Eur. J. Prosthodont. Rest. Dent., Vol.22, No. 4, pp 167-173
Printed in Great Britain

doi:10.1922/EJPRD_1194Abdulhadi07

Prosthetic Management and Analysis of Combined Extraoral-Intraoral Maxillofacial Defects Complicated with Microstomia. A Report of Three Cases

Laith Mahmoud Abdulhadi*

Abstract - *Different prosthetic treatment plans for three patients with variable degrees of acquired maxillofacial defects were reported and analyzed. Combined extraoral-intraoral prostheses were selected to restore the three cases. Two patients were rehabilitated using two separated prostheses, while the third one was restored with a coupled two-unit prosthesis. The design of extraoral-intraoral prosthesis either separated or connected, is influenced by the condition and nature of the residual tissues, defect configuration, patient needs, degree of tissue damage and the anticipated success rate or complications with the treatment. It was observed that separating the intraoral part from that of the extraoral resulted in better retention, stability, and more comfort to the patient with combined defects. Furthermore, fabrication and repair of each part is technically easier as perceived it can be carried out independently and the patient can continue to use one-part and send the other for repair. Another advantage is the reduction of size and weight of the prosthesis.*

KEY WORDS: Combined extraoral-intraoral prosthesis, Obturator, endosseous implants, Mini-dental-implants, microstomia.

INTRODUCTION

Prosthetic management of combined extraoral-intraoral defects is a challenging task for both anaplastologist and patient. The treatment becomes more difficult when it is complicated with structural and functional limitations like excessive tissue loss, irregular post-surgical defect, absence of bony support and microstomia [1-5]. Location, thickness and condition of the remaining structures after radiotherapy are additional compromising factors. It has been documented that after a single dose of >20 Gy, changes in bone mineral content have been detected usually more than 30 weeks after irradiation. These changes are associated with reduction in blood flow and are dose-related [6]. Effective retention of the episthesis is a major concern for the anaplastologist and the patient during restoration of extraoral defect. Currently, increasingly more prostheses are designed to be implant-retained due to limitations of biological adhesive or the absence of other powerful retentive means. Implants can offer a good anchoring solution when placed in favorable supporting areas to retain the future prosthesis. The successful use of implants is subjected to many issues that should be considered as part of an integrated treatment plan. Generally, the success rate for mandibular implants is higher compared with maxillary implants. Better survival rate has been reported for a radiation dosage less than 50-Gy though a lapse time more than twelve months between the last irradiation session and implant placement does not promote better clinical results [7]. A follow-up after 88 months demonstrated that most loss of implants occured in irradiated bone (78.8% overall implant survival rate). In addition, severe skin reactions were observed around the implants in the orbital region [8]. The success of implant survival inside the orbital rim, especially in irradiated patients is uncertain [9] .

Apart from the patient's medical and dental health, treatment planning for such cases is governed mainly by the location and degree of mutilation. Depending on the outcome of combined defect examination, the anaplastologist should select the best design of the extraoral component to be aesthetically viable and retentive during daily functional and parafunctional activities, and at the same time ensure a secured, well-adapted intraoral part to the surrounding structures. One of design limitations of combined a extraoral and intraoral prosthesis is the dependence of the extraoral part on the mechanical quality of intraoral component when the two parts are attached to each other using rigid connection [4-6].

The decision of anaplastologist to select the type of anchorage for each part depends mainly on the defect configuration, residual tissue type and condition, and patient agreement. If a large maxillofacial tumor is excised, the prosthetic management plan may include endosseous implant placement to enhance the quality of the prosthesis if the patient agrees to undergo extra surgery. However, when the patient declines this strategy or their condition restricts further surgical intervention, the anaplastologist should look for an alternative plan that provides a prosthesis with potentially comparable mechanical quality. Combined extraoral-intraoral defects may be rehabilitated using various models and connections to link the two parts together. The provision of additional episthesis for the patient with sensitive tissues that may wear during home activity and sleeping should be considered. The episthesis should be comfortable, light-weight, and provide a safe open airway with a simple mechanism to inhibit inhalation of air impurities.

