

Prosthetic management in orofacial trauma

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ABSTRACT

Orofacial trauma result in tissue loss that can be of soft tissue, hard tissue or both tissues. This tissue loss can range from minimal to extensive tissue loss and the result can be impairment of oral function and compromise in quality of life. In management of orofacial trauma, various factors such as defect site, extent age among other factors are considered. There are variety of prosthetic replacement option depending on site of defect and these ranges from removable denture, fixed prosthesis, dental implants, obturators, nasal prosthesis, orbital prosthesis and auricular prosthesis. The advent of three-dimensional (3D) technologies has enabled the design and manufacture of prosthesis using computer aided design/ computer aided manufacturing (CAD/CAM) software that has helped in realization of treatment goals.

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Introduction

Orofacial trauma may result in various soft and hard tissue injuries ranging from fracture or avulsion of teeth, mandibular fracture, maxilla fracture, loss of supporting structure, neurologic involvement and injury to temporomandibular joint (Wiens, 1990). Skeletal fractures are often associated with the fracture of bones adjacent to the maxilla and also involves different degrees of overlying soft tissues such as the eyes, nasal airways, paranasal sinuses, and tongue (Sykes, Wolfaardt and Sukha, 2002). The loss of tissue may range from minimal tissue loss to extensive tissue loss with resultant impairment of oral function (speech, mastication), aesthetics and temporal or permanent compromise in quality of life. In the management of

orofacial trauma, factors to be considered are defect site, including size, location, amount of adjacent supporting tissue and patients age. Management of young patients who are still growing, will entail unique crafting of prosthesis to accommodate facial features during different growth stages (Hu *et al.*, 2017).

Management of orofacial trauma often involves multidisciplinary approach with both surgical and prosthetic option (Garhnayak *et al.*, 2010). Surgical option includes internal and external fixation, in extensive tissue loss, there might be need for free microsurgical transplants, grafts, distant or regional flaps (Cahill *et al.*, 2015).

There are variety of treatment option for rehabilitation of partial loss of hard and soft tissue loss including removable partial dentures, fixed partial dentures, crown and bridges, and teeth-implant supported prostheses (Uğurlu *et al.*, 2007). The three-dimensional (3D) technologies can also allow the user to design a

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prosthesis using computer aided design/ computer aided manufacturing (CAD/CAM) software and CAD/CAM to manufacture simple crowns, fixed dental prostheses, removable dental prostheses, or even craniofacial structures such as the nose and lips (Sykes *et al.*, 2004).

In management of some cases of tissue loss, replacement of lost tissue with prosthesis might have advantages over surgical reconstruction both in function and aesthetics. There are some factors that must be considered when managing with prosthesis. These factors include size, location, amount of adjacent supporting tissue around defect (Klimczak *et al.*, 2018). Large defects and defects adjacent to mobile tissues are better managed first with surgical approach (Bhandari, 2014). Other factors to be considered include timing for reconstruction (Thaller, Bradley and Garri, 2007), patient's demographics, functional status, preexisting medical conditions and psychological well-being (Wiens and Wiens, 2000). Orofacial trauma often occurs with involvement of both hard and soft tissue. When there is trauma involving the soft tissue alone, it can range from simple laceration to avulsion of biological structures.

Orofacial trauma can involve the lower third of the face or middle third or upper third of the face (Vaca *et al.*, 2018), or pan facial, involving the whole areas in the orofacial region. Trauma to the lower third of face includes the lower lip, tongue, mandible, alveolar bone and the teeth. The middle and upper third of face includes the upper lip, nose, maxilla, ears and eyes (Hu *et al.*, 2017).

It is essential that proper history and detailed examinations are undertaken to determine extent of trauma and tissue loss. It is important that presurgical planning be done before undergoing prosthetic treatment (Federspiel, 2009).

Prosthetic Management of lower third of face

Prosthetic treatment depends on extent of trauma. Orofacial trauma involving the teeth alone can require endodontic treatment with crown and complete loss of tooth/teeth may require a removable partial denture, fixed partial dentures or osseointegrated dental implant with superstructure (Carhill *et al.*, 2015). Associated loss of alveolar bone may also be treated with removable prosthesis, replacing both hard and soft tissues (Uğurlu *et al.*, 2007).

Loss of soft tissue such as the lower lip can be reconstructed with the use of implant retained facial prosthesis (Goiato *et al.*, 2009) in which the prosthesis is designed for the reconstruction of the lip. This prosthesis can also be retained with the help of clips, bars and magnet anchored on existing teeth (Ahmed *et al.*, 2014). The materials used for maxillofacial prosthesis are methacrylates, polyurethane elastomers, and silicone elastomers. These materials are clinically inert and they can be pigmented to match individual skin colour and texture of surrounding structures (Goiato *et al.*, 2009).

Facial moulage is made using polyvinylsiloxane and reversible hydrocolloid impression material. This moulage can then be used to fabricate a dental cast which is also used to fabricate wax prototype facial prosthesis for the defects (Ahmed *et al.*, 2014). For bone prostheses, the 3-dimensional printing can be employed for development and design of customized bone prostheses and scaffolds (Kroonenburgh *et al.*, 2012; Fan *et al.*, 2015; Imanishi and Choong, 2015; Denry and Kuhn 2016).

