Prosthodontic Management of Maxillectomy Patients with Dental Implants in Residual Zygomatic Bone: A Preliminary Report

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Purpose: This report describes the 3-year follow-up of clinical and radiographic evaluation of soft and hard tissue outcomes for dental implants placed in residual zygoma in patients with surgical resections. Obturator retention and support, together with a questionnaire evaluation of the patients' satisfaction before and after insertion of implants, also were carried out. ***Materials and Methods:*** A novel approach to the palatomaxillary reconstruction of eight maxillectomy patients (mean age: 40 years) using dental implants inserted into the remaining zygomatic bone on the affected side and left unloaded for 3 months is described. Ball (O-ring) abutments were used with acrylic resin soft tissue conformers after surgical soft tissue thinning above the implants. All patients were radiographically evaluated and clinically documented at regular follow-up appointments. ***Results:*** The 3-year follow-up period showed no implant failures, stable peri-implant soft tissue level, and an increase in all of the patients' satisfaction with their implant-supported obturators. ***Conclusions:*** Osseointegrated implants in residual zygomas are an integral part of oral rehabilitation strategies, with minimal cost and complications, for maxillectomy patients. This short-term record underscores both the potential of such management interventions and the importance of even longer-term clinical outcome documentation. *Int J Prosthodont 2014;27:534–540. doi: 10.11607/ijp.3598*

Prosthodontic management of palatomaxillary defects resulting from oncological surgical interventions almost invariably requires the prescription of an obturator.[1]

The size of the resultant defect affects prosthesis retention and the concentration of adverse forces on any remaining abutment teeth. Dental implants may be employed to provide collateral support and retention and minimize cantilever forces on abutment teeth.[2]

Zygomatic implants may be used for this purpose, although their long lever arm may be vulnerable to bending under load because of limited bone support. Consequently, zygomatic implants need to be rigidly connected to regular stable fixtures in the anterior maxilla to permit optimal load distribution, while long transmucosal implant parts may be associated with deep peri-implant pockets and a possible risk of bacterial colonization and soft tissue inflammation.[3–5]

The objective of this preliminary clinical report was to describe the authors' experiences with dental implants, together with use of acrylic resin soft tissue conformers following soft tissue debulking, in the prosthodontic management of patients who underwent maxillectomies.

Materials and Methods

A convenience sample comprising eight maxillectomy patients (five women and three men; mean age: 40 years, ranging from 20 to 60 years) agreed to participate in the study after reading and signing the institutional consent form.

Each patient's treatment included the following phases:

Phase I: Preoperative Clinical and Radiologic Patient Assessment (Figs 1–3)

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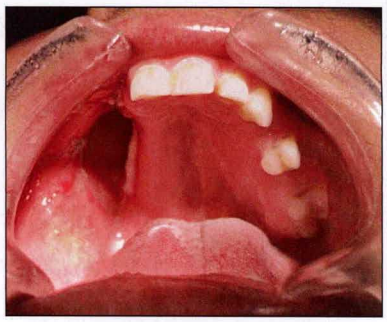
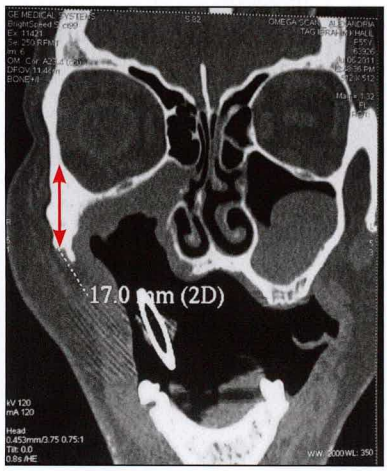
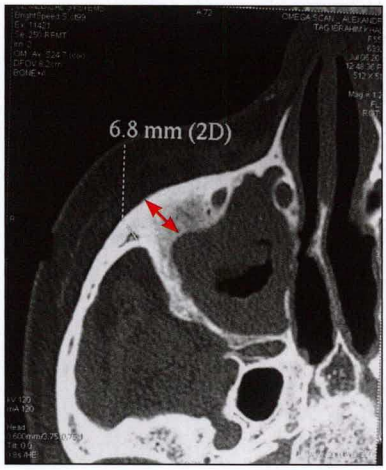
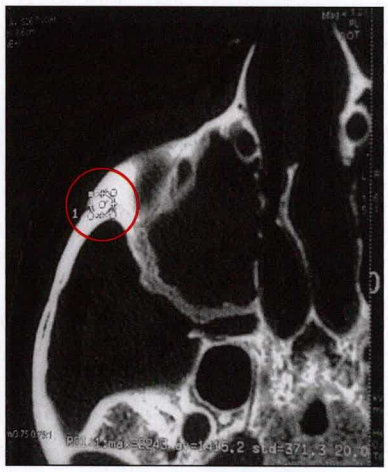