* BDS, CES, DSO

The aim of this report was to analyze and validate the management plan of three maxillofacial defects involving extraoral and intraoral structures with variable degrees of mutilation and physical limitations.

DESCRIPTION AND ANALYSIS OF THE TREATMENT PLAN

Case 1

The summary of medical, dental, and prosthetic status before and after treatment is shown in Table 1 and 2. The most significant findings are the large size defect, deleterious soft tissue quality, and absence of enough bone to support 3-4 conventional endosseous implants around the defect extraorally and intraorally. Thus, the decision was made to separate the mechanical interdependence between extraoral and intraoral parts. Effective retention for the episthesis alone should be first considered. Generally, the episthesis should be retained by 3-4 stable implants to overcome weight, size and location of prosthesis over movable middle and lateral structures of the face. Again, it was difficult to comply with this proposal due to the status of the remaining structures (Diagram 1). An alternative solution was attempted using four mini-dental-implants (MDIs) placed inside the supraorbital margin and on the zygomatic bone near the excised area. However, the zygomatic MDI was later removed due to unresolved infection and continuous pain. On the nasal and lip sides, the problem remained unresolved because of surgical limitations prevented the placement of any implant and the patient declined to undergo further surgery. This situation could be enhanced by the placement of additional mini-dental-implants on the remaining palatal area to add extra retention to the obturator but the patient also declined this option (Figure 1, 2) [3]. Therefore, the only available option was to add two small stops or hooks articulated with the nose pads of the glasses frame, biological adhesive and left auricular hook [10] to enhance the retention on the lateral side of the episthesis which contacted freely with the buccal obturator wall.

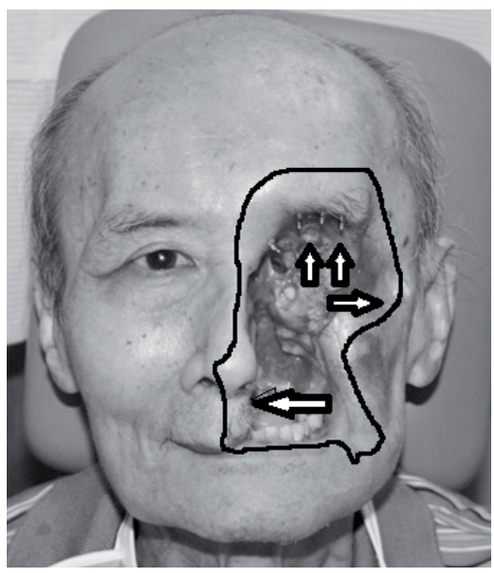

Diagram 1. *The proposed placement of mini- dental implants and epithesis extension*

Table 1. Information regarding each patient's medical and surgical history

	Case 1	*Case 2*	*Case 3*
Age	70 years	72 years	35 years
Gender	Male	Male	Male
Tissue loss	Extraoral: Hemi-mid face, half-nose, cheek, hemi-lip, left orbit and content Intraoral: Hemimaxillectomy with soft palate	Extraoral: hemi-mid face, nose, right cheek, Intraoral: Nasomaxillary, and unilateral middle palatal regions	Extraoral: Upper lip in middle area and Philitrum, nose. Intraoral: Nasomaxillary, and bilateral palatal regions
Operation	Radical excision with radial skin graft	Tumor excision and upper lip correction	Tumor excision and upper lip correction
Existing old treatment	Intraoral; obturator Extraoral; graft breakdown	Intraoral; fractured old Co-Cr obturator Extraoral; flap breakdown	Intraoral treatment; no prosthetic treatment done Extraoral; none retentive, retentive professional silicone nose
Remaining teeth	Maxillary 3 Anterior teeth	Maxillary left half arch and right molars are intact	Right first, second and left second molars
Cause	Recurrent SCC	Basoloid SCC	SCC (squamous cell carcinoma)
Mouth opening	Not applicable	Microstomia	Microstomia
Surgical results	Flap breakdown	Flap breakdown	No plastic surgery performed
Implant	Mini-implants (MDI) in the orbit	None	Ordinary endosseous implants
Irradiation	Yes	Yes	No
Degree of difficulty	Challenging	Moderate	Moderate

