

CLINICAL EVALUATION OF USING CUSTOM-MADE HEALING CAPS ON AURICULAR PERI-IMPLANT SOFT TISSUE HEALING

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ABSTRACT

BACKGROUND: Auricular defects showed significant challenges for the multidisciplinary team. To give the patient the best prosthetic auricular fitment, the skin nature of peri-implant tissues showed an important role in the success of the prosthetic outcome. Multiple attempts to reduce skin overgrowth and regain adequate skin thickness were considered essential to provide an adequate retained auricular prosthesis.

PURPOSE: The current study aimed to evaluate the efficacy of using clinical custom-made healing caps for implant retained auricles on peri-implant skin reaction and thickness during the healing and prosthetic phase.

MATERIALS AND METHODS: A total of eleven wide-diameter intraoral implants with O-ring attachment for four patients with unilateral congenital or acquired auricular defects were placed in the available mastoid region. The use of custom-made healing caps for assessment of skin reaction and thickness in the peri-implant tissues.

RESULTS: The use of Intraoral implants for auricular retained prosthesis showed a 100% success rate regarding osseointegration. The use of O-rings attachments served as a great help in attaching the healing caps. The healing caps provided clinically significant peri-implant tissue healing on different follow-up intervals that allowed the adequate stability and retention of the final prosthesis in situ.

CONCLUSIONS: In patients with aggressive skin reactions, the custom-constructed healing caps played a significant role in the execution of a prosthetic ear with acceptable retention and stability. The use of affordable healing caps helped minimise the auricular peri-implant tissue reaction and get the skin thickness that was essential for proper prosthesis rehabilitation.

KEYWORDS: Custom-made healing caps, implant retained auricular prosthesis, keloid skin reaction, Anaplastology.

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INTRODUCTION

Various cases of auricular defects are not indicated to surgical reconstruction; instead, prosthetic reconstruction or a combination of prosthetic and surgical rehabilitation might be required to get the desired, satisfying results.¹⁻⁴ Moreover, the use of intraoral implant-retained auricular prostheses is considered an alternative option in cases where the use of cochlear implants was not feasible.^{5, 6} Also, the exact recording of the tissue bed is essential in the proper prosthetic adaptation which can be obtained either by conventional or digital impression registration.⁷⁻⁹

The postoperative skin swelling, oedema and skin overgrowth that might entirely cover the exposed abutment can make it challenging for the prosthesis to adapt to the underlying tissue bed. This can negatively

affect the prosthesis's retention and stability, making it more prone to dislodgement.^{5, 6, 10} Therefore, this article aimed to highlight the clinical impact of using custom-made auto-polymerized acrylic healing caps that connect to O-ring type housing on multiple cases with or without keloid reaction that requested skin trimming around the retained extraoral implants.

MATERIALS AND METHODS

Four patients presented with unilateral auricular defect were enrolled in the study, provided informed consent was signed upon approval of enrolment. A cone beam computerized tomography scan (CBCT scan) was taken for each patient to assess the amount of bone availability (at least 5-6 mm). Patients who had been exposed to radiation treatment because of tumours were excluded. Patient data are presented in Table I.

Two to three implants were placed for each patient, positioned in a tripod or bilateral configuration with a total of eleven implants. (Table 1)

The patient was positioned on his side and wrapped with towels to allow full access to the normal ear where the external auditory canal was blocked and petroleum jelly was applied to the impression area. For the normal ear a mix of irreversible hydrocolloid impression material (Cavex CA37 RW Haarlem, NETHERLANDS). After setting, the plaster model (Type II; Dentex Prevest Denpro Ltd, Jammu, India) was poured for the registered impression.

As for the defective ear, a low-viscosity PVS impression material (Elite HD+ Light Body Normal, Zhermack) was dispersed till it finally set, then a coat of PVS tray adhesive (Caulk Tray Adhesive, Dentsply Caulk, Dentsply International Inc., Milford, DE), then the impression was detached from the skin. A dental stone cast (Elite rock type 4 x-hard stone, Zhermack) was being poured.

A colour-tinted Modelling base plate wax (Cavex, set up Regular, modelling wax, RW Haarlem, Netherlands) was used to carve the trial waxed ear like the normal one.

After approval of the trial waxed pattern clinically for proper fit with the existing tissues, a CBCT was registered for each case to identify the position of implants and a surgical guide was printed with the drilling holes for expected implant places.