Fig 1 Preoperative intraoral view of the surgical defect.

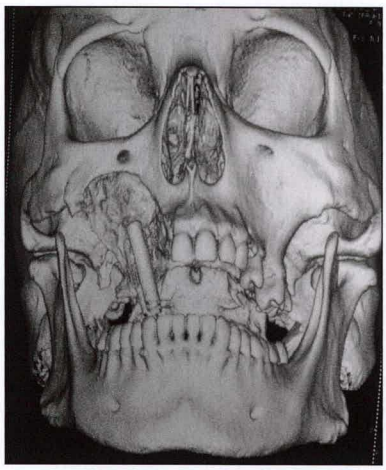


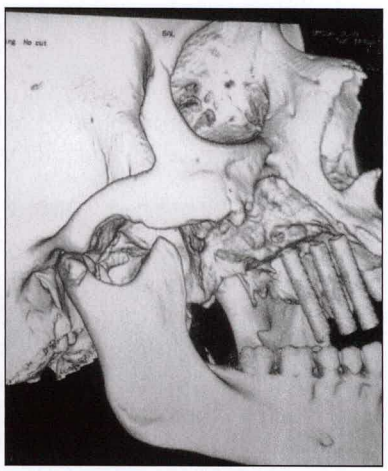




Figs 2a to 2c The coronal and axial CT scans for measuring the height, length, thickness, and bone density of the residual zygomatic bone.

Figs 3a and 3b Three-dimensional CT scan to evaluate the morphology of the residual zygoma and its relation to the adjacent anatomical structures and to estimate the proper placement angulation of zygomatic implants.





Phase II: Surgical Placement of Dental Implants into the Residual Zygomatic Bone

The surgical procedure of zygoma exposure was carried out as conventionally described in the literature[6] (Fig 4); two Tapered SwissPlus implants (Zimmer Dental) were used for each patient, and primary stability was measured by the Osstell apparatus (Osstell Mentor, Dentium; Fig 5). Before suturing the flap, the thickness of soft tissue overlying the implants was evaluated, and it was found to range from 1.5 to 2.0 cm. The implants were left for 3 months to osseointegrate.

Postoperative computed tomography (CT) scans were made to check the position of implants (Fig 6).

Phase III: Prosthetic Phase

Definitive prosthesis construction was carried out after complete healing of the surgical wound, and the patient wore the obturator for nearly 3 months.

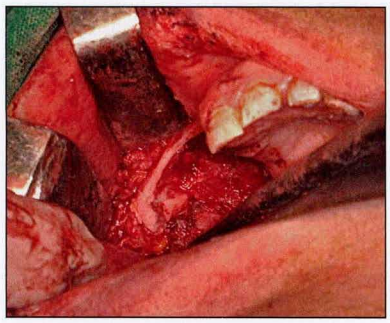


Fig 4 The deflection of the flap revealed the inferior aspect of the infraorbital rim and laterally the residual zygomatic bone.