Table 2. Details of the prosthetic management of each patient

Management plan		*Material used*	*Retention mean*	*implants*	*Hook*	*Connection to 2nd part*	*Support of the external*	*Stability and retention*
Case 1	Extraoral Part	Silicone supported by acrylic base	Implant, glasses frame + auricule Hooke	3-4 Orbital mini-dental implants	Auricle-hook Hat	Free contact to the intraoral part	Marginal support only on structure around defect	Vertical R&S achieved, Lateral Less successful
	Intraoral Part	Acrylic resin	SSW clasps	N/A	N/A	Free connection to extraoral part	Teeth, Soft and hard tissues	Moving but patient adapted to it
Case 2	Extraoral part	Silicone supported by acrylic base	Magnetic connection (powerful magnet)	N/A	N/A	Magnetic with indexed connection	Marginal on skin+bone + Obturator nasopalatal extension	Vertical stability slightly affected ,lateral is better
	Intraoral Part	Co-Cr alloy and acrylic resin	Cast clasp, guiding plans	N/A	N/A	Keeper-magnet	Teeth , anterior palate	Retention and stability very good
Case 3	Extraoral Part	Silicone supported by acrylic resin	Clip-bar-Implant system	2 conventional endosseous implants	N/A	N/A	Periphery of defect, bar system	R&S very good but deteriorate after 7 months
	Intraoral part	Co-Cr alloy and acrylic resin	Cast clasps	N/A	N/A	N/A	3 teeth, and remaining palate	R&S very good from the first day

Figure 1. *The hemi- face defect*

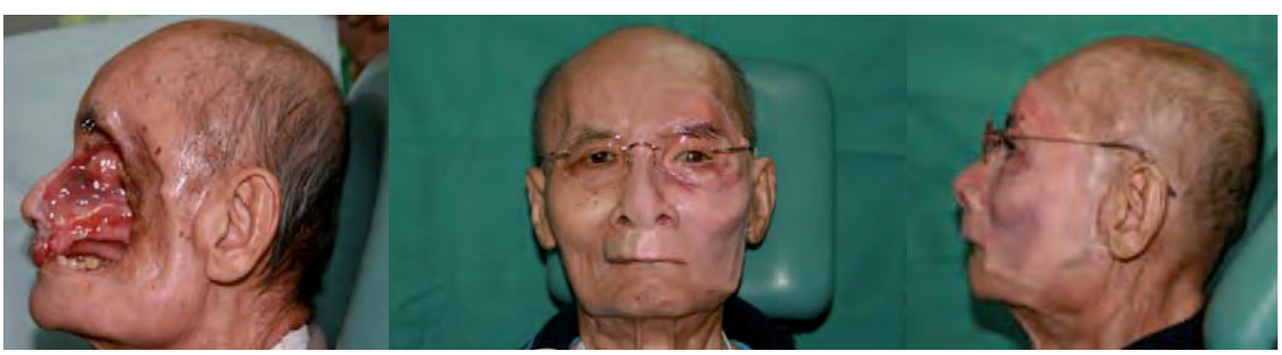

Figure 2. *Mini dental implants placed at the orbit margin and the final epithesis in its place*

Case 2

The dental, medical patient information and prosthetic management are summarized in Table 1 and 2. The remaining natural teeth were in healthy condition. Therefore, they could be used to retain the obturator. The patient had been treated with irradiation and had microstomia due to surgical correction and scar formation. Preferably in such a case a separation between the extraoral and intraoral prostheses should be prescribed. Whilst three endosseous integrated implants should have provided effective retention and stability if placed evenly around the defect. However, the history of tissue irradiation, and patient's wish not to undergo further surgery, changed the management plan from separated, to connected extraoral-intraoral prostheses. A coupling mechanism was chosen to obtain a firm connection between the episthesis and the obturator by incorporating powerful magnets. In addition, intimate contact of episthesis borders with the intact tissues surrounding the defect area was optimized to help secure the episthesis during function (Figure 1, 2)[4].