At surgery, conventional drilling was conducted to place the implant (BL-4306 C-TECH IMPLANTS. R.L) using sequential drills. Cover screws were tightened, and implants were left unloaded to facilitate osseointegration. (Figure 1) After 3 months of osseointegration, using second-stage surgery to place O-ring abutments, in which a follow-up of 2 weeks for skin healing was monitored.

Two hand instruments were used to examine implant mobility, where abutments were tightened to 35 Ncm.

Measure the thickness of the skin collar around the implant, where the O-ring abutments should be above the skin with 2-3 mm to facilitate prosthetic reconstruction. Skin monitoring was assessed for any oedema, swelling or infection before prosthetic loading. (Figure 2)

A vinyl polysiloxane material (Reprosil; Dentsply Caulk, Milford, Del) impression was made on the abutment level for the affected ear, where the implant-abutment analogue was secured to the impression.

Auto-polymerizing acrylic resin (Orthocryl 2000; Dentaurum) caps for skin healing were fabricated according to a previous technique Soliman et.al.⁶ to prevent skin overgrowth, especially in cases with progressive skin keloid reactions. The healing caps were incorporated during the fabrication of the

silicone prosthetic ear after being cleaned and primed (Primer S-2260; Dow Corning Corp, Midland, Mich) to adhere during silicone vulcanization. (Figures 3 &4) All implants were evaluated for their success and failure of osseointegration using the criteria resulting from the International Congress of Implantologist (ICOI) Pisa Consensus in 3rd month of osseointegration.¹¹ At 1,3-, 6- and 12-month intervals the thickness of the healing skin around the dental implants was measured using a plastic periodontal probe. As for peri-implant soft tissue assessment, 5- a point scale (Likert scale) was used according to Holgers et al.¹² . classification at intervals of 1,3,6 and 12 months. (Figure 5)



Figure 1: Second stage implant surgery.



Figure 2: 3 month follow up of peri-implant skin reaction after abutment tightening.



Figure 3: Custom-made auto polymerized healing cap.



Figure 4: Healing cap in-situ.



Figure 5: A 6 month follow up with controlled peri-implant tissue healing.

Table 1: Demographic data for patients' selection

P Patient No	Gender	Age (years)	Nature of Defect	Reason of loss	Unilateral Or Bilateral	Enrolled or rejected (Reason)
1.	Male	27	Acquired	Train accident	Unilateral	Enrolled
2.	Female	18	Acquired	Accidental burn	Unilateral	Enrolled
3.	Male	31	Acquired	Car Accident	Unilateral	Enrolled
4.	Male	19	Congenital	Syndrome	Unilateral	Rejected (Patient asked for plastic reconstruction)

5.	Female	14	Congenital	Syndrome	Bilateral	Rejected (Incomplete growth-age must be 16 or more)
6.	Male	17	Congenital	Syndrome	Unilateral	Enrolled
7.	Male	30	Acquired	Tumour	Unilateral	Rejected (radiation was given which render implant placement)
8.	Male	17	Acquired	Tumour	Unilateral	Dropped during the follow-up due to failure to establish hygiene measures

Table 2: Peri-implant soft tissue healing condition.

Peri-implant soft tissues condition Median (Min-Max)	1 month (0-3)	3 months (0-2)	6 months (0-2)	12 months (0-2)
P1	P=0.24			
P2	P=0.286			
P3			P<0.001*	
P4			P=1	
P5				P<0.001*
P6				P=0.242

χ^2_{Fr} : Freidman test
 P: Significance within sessions;
 P1: Significance between 1month and 3month,
 P2: Significance between 3month and 6month, P3:
 Significance between 1month and 6month, P4:
 Significance between 6month and 12month, P5:
 Significance between 1month and 12 month and
 P6: Significance between 3month and 12 months; Sig
 between sessions assessed by Kruskal Wallis Test.*:
 statistically sig <.05

Table 3: Skin thickness assessment of peri-implant tissues

Skin thickness	1 month (N=15)	4 month (N=15)	6 month (N=15)
Median (Min-Max)	3(1-6)	2(1-5)	2(0-5)
P1	P=0.362		
P2		P=0.204	
P3		P=0.002*	

Test*: statistically sig <.05, χ^2_{Fr} : Freidman test, P: Significance within sessions; p1: Significance between 1month and 4month, P2: Significance between 4month and 6month, p3: Significance between 1month and 6month. Sig between sessions assessed by Kruskal Wallis Test.