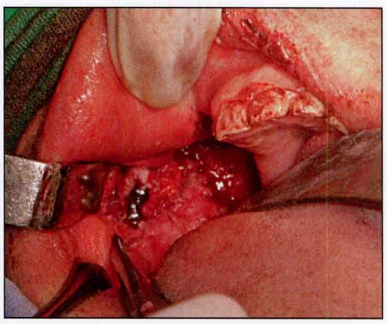


Fig 5 The cover screws were tightened to the implants by the 1.25-mm-diameter hex tool.

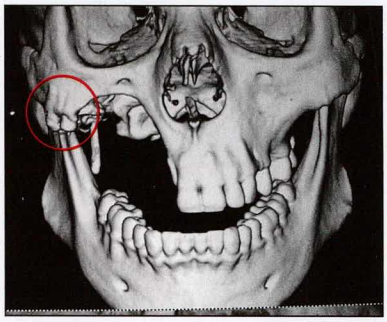


Fig 6 Three-dimensional CT scan showing the zygomatic implants in a coronal view.

Q1:	***During the day, how many hours do you wear your obturator prosthesis?***			
	Nearly 24 h	Nearly 12 h	Less than 8 h	Nearly not worn
	(0)	(1)	(2)	(3)
Q2:	***Do you wear your obturator prosthesis for social occasions?***			
	Yes	No		
	(0)	(1)		
Q3:	***Do you wear your obturator prosthesis for eating?***			
	Yes	No		
	(0)	(1)		
Q4:	***How well are you able to chew your daily soft food?***			
	No difficulty	Little difficulty	Great difficulty	
	(0)	(1)	(2)	
Q5:	***Can you eat hard food?***			
	Yes	No		
	(0)	(1)		
Q6:	***Can you eat on the defect side comfortably?***			
	Yes	No		
	(0)	(1)		
Q7:	***How well are you able to swallow daily food?***			
	No difficulty	Little difficulty	Great difficulty	
	(0)	(1)	(2)	
Q8:	***How well is the oro-nasal separation during drinking and eating?***			
	Very good	Fairly good	Fairly bad	Very bad
	(0)	(1)	(2)	(3)
Q9:	***Can you speak comfortably with your obturator prosthesis without dislodgement?***			
	Yes, for long period of time	Yes, for short period of time	No, I can't speak with it	
	(0)	(1)	(2)	
Q10:	***In your opinion, how stable is your obturator during speech?***			
	Very good	Fairly good	Fairly bad	Very bad
	(0)	(1)	(2)	(3)
Q11:	***How satisfied are you with your obturator prosthesis esthetics?***			
	Very satisfied	Fairly satisfied	Fairly unsatisfied	Very unsatisfied
	(0)	(1)	(2)	(3)
Q12:	***Do you perform oral hygiene care?***			
	Regularly	Not often	Not at all	
	(0)	(1)	(2)	
Q13:	***How much is the effect of your obturator prosthesis on your daily life?***			
	Great effect	Moderate effect	Minor effect	No effect
	(0)	(1)	(2)	(3)
Q14:	***By the help of your obturator prosthesis, do you feel that you are?***			
	Normal person	Near normal	Abnormal	
	(0)	(1)	(2)	

Fig 7 A 14-item questionnaire was given to each patient to evaluate functional, esthetic, and psychologic satisfaction.

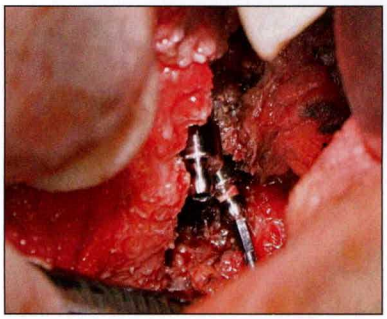


Fig 8 The ball abutments were tightened to the implants by a calibrated torque wrench to 30 Ncm.