A sectional impression technique was used to make the impression (primary and final) for both the maxillary and mandibular arches [1,2]. A conventional metal frame obturator was designed and fabricated. The patient was asked to assess the ease of insertion and removal and fluid leakage. Then, the infrastructure of episthesis was constructed directly on the defect area by adapting double layers of modeling wax over the defect area and peripheries. It was processed into acrylic resin to act as infrastructure for the episthesis. Double magnets were fixed inside the nasal extension of the obturator facing a retainer placed inside the acrylic base of the episthesis. The missing structures (nose and part of the cheek) were shaped gradually and directly on the face by adding layer after layer of softened modeling wax until complete formation of the facial configuration. This was then flasked and processed into silicone following the conventional curing technique after skin color matching. Unfortunately, with this approach it was not possible to use the external part alone, when the obturator was removed. Additional retentive means such as the use of a spectacle frame with magnets or attachments to hold the episthesis in the absence of obturator should be considered (Diagram 2) [4, 7, 11].

Figure 3. *The Mid face defect and after obturator insertion*

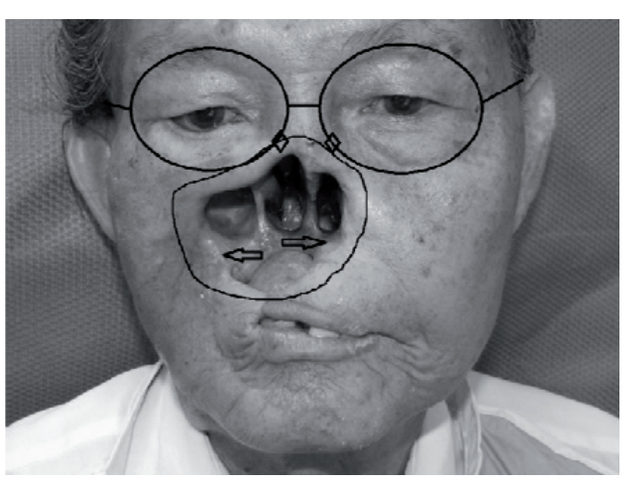

Diagram 2. *The proposed management of the epithesis with mini-dental implant placement and the spectacle frame –magnet-connection to the epithesis in case of failure*

Figure 4. *The magnet placement and the final epithesis retained in its place.*

Case 3

The final prosthetic management and most significant findings of the patient are cited in Table 1, and 2. The extraoral–intraoral defect was occluded by two separated prostheses. Limitation of mouth opening again required the use of sectional impression techniques. Following surgery to excise the anterior and middle segments of the palate only a narrow band of tissue remained posteriorly holding three molars; one molar the on the right side and two molars on the contralateral remaining ridge. The teeth location and quality provided good base for the prosthesis with molar clasping. Two conventional endosseous implants were placed across the nasal defect and connected to each other using cast a bar and acrylic resin base was fabricated directly on the face using the same technique as the direct wax adaptation previously cited in Case 2. The adaptation and location were checked on the bar connecting the two facial implants. A "U" shaped trench that incorporated the metal housing with its plastic clip was created inside the base. It was fixed to the base using a pick-up technique and autopolymerized acrylic resin. The base holding the housing was rechecked for proper location, and adaptation to the soft tissues boundaries. The arbitrary dimensions of the nose, its form and appropriate site on the face were calculated using a reference photo of the patient taken before surgery. Some changes were made regarding the measurement to compensate for facial changes, the defect extension and the unsupported sub-nasal tissues. The nose was sculpted directly on the acrylic resin base by adding softened thin layer after layer of modeling wax until the desired form, and dimensions were achieved. The nose was tried several times and evaluated for extension, retention, thickness, suitability, and the opinions of the patient's relatives were considered. The waxed nose was refined for anatomical detail, margins, thickness, wax deficiency, air bubbles, and roughness. The nostrils and the void space between the acrylic clip base and interior aspect of the sculpted nose were filled with plaster of Paris to keep the nose light in weight, and nostril tubes open and to make the inner aspect smooth after processing. The waxed nose was flasked, wax eliminated, and the two parts of the mold were isolated. A primer was applied to the acrylic base and silicone color was selected and matched to skin in the presence of the patient. The silicone was processed

Diagram 3. *The alternative plan when patient refuse the skin implant placement*

Figure 5. *The implant-bar-clip system and the obturator*

Figure 6. *The waxed nasal part tried on patient face and after processing and placement to cover the defect.*

according to manufacturer's instructions. The flask was opened and the prosthesis retrieved. The excess material was removed and the episthesis fitted. Extrinsic color was applied the next day using silicone color mixed with silicone sealant. The prosthesis was well retained and it would be possible to repair one part of the prosthesis, independently of the other.