RESULTS

Regarding implant success, all eleven implants showed significant osseointegration with a 100% success rate. All implants were assessed for hygiene level and reported to be of clinically acceptable hygiene levels during the first three months of healing with minimal skin inflammatory response. Upon evaluation of the peri-implant soft tissue condition at different time intervals of 1 month, 3 months, 6 months, and 12 months. The peri-implant soft tissue condition results in 1st month ranged from grade 0 to grade 3 with a predominance of Grade 1 and no implants showed infection (grade 4) soft tissue reaction.(Table 2)

As for 3, 6, and 12 months intervals, patients showed a range from no irritation of tissues (grade 0), slight redness (grade 1) and red and slightly moist tissue (grade 2) with a predominance of Grade 1 noticed at this time interval. None of them showed granulation and red and moist tissue (grade 3) or infection (grade 4). Although, the statistical difference for the measured peri-implant soft tissue reaction was only significant between 1 and 6-month intervals $P_3 < .001^*$, and between 1 and 12-month intervals was found $P_5 < .001^*$.

While the peri-implant skin thickness varied between patients or even in the same patient but at different intervals and ranged from 1 mm thickness as the most minimal observed reading to 6 mm thickness as the maximum observed one. However, the statistical significance was only reported between values measured at 4 and 6 months ($P=0.002$). (Table3).

DISCUSSION

In the present study, all 11 placed implants showed clinical and radiographic osseointegration with lack of any clinical signs of mobility and pain through the pre-prosthetic and prosthetic phase. This finding is in accordance with Nishimura et al,¹³ and Schlegel et al,¹⁴ who reported a 100% survival rate of using

craniofacial implants in the mastoid region. This was explained by the absence of any pressure on the implant site and the use of delayed loading of implants to minimize any applied load that might interfere with the process of osseointegration.^{4, 15}

Implant survival and extraoral peri-implant tissue health were found to be clinically significant for successful prosthetic reconstruction. The absence of healing abutments to trim the skin around extraoral implants has an influence on the loading of the abutments during the prosthetic phase, in which the thick and hairy nature of the skin around the mastoid region might have a significant inflammatory response which renders the prosthetic fitment. Therefore, in the present study using the specially fabricated caps played a significant role in promoting peri-implant soft tissue healing and preventing crust formation.⁶

These findings agreed with Soliman et. al.⁶ previous technique which demonstrated the efficacy of using high-strength, lightweight, and biocompatible crosslinked auto-polymerized acrylic resin caps as skin former in the extraoral maxillofacial auricular prosthesis.

In this study, the Likert scale was used to assess the peri-implant soft tissue condition at different time intervals of 1, 3, 6 and 12 months which revealed a range of peri-implant soft tissue reactions, with a predominance of (grade I) among the four intervals, Since the variant nature of the skin in the different cases or in the same case among the healing phase, a range of grade 0, I and II was clinically significant during the healing capacity, especially at the initial healing phase earlier to the use of prosthetic abutments.¹² However, the absence of grades III and IV during the healing phase was noticed. These results were correlated to the individual's hygiene protocol and follow-up of the cleaning measures that were assessed and monitored during the pre-prosthetic (1,3,6 months) followed by the prosthetic phase (12 months). Cases with keloid reaction showed resistance to healing capacity and required a strict hygiene measure protocol. Females show being more compliant with cleaning and care protocol during the study which was significantly noticed.¹³

Therefore, on observing the skin healing around the used implants regarding the use of newly custom-made auto-polymerizing acrylic resin healing caps, a markable clinical skin reduction in the peri-implant tissues was observed especially in patients with keloid skin nature. Healing caps helped in creating a compressed reduced and trimmed skin that provided room for prosthetic silicon ears which agreed with Khamis et.al. and Soliman et.al.^{5, 6}

Skin thickness was measured using a plastic periodontal prob and showed a clinically significant reduction during the intervals of 6- and 12-month

recall visits, and between the 1- and 12-month recalls. This again might be attributed to the progressive peri-implant soft tissue healing which was clinically improved after using the custom-made healing caps.¹³

The variant age of the patients, the nature of the skin and the patient hygiene measures showed a significant limitation in the current study which was dependent on the nature of the dictated skin and compliance of the patient to be enrolled in the study.

CONCLUSION

With the availability of multiple abutment connections, the use of intraoral implants is considered a viable alternative to the use of cochlear implants in case of their infeasible. The custom-made healing caps served a great hand in executing a prosthetic ear with adequate retention and stability, especially for cases with massive keloid formation that showed a great challenge to many anaplastologist. The use of economical healing caps served in reducing auricular peri-implant tissue reaction along with approaching the required skin thickness based on the prosthetic need.

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