The middle and upper third of face

The midface is basically the most prominent features of the face and separates the oral cavity from the orbital cavity. Trauma involving the midface resulting in defects are commonly complex three-dimensional defects involving both soft and hard tissues (Hu *et al.* 2017). The aim of management is to separate the oral, sino nasal, orbital, and intracranial cavities; eliminate dead space and cover exposed dura; restore the functions of speech, swallowing, and mastication; replace the skeletal framework; and achieve the best aesthetic (Hu *et al.*, 2017).

Defects involving the palate will require the fabrication of an obturator. It should be noted that an increase in size of maxillary defect result in decrease dentition, decrease in supporting tissues and decrease in stability of the obturator (Beumer, Curtis and Marunick 1996).



Where there is loss of soft tissue, 3 or 4 dental implants are employed to enable anchorage and retention of prosthesis. These implants are usually located on the zygomatic buttress, supraorbital rim, vomer, and horizontal part of the hard palate (Wolfaardt et al., 2003). Preservation of remnant palate, premaxilla, abutment tooth is crucial for the retention and stability of prosthesis (Murat *et al.*, 2012).

For complex midface defects, alloplastic prostheses provide an obturator role amongst the orbital, maxillary, and oral cavities, as well as an external coverage. Midface prostheses frequently consist of acrylic, silicone, or other polymers and can be removed, cleaned, and reinserted (Özkan, Coşkunfirat and Özkan, 2012).

The nasal defect

Nasal prostheses are used for reconstruction of nasal defect. The stock nasal prostheses can be retained by nasal implant (Seçilmiş and Oztürk, 2007; Dimitroulis, 2007; Ciocca *et al.*, 2007; Mueller *et al.*, 2015). The implant is inserted into the floor of the nasal cavity or glabella (Dimitroulis, 2007; Mueller *et al.*, 2015). The impression of affected area is made to fabricate a cast that is used to fabricate the final prosthesis, incorporating aesthetic details (Malard *et al.*, 2015) retention of prosthesis can be achieved by fixing it anatomically to existing structures like bony undercuts, mechanical means with the use of spectacle frames, chemical means with glued-on nasal prosthesis or with the aid of osseointegrated dental implants. (Flood and Russell 1998; Ethunandan, Downie and Flood, 2010).



Nasal prosthesis wax-up.

The orbital defect

In reconstruction of the orbit, orbital implant is initially inserted into the anophthalmic cavity to provide 75% of original ocular globe and aesthetic (Hughes, 2007). Integrated or non-integrated implants can be used (Begum, Kola and Joshi 2011). The orbital prosthesis fits over these implants and under the eyelid. The prostheses are often made from glass, acrylic or silicone spheres. The prosthesis can either be customized or stock made. Customized prostheses have better adaptation and mobility (Da Costa *et al.*, 2017).



The auricular defect

An auricular prosthesis is used to reconstruct auricular defect using an implant or adhesive-retained prosthesis (Kolodzynski et al., 2017). Adhesive-retained prosthesis is not as retentive as implant-retained prosthesis and there is a risk of adverse tissue reactions (Tjellstrom *et al.*, 1985). The use of implant retained auricular

protheses requires daily maintenance to prevent skin infections (Federspiel 2015).

Auricular prosthesis wax-up

Daily cleaning and proper care of these prosthesis is fundamental in maintaining its quality. Silicone has been reported to be the major retainer of surface microorganism (Goiato *et al.*, 2010). Therefore, daily cleaning of prosthesis requires the use of water, neutral soap and 2% chlorhexidine gluconate solution, the neutral soap can be substituted with a mixture of hydrogen peroxide and water (Chamaria *et al.*, 2019). In cleaning mucosal surfaces, the use of boiled water or filtered water is required during cleaning, cleaning 3 times daily for prosthesis especially that for the orbit is recommended (Goiato *et al.*, 2010).

The computer aided design/ computer aided manufacturing (CAD/CAM) software.

Records and data are gathered using computed tomography, photogrammetry and laser scanners. Images captured are processed and computer aided challenges in fabrication of ocular prosthesis using this method, there is need for widespread availability and cost effectiveness of digital systems (Ariani *et al.*, 2013).



CONCLUSION

The recent advancement in fabrication of orofacial protheses has shifted from impression-based fabrication to computer aided technology in addition to the enhancement of retention with dental implant. Diagnostic assessment and intervention which is patient specific has been made more effective with the advent and rise in CAD/CAM technology. This has contributed to the effective restoration and

design software are used to design the mold from scanners (Farook and Alan 2019). This design or mold can then be printed to conventionally fabricate prosthesis or computer aided manufacturing (CAM) software is used to mill or fabricate prosthesis. The latter technique is preferred as a result of better fit and colour match. The advantages of these method include reduction in intensity of manual operation and enhanced retention (Gu *et al.*, 2017; Farook and Alan 2019).

The main disadvantage of this digital method is sensitivity to moisture and muscle movement with the resultant adverse effect on overall fit especially for prosthesis directly designed and printed (Farook and Alan 2019). The 3D Photogrammetry, laser scans and direct printing of prosthesis were more favored. However, there is reported challenges in fabrication of ocular prosthesis using this method, there is need for widespread availability and cost effectiveness of digital systems (Ariani *et al.*, 2013).

rehabilitation of patients with orofacial trauma. In addition to the recent rapid prototyping and bioengineering reconstruction of soft tissues. These modalities of treatment have contributed to the realization of the treatment goals.

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