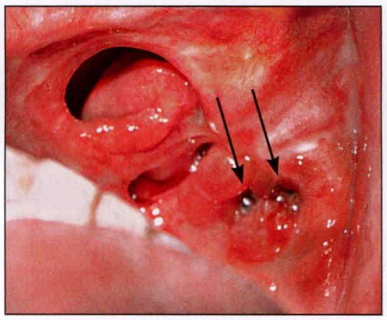


Fig 9 Regrowth of soft tissues above the implants.

Fig 10 The two acrylic resin soft tissue conformers.

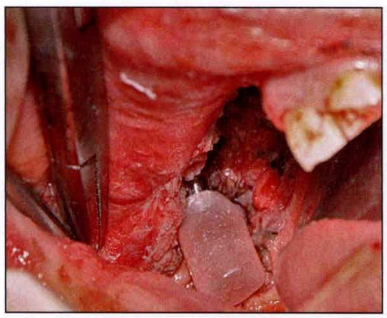


Fig 11 The two acrylic resin soft tissue conformers were attached to the ball abutments.

Fig 12 The definitive obturator with the housings.

A 14-item questionnaire made by the authors was given to each patient for self-completion to evaluate functional, esthetic, and psychologic satisfaction (Fig 7). Each item was scored by a number, with the final score (range: 0–29) for each patient being the sum of all items.

Phase IV: Stage-Two Surgery for the Connection of Ball Abutments

Following surgical implant exposures, ball abutments (Zimmer Dental) were connected (Fig 8) and surgical debulking was done to the soft tissue above and around the abutments. Unfortunately, 2 weeks after the surgery regrowth of soft tissue occurred (Fig 9).

Consequently, subsequent soft tissue management was done by the combined use of soft tissue thinning and acrylic resin soft tissue conformers. Two such conformers were fabricated for each patient before the stage-two surgery: Their length ranged from 1.5 to 2 cm, according to the thickness of soft tissue, with a diameter ranging from 3 to 4 mm according to the peri-implant distance (Fig 10). They permitted the healing peri-implant soft tissues to be molded into the desired contours and reasonable height. The two conformers were connected to the top of the ball abutments and then splinted together with a small amount of autopolymerizing acrylic resin (Fig 11). The soft tissue flap was sutured around them. The conformers were not removed for 2 weeks until preliminary soft tissue healing occurred to the debulked surgery site. Following soft tissue healing around the implants, the acrylic resin conformers were connected to the obturator (Fig 12).

Patients were instructed to wear their prosthesis for long periods of time throughout the day. Removal was for very short-term hygiene purposes exclusively to avoid mucosal tissues encroachment and associated discomfort to the patient during insertion of the obturators. The obturators were guided into place by the teeth and the surrounding anatomy of the surgical defect.

Phase V: Clinical Follow-up Phase

Peri-implant soft tissue was clinically evaluated over the next 3 years using the following four indices: Modified Plaque Index (MPI), Modified Gingival Index (MGI), peri-implant probing depth (PPD), and relative clinical attachment level (rCAL).

Table 1 Clinical-Pathologic Diagnoses for Study Participants

Patient	Sex	Age (years)	Previous pathology	Aramany classification[10]	Opposing dentition
1	M	32	Ameloblastoma	Class I	ND
2	F	35	Myxoma	Class I	ND
3	M	25	Ameloblastic carcinoma	Class II	ND
4	F	60	Osteomyelitis	Class I	ND
5	F	45	Keratocyst	Class II	ND
6	F	20	Myxoma	Class II	ND
7	M	51	Myxoma	Class IV	ND
8	F	23	Squamous cell carcinoma	Class IV	ND

M = male; F = female; ND = natural dentition.

Table 2 Descriptive Statistics of the MPI Scores of All Patients at Different Time Periods

	2 wk	3 mo	1 y	2 y	3 y
Range	0.25–0.88	0.25–0.63	0.0–0.88	0.0	0.0
Mean ± SD	0.60 ± 0.22	0.42 ± 0.13	0.21 ± 0.33	0.0	0.0
Median	0.63	0.38	0.13	0.0	0.0
P_1		.174	.244	.059	> .99
P_2					.027*

P_1 = P value for Wilcoxon signed ranks test between each successive periods; P_2 = P value for Wilcoxon signed ranks test between 2-week and 3-year follow-up period of implants.
*Statistically significant at $P \leq .05$.

