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CUSTOM MADE ATTACHMENT SUPPORTED TOE PROSTHESIS

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INTRODUCTION

Loss of a missing organ has been a major form of physical impairment for an individual. The manifestations of such a physical loss leave a psychological trauma to the patient. Finger and partial finger amputations are some of the most frequently encountered forms of partial hand loss. The commonest causes of these amputations may be trauma/accident, congenital absence or malformations **[1, 2]**. All such situations pose a varying degree of difficulty in management. Prosthetic rehabilitation of such defects poses a challenge to maxillofacial prosthodontist.

An amputation is the surgical removal of part of the body, such as an arm, leg, fingers, toe. Finger or toe amputations can be major or minor. Of the minor amputations, one of the most commonly performed is the partial toe amputation. It affects about 2 per 1000 head of population in industrialized countries making it the most common type of amputation surgery **[3]**. Toe amputations are a very common level of amputation in patients with peripheral vascular disease, diabetes mellitus and post trauma. Apart from the psychological impact, toe amputation affects the gait and stance of the patient.

Success of the prosthesis depends on the precision in meticulous planning and designing of prosthesis, technique and materials used **[4]**. Hence, accurate impression technique, carving of wax

patterns that would provide desired aesthetics, retention and stability is of paramount importance. Most of the conventional custom finger prosthesis made up of autopolymerizing resin or polyvinyl chloride have not been able to provide the desired results due to poor esthetics, lack of flexibility and the tendency to stain. The prosthetic rehabilitation should be as barely discernible as possible with an attempt to create the prosthesis life like and natural. Fabrication of such prostheses with realistic skin surface and seamless visual integration with surrounding tissues requires high degree of clinical skill and laboratory expertise.

Case Report

A 29 years old male patient professionally physical trainer, reported to the Department of Dentistry, Prasad Medical University, Banthra with complaint of missing great toe of the left foot **(Figure 1)** with complains of inability in doing exercise with bad appearance for last two years_ History revealed that the patient had met with a road traffic accident 2 years back following which he had to undergo amputation of the great toe at the level of metatarso-phalangeal joint .After few months of great toe amputation patient felt difficulty in doing some exercise. In clinical examination a growth of remnant of nail was present on amputated toe **(Figure 1)**.

A complete medical history was elicited and the patient was found to be medically fit to undergo prosthetic rehabilitation. Various treatment options were discussed with patient and a treatment plan involving customized attachment retained silicon toe prosthesis was finalized.

Fabrication

Before starting with the clinical steps rough measurements of the patients unaffected toe was made. Patient's affected and unaffected feet were thoroughly cleaned. Alginate was mixed and loaded into the plastic box. It was also simultaneously applied onto the patients affected feet ensuring proper coverage of the amputation areas. The patient was instructed to insert the foot into the plastic box and maintain it in the weight bearing position till the alginate has set. Alginate impressions of the normal contra-lateral side were also made **(Figure 2)**. The impression of the affected foot was poured in dental stone to obtain a positive replica. After setting of cast, toe affected toe was separated with a fine saw. On the other side, modelling wax was poured into the impression of the contralateral foot so as to obtain a wax model to guide the fabrication of prosthesis.

Custom attachment fabrication

A wax pattern was fabricated on the part of toe stump where nail remnant was present and casting was done. Casted attachment was finished and tried on affected toe. A commercial rubber sleeve was used as female attachment **(Figure 3)**.

Fabrication of Wax pattern and Patient Trial

The wax pattern of toe was removed and aligned in the correct position on the working cast. Before wax pattern adaptation a light scraping of cast was done for tight fitting of prosthesis and a tin foil was used as separating media. The wax build up was extended so as to form a sleeve extending up to half the length of the toe. The anatomy of toe was modified so that it forms mirror image of the contra lateral side. The wax pattern was tried on the patients affected feet while the patient stands erect. Any modification required in the morphology and fit of the prosthesis was done during the try in appointment. Once patient satisfaction was assured the finishing of the wax pattern was done. The portion corresponding to the nail bed was contoured and the margins undermined. The wax pattern was now ready for investing. Before investing custom attachment was attached on nail remnant and a final impression was taken with light body impression material and poured with dental stone for the final working cast **(Figure 4, 5)**. Commercial rubber sleeve was attached on attachment portion obtained in final cast **(Figure 6)**.

