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Extraoral maxillofacial prosthesis implant retention systems: a critical review.

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Abstract

Objectives: The purpose of this literature review is to provide information on the different available techniques for implant-supported prosthetic retention, which are bar-clip, o-ring or magnets. Through presenting the practitioner preferences reported in literature, although limited from strict comparison due to the heterogeneity of methodologies and studied individuals, this review aims to identify the choices for maxillofacial prosthesis implant retention systems, regarding patient comfort and good aesthetic outcome, as an aid to surgical and prosthetic planning for implant-supported extraoral maxillofacial prosthetics. With proper knowledge of each implant retention system, a practitioner can design a treatment plan which allows for a more natural and comfortable prosthetic.

Methods and Materials: Papers were searched through the PubMed and Scopus databases. The literature search was restricted to papers published from 2001-2013 although patient studies may have been conducted prior to 2001. MeSH terms for the searches were "Maxillofacial Prosthesis" and "Craniofacial Prosthesis OR Craniofacial Prostheses". Overall, 2630 papers were returned. After eliminating duplicates, titles and abstracts were analyzed, 25 papers were filtered and reviewed. Of these, 12 papers were excluded, because they were case reports or non-systematic literature reviews. Of the remaining 13, 10 papers presented group analysis and were deemed appropriate to access practitioner's choices, as cited in the abstract. These papers refer to 1611 prosthesis. Three papers do not mention the type of prosthetic connection chosen, so they were not counted for this purpose.

Results: The most popular choices of retention system for different patient conditions were analysed, even though the sites and corresponding retention systems were not specified in all of the 10 papers based on group analysis. The bar-clip system was the most used in auricular (6 papers out of 10) and nasal prosthesis (4 papers out of 10). For the orbital region, 6 out of the 10 favored magnets.

Conclusions and relevance: Non-osseointegrated mechanical or adhesive retention techniques are the least expensive and have no contraindication. When osseointegrated implants are possible, there is a more commonly used system for each facial region. The choice of implant retention system is mostly determined by two factors: standard practice and maxillofacial surgeon and maxillofacial prosthetist abilities.

Keywords: Facial prosthesis; Extraoral implants; Craniofacial implants

Manuscript Text

INTRODUCTION

The usage of maxillofacial prosthesis is extremely important for social reintegration of patients with deformities, either congenital or acquired (1). Tumoral lesions are one of the main causes of maxillofacial deformities. Most diagnoses are made at an advanced phase of the illness. At such an advanced phase, the treatment generally involves mutilation and life expectancy has little improvement (2). The reconstruction method is determined by many factors; most important being the place of the lesion, its size, etiology, gravity, as well as age and social factors.

The prosthetic rehabilitation process has considerable advantages. For example, prosthesis offers both the surgeon and the patient means to observe wound healing and evaluate the recurrence of illness. In many cases, being a scar-free technique, it has aesthetic superiority over plastic surgery results in cartilaginous sites such as ears, reduced cost, and simplicity of installation. These factors often make prosthesis the best available method for rehabilitation of face mutilations (1).

Facial prosthetics require a means of retention. The main methods of retention involve the use of adhesives, anatomic countersinks, glasses or magnets (3). Over the last two decades, osseointegrated implants have been used to improve the hold and retention of facial prosthesis. However, certain factors can still preclude surgical reconstruction, such as radiation therapy, anatomic complexity, recurring lesions, aspects of the area to be recovered and the complexity of the procedure (4).

Implants have been employed for retention in the intra or extraoral craniofacial regions. These implants can offer excellent support and retention. They eliminate or reduce the need for adhesives. Implants allow appropriate orientation and setting of the prosthesis by the patient, but a satisfactory result can only be achieved by careful planning of number, position and orientation of implants; and in addition the correct bonding between prosthesis and implant retention structure (5).