Table 3 Descriptive Statistics of MGI Scores of All Patients at Different Time Periods

	2 wk	3 mo	1 y	2 y	3 y
Range	0.63 – 0.88	0.13 – 0.38	0.0 – 0.50	0.0	0.0
Mean ± SD	0.69 ± 0.10	0.21 ± 0.10	0.10 ± 0.20	0.0	0.0
Median	0.63	0.19	0.0	0.0	0.0
P_1		.026*	.414	.180	> .99
P_2					.024*

P_1 = P value for Wilcoxon signed ranks test between each successive periods; P_2 = P value for Wilcoxon signed ranks test between 2-week and 3-year follow-up period of implants.
*Statistically significant at $P \leq .05$.

Clinical evaluation of peri-implant hard tissue by means of resonance frequency analysis (RFA). RFA analyses of implants at 6 and 12 months after connection of abutments were undertaken, but the method was discarded and replaced with bimanual manipulation of the implants between the ends of two blunt instruments and pressure application in two directions for the next 2 years. This suggested that RFA is not an essential adjunct to determining implant treatment outcomes as shown in numerous earlier successful outcome studies.[7,8]

Radiologic evaluation of implants. Occipitomental radiographs were made at 6 and 12 months after loading of implants for the first year, then yearly for another 2 years to randomly evaluate the bone-implant interface. They were not used to measure the bone-implant interface due to the inability to visualize the zygoma in a standardized fashion.[6,9]

Patient satisfaction. The obturators were reevaluated after insertion of implants by the questionnaire for 3 years of follow-up.

Results

Data Collection

Data were collected, tabulated, and statistically analyzed using Wilcoxon signed ranks test (Table 1).

Clinical Evaluation of Peri-implant Soft Tissue

The total mean of MPI and MGI scores, as well as PPD and rCAL measurements and the statistical analyses for all of the patients, are shown in Tables 2 to 5. It was noted that there was a generalized decrease in the mean of all indices throughout the follow-up period,

Table 4 Descriptive Statistics of PPD Measurements (mm) in All Patients at Different Time Periods

	2 wk	3 mo	1 y	2 y	3 y
Range	2.12 – 3.10	1.69 – 3.26	1.63 – 3.01	1.63 – 2.99	1.63 – 2.99
Mean ± SD	2.55 ± 0.37	2.18 ± 0.57	2.09 ± 0.50	2.07 ± 0.49	2.06 ± 0.49
Median	2.49	2.04	2.03	1.97	1.94
P_1		.046*	.115	.167	.340
P_2					.028*

P_1 = P value for Wilcoxon signed ranks test between each successive periods; P_2 = P value for Wilcoxon signed ranks test between 2-week and 3-year follow-up period of implants.
*Statistically significant at $P \leq .05$.

Table 5 Descriptive Statistics of rCAL Measurements (mm) in All Patients at Different Time Periods

	2 wk	3 mo	1 y	2 y	3 y
Range	3.56 – 4.60	3.16 – 4.74	3.04 – 4.55	3.03 – 4.48	3.02 – 4.46
Mean ± SD	3.98 ± 0.36	3.62 ± 0.59	3.53 ± 0.55	3.50 ± 0.53	3.49 ± 0.53
Median	3.90	3.45	3.48	3.43	3.41
P_1		.046*	.249	.172	.042*
P_2					.028*

P_1 = P value for Wilcoxon signed ranks test between each successive periods; P_2 = P value for Wilcoxon signed ranks test between 2-week and 3-year follow-up period of implants.
*Statistically significant at $P \leq .05$.