Some studies concluded that craniofacial rehabilitation with extraoral implants is a safe, reliable, and predictable method to restore the patient's normal appearance; even though peri-implant soft tissue responses ranging from Grade 1 to Grade 3 may occur within a 2-year observation period [12]. When a patient refuses craniofacial implants, alternative methods such as spectacle frames have to be considered to retain and support the two-part prosthesis (Figure 5, 6) [7].

DISCUSSION

The use of craniofacial implants to retain functional and aesthetic restorations, with minimal morbidity in patients with oral and maxillofacial defects is well established [12- 15]. The application of the principles of osseointegration to the craniofacial skeleton can offer the patient with defects from trauma or ablative cancer surgery an episthesis, with minimal retention problems and is included in many maxillofacial prosthetic training programs [16]. Nevertheless, some authors have concluded that implant-retained extraoral prostheses have limited survival rate due to discoloration, tearing, and mechanical failure of the acrylic resin substructure or even the retentive elements. It seems that the anatomical site into which the implant is placed has an effect on the success rate. Furthermore poorer survival was observed in irradiated patients [9, 17] and soft tissue reactions may occur due to lapses in maintenance and hygiene [15,18]. Therefore, there are occasions when additional retention systems must be employed

Of the 3 cases considered here the management plans were modified to comply with patient needs:

In Case 1, MDIs were placed inside the orbital rim due to the absence of sufficient bone structures for a conventional approach. MDIs have been used before to solely retain an obturator[19]. In the current situation, multiple MDIs offered excellent vertical anchorage and resistance, despite of the weight of the episthesis (120 g)[3]. On the distal extension of the episthesis, an auricular hook was used for retention following the loss of zygomatic MDI in this area due to severe pain and unresolved infection. Laterally, the prosthesis was retained partially by the orbital MDI and a short tube extension inside the intact nostril. The medial silicone border of the prosthesis was fixed to the unharmed dorsum of the nose using biological adhesive. Three well distributed retention locations for the prosthesis were obtained, except at the lip margin, which was left free to permit some movement for the patient. MDIs can support the episthesis, provided multiple units are used and they are well placed and subjected to minimal or moderate displacing forces. These implants may enhance the mechanical features of the prosthesis, enabling a smaller, lighter prosthesis with better prognosis compared to the conventional design with magnets or precision attachments.

In Case 2, the episthesis became loose after nearly 6 months of use due to clasp fracture and a new Cobalt-chromium framework had to be made. The same design was used to fabricate the new prosthesis. In Case 3, the patient returned after nearly 7 months with broken clips and detached silicone from the base. A new episthesis was fabricated. However, the obturator was still retentive and well adapted. Rehabilitation of patients with craniofacial defects can be a challenging activity for the restorative team due to the size of the defect and the condition of the remaining anatomical structures[19, 20].

CONCLUSION

The management of combined maxillofacial defects should be well planned to achieve successful results. The anaplastologist should always find equivalent alternatives to resolve problems that arise during the treatment. Separation between the episthesis and obturator offers many advantages over coupled prostheses. In addition, it was more acceptable by the patient and the maxillofacial prosthodontist within the reported cases.

ADDRESS FOR CORRESPONDENCE

Laith Mahmoud Abdulhadi, Faculty of Dentistry, Block E, Floor 6, Mahsa University College, Pusat Bandar Damansara, 50490 Kuala Lumpur, Malaysia. Email: laithmahmoud@mahsa.edu.my