Oncological patients are frequently treated with surgery and then radiation therapy. Once irradiated, the bone for implant placement can be severely compromised or lost. Its osteogenical potential and microvascularization are reduced. To ameliorate that, there are proposals of therapy with cooperating hyperbaric

oxigenotherapy, after the implant is placed in the irradiated bone (6). The effectiveness of hyperbaric oxigenotherapy is still uncertain, but promising (7).

In recent years, there have been many new developments and advances of extraoral implant retention systems, fixation and anchoring. Modifications have been proposed for dedicated extraoral implant retention systems, found in some of the selected articles (21, 26, 29). The main purpose is to reduce the stress on the supporting bone, thus prolonging the useful life of implants. They represent a significant potential impact on the rehabilitation of patients in need of maxillofacial prosthesis. In a MEDLINE review from 1969 to 2002 (21), Abu-Serriah *et al.* presented the most extensive report on the evolution of extraoral implants. This review was therefore considered a milestone from which to establish the time range of this current critical review. It is furthermore complementary to the review of Barber *et al*. (34), although this is restricted to mandibular and maxillofacial oncological reconstruction.

There are four ways to achieve prosthesis retention: anatomically, mechanically, adhesively and surgically (33). In the present study, the anatomical, mechanical, chemical and surgical anchoring types which do not employ implants for rehabilitation were denominated as non-osseointegrated systems and the surgical anchoring types which employ implants as ways of retaining maxillofacial prosthesis as osseointegrated or implant retention systems. Figure 1 shows external hexagon system extraoral implants analogs transferred in the cast model for laboratorial phase of auricular prosthesis.

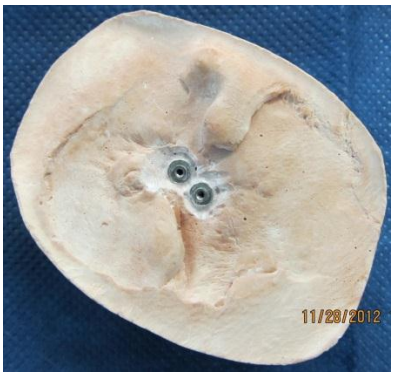

Figure 1- Cast model with external hexagon system extraoral implants analogs.

The purpose of this paper is to review the evolution of osseointegrated retention systems of maxillofacial prosthesis from 2001 to 2013. The inclusion criteria are limited to those based on bar-clip, o-ring

or magnet-retention. The analysis comprises the following variables: survival rates of implants along time; average patient age; etiology of facial defect; type of retention systems related to the site of prosthesis.

METHODS AND MATERIALS

To aggregate the relevant references, we performed a bibliographic search in electronic databases. We focused on searching for papers which report on the application and/or evolution of systems of fixation and retention in maxillofacial prosthesis. PRISMA Guidelines were followed. Registration on Cochrane Database was not undertaken because the study is exploratory in nature. The risk of bias was made by the domain bias of performance and detection.

EndNote® software (Thomson-Reuters Corporation, New York, NJ, USA) was employed to enable storage and organization of references obtained in database searches.

The research is based on the following question: how have osseointegrated retention techniques for maxillofacial prosthesis on patients with facial defects been adopted in clinical practice over the period 2001-2013? The period was chosen to cover a different time range from previous, non-systematic, existing literature reviews accessed from 10/10/2012 to 04/17/2014 (21, 22, 25, 26, 27).

As an approach to answering this question, we considered comparing the existing osseointegrated implant systems, analyzing a few variables, such as: survival rate of implants along time, average age of patients, etiology of facial defect and site of retention system related to the type of prosthesis.

Based on this main question, a protocol was developed, with inclusive criteria based on the PICO (Patient, Intervention, Comparison, Objectives) classification, as follows:

P: Patients with need of rehabilitation with extraoral facial prosthesis.

I: System of retention of extraoral prosthesis.

C: Osseointegrated systems X Non-osseointegrated systems.

O: Type of retention employed to fix extraoral prosthesis, survival rate of implants along time, average age of patients, facial defect etiology and site of retention systems.

