designed to provide retention via frictional forces. Consequently, the prosthesis could be easily taken on and off by the patient without the use of any devices.

The prosthesis was fabricated from silicone, contributing to the satisfactory esthetic result. The acrylic resin substructure that incorporated the coping provided a rigid support for the prosthesis. However, discoloration of the prosthesis, which is attributed to color instability of the silicone material, was observed. Although implant anchorage improves the esthetic and functional results of a digital prosthesis, further studies with long-term follow-up periods and a larger patient group are necessary to evaluate clinical success and advocate the routine use of this treatment.

References

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Literature Abstract

Effect of reinforcement on overdenture strain

This in vitro study aimed to quantitatively evaluate the effect of metal reinforcement on overdenture strain around copings and at the midline. A mandibular edentulous cast with a 2-mm-thick artificial mucosa and artificial abutment teeth installed bilaterally in the canine position was produced. The coping had a dome-shaped upper surface with a height of 6 mm. The 4 test designs were as follows: no reinforcement (BS), reinforcement with cobalt-chrome wire (BW), cast metal reinforcement without reinforcement over the coping top (BA), and cast metal reinforcement with reinforcement over the coping top (BB). Bonding between the metal and resin was improved by sandblasting and use of a 4-META adhesive. On the lingual polished surface, strain gauges were attached—3 at the left canine position and 2 at the midline—with the grids oriented mesiodistally. A vertical load of 49 N was applied bilaterally at 6 points on the occlusal surface (first premolar, first molar, and second molar). The strain around the copings was found to be significantly greater with BS than with other types and significantly less with BB than with the other types. At the midline, the strain on BA and BB was significantly less than on BS and BW. Thus, the authors concluded that among the different kinds of reinforcements evaluated, the cast metal reinforcement that covers both the midline and the coping top significantly reduced strains on the overdenture. They suggested that this simple reinforcement was effective in preventing deformation and fracture of the overdenture. The effect of incorporation of popular attachment systems in this reinforcement design would be valuable information.

Gonda T, Ikebe K, Dong J, Nokubi T. *J Dent Res* 2007;86:667–671. **References:** 25. **Reprints:** Dr K. Ikebe, Division of Oromaxillofacial Regeneration, Osaka University Graduate School of Dentistry, 1-8 Yamadaoka, Suita, Osaka 565-0871, Japan. E-mail: ikebe@dent.osaka-u.ac.jp—*Tapan N. Koticha, Singapore*