REFERENCES

1. Al-Hadi, L.A. and Abbas, H. Treatment of an edentulous patient with surgically induced microstomia: a clinical report. *J Prosthet Dent*. 2002; **87**: 423-426.
2. Al-Hadi, L.A. A simplified technique for prosthetic treatment of microstomia in a patient with scleroderma: a case report. *Quintessence Int*. 1994; **25:** 531-533.
3. Abdulhadi, L.M. Multiple retentive means for prosthetic restoration of a large facial defect. *Chin J Dent Res*. 2010; **13**:61-66.
4. Abdulhadi, L.M. Rehabilitation of an extraoral and intraoral defect complicated with microstomia. A study case. *Eur J Prosthodont Restor Dent*. 2012; **20**:81-85.
5. Cheng, A.C., Wee, A.G. and Tat-Keung, L. Maxillofacial prosthetic rehabilitation of a midfacial defect complicated by microstomia: a clinical report. *J Prosthet Dent*. 2001; **85**:432-437.
6. Hopewell, J.W. Radiation-therapy effects on bone density. *Med Pediatr Oncol*. 2003; **41**:208-11.
7. Sammartino, G., Marenzi, G., Cioffi, I., Teté, S., Mortellaro, C. Implant therapy in irradiated patients. *J Craniofac Surg*. 2011**;** **22**:443-5
8. Visser, A., Raghoebar, G.M., Van Oort, R.P., Vissink, A. Fate of implant-retained craniofacial prostheses: life span and aftercare. *Int J Oral Maxillofac Implants*, 2008; **23:89**-98.
9. Roumanas, ED., Freymiller, EG., Chang, T.L., Aghaloo, T., Beumer J. 3rd. Implant-retained prostheses for facial defects: an up to 14-year follow-up report on the survival rates of implants at UCLA. *Int J Prosthodont*. 2002; 15: 325-32.
10. Ota, Y., Ebihara, S., Ooyama, W., Kishimoto, S., Asai, M., Saikawa, M., *et al*. A large maxillofacial prosthesis for total mandibular defect: a case report. *Jpn J Clin Oncol*. 1999; **297**: 256-260.
11. Morrison, D.C. A low cost magnetic retention system for facial prosthetics: A case study. A low cost magnetic retention system for facial prosthetics: A case study. *International Journal of Anaplastology*. 2008; **2**:37-44.
12. Curi, M.M., Oliveira, M.F., Molina, G., Cardoso, C.L., Oliveira Lde, G., Branemark, P.I., Ribeiro Kde, C. Extraoral implants in the rehabilitation of craniofacial defects: implant and prosthesis survival rates and peri-implant soft tissue evaluation. *J Oral Maxillofac Surg*. 2012; **70**: 1551-7.

13. Gacto-Sanchez, P., Infante-Cossio, P., Gomez-Cia, T., Lagares A., Belmonte-Caro, R.The Ti-Epiplating system as an alternative for ear prostheses in burned patients. *J Burn Care Res.* 2011;**32** :e101-7
14. Kim, D.D., Ghal, G.E. Dental implants in oral cancer reconstruction. *Oral Maxillofa.c Surg Clin North Am*. 2011; **23**:337-45.
15. Cuesta-Gil, M., Ochandiano Caicoya, S., Riba-García F., Duarte Ruiz, B., Navarro Cuéllar, C., Navarro Vila, C. Oral rehabilitation with osseointegrated implants in oncologic patients. *J Oral Maxillofac Surg*. 2009; **67**: 2485-96.
16. Biama, R.F. Implant –supported facial prostheses. *J Mich Dent Assoc*., 1996; **78:50**-4, 56-64.
17. Karakoca, S., Aydin, C., Yilmaz, H., Ba,l B. Retrospective study of treatment outcomes with implant-retained extraoral prosthesis: survival rates and prosthetic complications. *J Prosthet Dent*. 2010; **103**:118-26.
18. Karakoca, S., Aydin, C., Yilmaz, H., Bal, B.T. Survival rates and periimplant soft tissue evaluation of extraoral implants over a mean follow-up period of three years. *J Prosthet Dent*. 2008; **100**:458-64.
19. Bohle, G.C., Mitcherling, W.W., Mitcherling, J.J., Johnson, R.M., Bohle, G.C. 3rd. Immediate obturator stabilization using mini dental implants. *J. Prosthodont*. 2008; **17**: 482-6
20. Cortes, A.L., Smith, C. Al-Saleh, K. An intraoral-extraoral combination appliance. A maxillofacial prosthetic device. *J Dent Technol*. 1996; **13**:13-17.