The following papers were excluded: papers of literature review and case reports; papers not written in English, German or Portuguese; papers that do not fulfill the inclusion criteria; papers that were not published between 2001 and 2013.

We searched for papers using both PubMed and SCOPUS, as they are focused on the health sciences and have a large database of papers available for searches.

To extract keywords for our search, we started by randomly choosing a few papers in the area of facial rehabilitation. They had as main subjects: retention, fixing and anchoring extraoral systems, and also provided evidence of possible studies to be included in the systematic review. Then, a group of keywords relevant to the research objectives were extracted from the selected papers.

Afterwards, from these keywords, we extracted the most relevant descriptors. Free words were utilized to filter the results obtained in the descriptor search. Finally, a bank of descriptors of Medical Subject Headings (MeSH-PubMed) was assembled.

Among the most relevant descriptors, the chosen term was "Maxillofacial Prosthesis" and in the free terms "Craniofacial Prosthesis OR Craniofacial Prostheses" were selected.

The term selection for the database search was wide to avoid the non-inclusion of relevant papers. If the search was elaborated with more specific descriptors, perhaps some relevant papers could be excluded.

For the searches using Medline (PubMed), the following strategies were employed, using the "advanced search" feature:

- Strategy 1: MeSH Terms + Maxillofacial Prosthesis
- Strategy 2: All Fields: Craniofacial Prosthesis OR Craniofacial Prostheses
- Filter: From 2001 to 2013.

For Scopus, we used the same terminology as the search in Medline, with the caveat that Scopus does not have controlled vocabulary. The strategies employed were:

Strategy 1 – ALL ("maxillofacial prosthesis")

Strategy 2 – ALL ("craniofacial prosthesis" OR "craniofacial prostheses")

Filter: 2001 to 2013

The selection of papers to be included in the review was based on the following steps:

1: After performing the database searches, we evaluated the titles of all the papers.

2: The papers whose titles matched our review proposition were pre-selected; then, we read their abstracts.

3: The papers whose abstract indicated relevance to our research objective were read entirely. We checked if they fulfill our inclusion requirements, or were to be eliminated by exclusion criteria. When there was doubt from reading only the abstracts, the entire text was read, in order to avoid research bias.

4: After inclusion and exclusion criteria analysis was performed by double-blind investigators

For the aggregated results, 2,630 thousand references were analyzed according to titles and article abstracts; eliminating duplicates, according to the procedure depicted in the PRISMA Flowchart presented in Figure 2. After this analysis, we chose 25 papers, and two double-blind investigators reviewed and evaluated these papers according to previously mentioned inclusion and exclusion factors. Analyzed papers for which the investigator responses differed to our own were reassessed, in order to achieve an inclusion or exclusion consensus, avoiding bias.

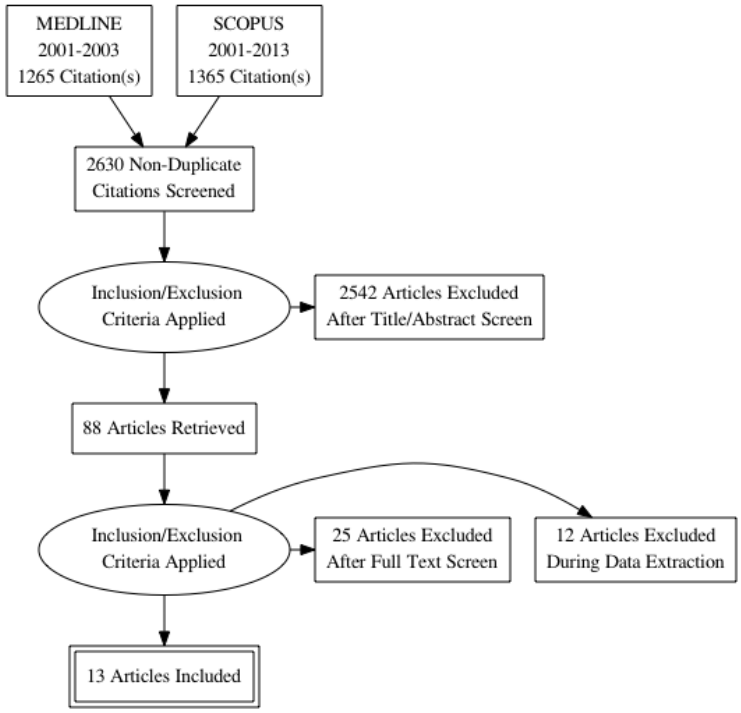

Figure 2 **-** PRISMA flowchart of methodology employed.