Normal flask was used for the investing. Separating medium was applied all over the workingcast except on the wax pattern. Dental stone (Orthokal, Kalabhai, India) was mixed according to manufacturer's specification and poured into the custom flask. The working cast was placed into the stone ventral side first and immersed until only the wax pattern covering the dorsal surface is exposed above the stone. After the initial pour had set, separating medium was applied over the stone portion and the counter pour was done with dental stone (Orthokal, Kalabhai, India). The lid portion of the box was slid into position. Once the stone had set dewaxing was done, the flask was separated along the mould space. The mold surfaces were cleaned with diluted soap solution and placed under running tap water. Once the mold was sufficiently dried, petroleum jelly was applied as a separating medium for the silicone material. Packing of Silicone Medical grade RTV silicon is used in a ratio of 10:1. Shade matching is done for both dorsal and ventral surfaces of the toe. Before packing of silicone commercial rubber sleeve should be checked properly that it is fit on cast properly **(Figure 6)**. The silicon is carried with a brush and coated on the respective surfaces. The remaining silicon is filled between the two halves of the mold, and the flask is approximated and tightened under a clamp. This flask and clamp assembly is allowed to polymerize at room temperature for 24 hours following which the flask is removed from the clamp and the prosthesis is retrieved from the cast. The prosthesis is cleaned with acetone before extrinsic staining is done. The excess material is cut with scissors and the margins of the cut ends are trimmed with silicon finishing trimmers. The prosthesis is tried on the patient's foot. Artificial nails were purchased, trimmed and attached to the respective nail beds with some hair fibers **(Figure 7, 8)**.

Fig 1

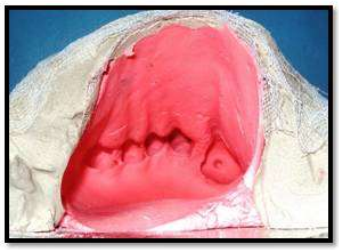

fig 2

Fig 3

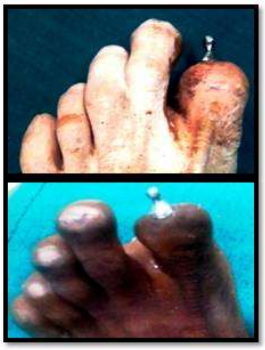

fig 4

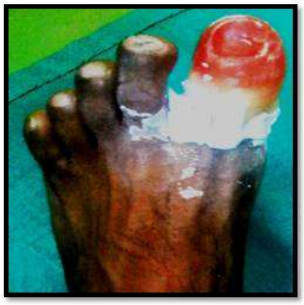

Fig five

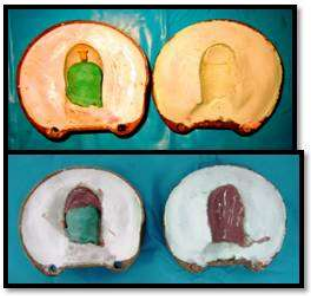

fig 6

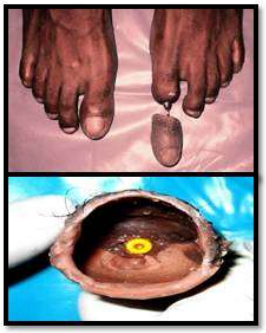

Fig 7

fig 8

DISCUSSION

Diabetes mellitus and peripheral vascular occlusive disease are major causes of toe amputation, but natural disasters and accidents also contribute to the number of people who have undergone amputation of toes. The amputation of one or more fingers of the hand or toe of feet, as the consequence of trauma or congenital absence of one or more phalanges, carries a serious reduction of hand and foot function and social dysfunction for the patient **[5]**. Many injuries and traumatic amputations of fingers and toe can be rescued by microsurgery through re-implantation. However, it may not be advisable **[6]** or possible in some cases such as the patient's unwillingness or factors such as cost **[7]**. Single toe amputation usually affects a person's ability to do some specific type of exercise if the person is professional trainer. It can also affect the position of the other toes, potentially causing deformities over time **[8]**. The hallux (big toe) plays an important role in stabilizing the medial aspect of the foot and the extensor hallucislongus (EHL) is one of the most important extrinsic muscles of the foot during the swing phase of gait **[9]**. Therefore, amputation of the hallux frequently leads to a propulsive gait. The degree to which function gets affected depends on the level of amputation **[10-15]**. Loss of one or more distal phalanges of any toe has minimal effect on standing and walking but will deleteriously affect running and doing some exercise as propulsion in late stance is slightly lessened. As the proximal phalanges are the site of insertion of plantar aponeurosis, its removal impairs comfortable standing especially for longer duration. 4Apart from these physical and structural effects there is also the psychological impact associated with any kind of amputation.

Historically, a variety of prosthetic/orthotic modalities have been utilized to toe amputations. Before 1984, toe prostheses were primarily rigid devices of conventional design fabricated from leather and metal or plastic laminate with a foam filler. These devices did not replace anatomical motion lost by amputation, but they did retain rollover in the toe section.

CONCLUSION

The field of prosthesis fabrication for amputated patients is an area in which further researches are necessary. It is very essential to find a balance between the degree of functional rehabilitation to be achieved and the cost for providing the same. The clinician will always need to weigh various considerations including level of amputation and realistic functional expectations with additional support when deciding a specific prosthetic device for a partial foot amputation patient so that it maintains the highest level of function. The

flexible silicone prosthesis using room vulcanizing silicone is a compromise, but definitely an acceptable compromise.

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