Table 6 Descriptive Statistics of Total Mean Score of the Questionnaire in All Patients at Different Time Periods

		With implant-teeth–supported obturator			
	With conventional obturator	3 mo	1 y	2 y	3 y
Range	10.0–29.0	0.0–3.0	0.0–2.0	0.0–1.0	0.0–1.0
Mean ± SD	17.0 ± 7.43	1.50 ± 1.38	0.67 ± 0.82	0.50 ± 0.55	0.50 ± 0.55
Median	16.50	1.50	0.50	0.50	0.50
P_1		.027*	.059	.317	.99
P_2					.027*

P_1 = P value for Wilcoxon signed ranks test between each successive period; P_2 = P value for Wilcoxon signed ranks test between conventional obturator and implant-teeth–supported obturator at 3-year follow-up.
*Statistically significant at $P \leq .05$.

which indicated good oral hygiene and good circumoral soft tissue health around the implants.

Radiographic Evaluation

No translucencies were detected around any of the implants in all follow-up occipitomental radiographs throughout the observational period.

Patient Satisfaction Questionnaire

The total mean scores of all items of the questionnaire for all patients and their statistical analyses are shown in Table 6. A statistically significant decrease in the total mean score between the conventional obturators and the obturators after insertion of implants was noted, suggesting an improvement in the patients' quality of life and self-esteem.

Discussion

Conventional-length dental implants placed in residual zygomatic bone were an integral part of the surgical protocol used to manage the maxillectomy patients in this report. The primary reason for the standard implant choice instead of long zygomatic implants was to be able to maintain all possible dentition beyond the surgical site for all of the patients. There was, therefore, no chance of obtaining anterior site implant support. Overloading of zygoma implants can be expected for two reasons: *(1)* limited bone support provided by the two cortical fractions from zygomatic bone and *(2)* the resultant mechanical stresses applied with an angle of 30 to 60 degrees to the implants.[2,9,11] The ease of using ball abutments and the reduced costs resulting from not using zygomatic implants and their special abutments were two additional reasons for selecting this technique.[12]

Three decisive modifications were introduced in this management protocol:

1. **Unilateral placement of two parallel implants instead of one implant for better distribution of forces.** The mesial implant enabled trapezoid rest and was used to reduce the leverage on the dorsal implant and consecutive overloading from anterior biting and mastication, as described in other studies.[5,6,12]
2. **Use of implants with short lever arms.** The length of their transmucosal part was only 2 mm, whereas those of oncology zygoma implants range from 7.5 to 22.5 mm. The short implant collar made the implant platform rest close to the zygomatic bone, which is regarded as the ideal situation for an implant platform to reduce the effect of leverage of forces acting on the implants.[5]
3. **Use of resilient O-ring attachments, which permit prosthesis movement in many directions and relieve lateral and rotational forces acting on the implants.**[12] These modifications arguably resulted in a successful osseointegration of implants, as revealed by the results obtained from the measurement of the implants' stability and radiographic evaluation.

In this report, soft tissues bulks above the implants were a problem. They were treated by the thinning of these tissues and the use of acrylic resin soft tissue conformers. Follow-up assessments demonstrated a healthy peri-implant soft tissue response to this approach and the required strict oral hygiene instructions and maintenance. The observations were similar to those described by Shirota et al for one patient.[13]

The positive impact of implants on the patients' quality of life was shown from the marked positive changes in their responses to the questions, which meant greater patient acceptance than with the conventional obturators. The increased satisfaction may be due to the improvement of retention and stability of obturators by implants, which led to the improvement of different functions performed by patients. Furthermore, the patients of this study had no problems at the resection side such as paresthesia or abnormal lip function, and minimal facial retraction, because the prosthetic rehabilitation was started from the day of resection by the surgical obturator.

Conclusions

Within the limitations of this preliminary study, the prosthodontic management of maxillectomy patients with the combined use of conventional implants inserted in residual zygoma and acrylic resin soft tissue conformers can be considered a simple, lower cost alternative to the long zygoma implants with their special abutments. Immediately attaching conformers to the prosthesis at the time of implant uncovering is recommended for future management of similar clinical examples.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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