RESULTS

The search results at Medline and Scopus databases filtered according to PRISMA method shown in Figure 2were exported to the reference manager EndNote®. The duplicated references in both databases were excluded, as described in Table 1.

Database	Strategy	Result	Selected Papers
Medline # 1	Maxillofacial Prosthesis	416	09
Medline # 2	Craniofacial Prosthesis OR Craniofacial Prostheses	849	32
Medline # 1+2	Total	1265	41
Scopus # 1	Maxillofacial Prosthesis	462	12
Scopus # 2	Craniofacial Prosthesis OR Craniofacial Prostheses	903	35
Scopus # 1+ 2	Total	1365	47
Medline+Scopus	Total	2630	25

Table 1- Result of searches in database according to search strategies employed.

After these steps, of the 25 selected papers, 13 were included in this study (shown in Table 2), while the other 12 were excluded. Single case reports and literature reviews without implant survival rates data were excluded.

The included papers were analysed according average age in years, etiology, prosthesis type, region of implant placement, choice of retention system per maxillofacial region, number of implants, diameter and length of implants, submission to radiation therapy, implants in irradiated area before and after radiation therapy, and number of lost implants. Even though the research subjects could have been treated over the years prior to the date of paper publication, this was not considered to disqualify them from the investigation range. The results are summarized in Table 2, in which the papers are ordered chronologically in terms of publication date.

The collected data shows the different approaches of the workgroups, mainly regarding the choice of prosthetic system over implants. Another important feature to be noted is the heterogeneity of both etiology and age range. The publication by Hatamleh *et al.*, (1) does not specify any information about the patients, but it presents valuable data about practitioners' choices for maxillofacial prosthetics.

General data								
Reference	**Year**	**Number of individuals**	**Sex**	**Individuals submitted to radiation therapy**	**Average age in years (min-max)**	**Period**	**Etiology**	**Total number of prosthesis**
P. J. Schoen *et al.* (8)	2001	26 individuals	20 ♂ 6 ♀	12	(23-86)	1988-1998	26 neoplastic	26
P. Scolozzi, B. Jaques (9)	2003	26 individuals	13 ♂ 13 ♀	18	67 (32-87)	1995-2001	26 neoplastic	26
B. A. Miles, D. P. Sinn, G. G. Gion (10)	2006	32 individuals	24 ♂ 8 ♀	1	29,1 (1,5-66)	1994-2004	9 congenital 6 neoplastic 8 trauma 7 burnt 1 fungical 2 syndromes	34
S. Karakoca *et al.* (11)	2008	33 individuals	23 ♂ 10 ♀	9	45,4 (10-75)	2003-2007	5 congenital 19 neoplastic 6 trauma 3 burnt	33
A. Leonardi *et al.* (12)	2008	33 individuals	-	4	-	2002-2008	12 congenital 8 neoplastic 8 trauma 7 infection	35
A. Visser *et al.* (13)	2008	95 individuals	65 ♂ 30 ♀	33	(8-86)	1988-2003	24 congenital 59 neoplastic 12 trauma	95
M. M. Hatamleh, *et al.* (14)	2010	220 maxillofacial prosthetists and technologists (MPTs)	-	-	-	1 year	-	1193
B. Karayazgan-Saracoglu *et al.* (15)	2010	52 individuals	35 ♂ 17 ♀	21	46,8 (7-78)	7 anos	4 congenital 41 neoplastic 7 traumas	52
B. J. Benscoter *et al.* (17)	2011	8 individuals	6 ♂ 2 ♀	4	46 (15-77)	2003-2010	1congenital 5neoplastic 1 trauma	8
G. Pekkan, S.H. Tuna, F. Oghan (16)	2011	10 individuals	5 ♂ 5 ♀	3	37 (13-62)	2001-2006	4 congenital 5 neoplastic 1 trauma	10
S. Karakoca-Nemli *et al.* (19)	2012	20 individuals	14 ♂ 6 ♀	7	34,1 (10-72)	2007-2009	6 congenital 10 neoplastic 4 trauma	20
J. A. P. Oliveira *et al.* (20)	2013	59 individuals	41 ♂ 18 ♀	14	-	1995-2010	59 neoplastic	59

Table 2 **–** General data from included papers.

Prosthesis characteristics								Implant characteristics				
Reference	**Prosthesis type**	**Retention system x region**						**Number of implants**	**Number of implants X region**	**Implants in irradiated area (before and after radiation therapy)**	**Diameter / Length (in mm)**	**Implant Loss**
P. J. Schoen *et al.* (8)	13 auricular 13 orbital		Magnets	Bar-clip				75	26 auricular 49 orbital	6 auricular after 21 orbital before 14 orbital after	- 3 a 10	3 before radiation therapy 2 after radiation therapy
		Auricular	-	13								
		Orbital	13	-								
P. Scolozzi, B. Jaques (9)	11 orbital 4 orbital and nasal 3 orbital-nasal and maxillar 8 nasal		Magnets	Bar-clip				62	27 orbital 12 orbital and nasal 3 orbital-nasal and maxillar 8 nasal	38	3,3 ou 4,1 8 a 10	0
		Orbital	1	10								
		Orbital and nasal	-	4								
		Orbital-nasal and maxillar	-	3								
		Nasal	-	8								
B. A. Miles, D. P. Sinn, G. G. Gion (10)	22 auricular 9 orbital 2 nasal 1 frontal			Magnets				114	72 auricular 31 orbital 7 nasal 4 frontal	-	3,5 5,5	8
		Auricular		22								
		Orbital		9								
		Nasal		2								
		Frontal		1								
S. Karakoca *et al.* (11)	14 auricular 10 orbital 9 nasal		Magnets	Bar-clip				98	43 auricular 31 orbital 24 nasal	24	4,1 2,5 a 10	8
		Auricular	-	14								
		Nasal	2	7								
		Orbital	8	2								
A. Leonardi *et al.* (12)	21 auricular 4 orbital 8 nasal 2 midface	14 bar-clip 42 magnets	111	-				-	-	3	-	3
A. Visser *et al.* (13)	60 auricular 26 orbital 9 nasal		Magnets	Bar-clip				270	153 auricular 99 orbital 18 nasal	104	- 3 a 10	22 irradiated 8 non-irradiated
		auricular	-	60								
		orbital	-	26								
		nasal	most	A few								
M. M. Hatamleh, *et al.* (14)	31% auricular 13% orbital 42% ocular 12% nasal 1% mixed		Bar-clip	Adhesive	Anatomical	Mechanical	Magnets	-	-	-	-	-
		Auricular	71%	19%	10%	1%	-					
		Orbital	4%	48%	-	16%	32%					
		Nasal	17%	45%	30%	8%	-					
		Ocular	-	-	100%	-	-					
B. Karayazgan-Saracoglu *et al.* (15)	14 auricular 17 orbital 12 nasal 9 midface		Magnets	Bar-clip				159	32 auricular 54 orbital 37 nasal 36 midface	68	- 3,5 a 5	7 irradiated 6 non-irradiated
		Orbital	17	-								
		Nasal	12	-								
		Midface	9	-								
		Auricular	-	14								
B. J. Benscoter *et al.* (17)	7 auricular 1 orbital	-						27	25 auricular 2 orbital	15 auricular	-	1 irradiated
G. Pekkan, S.H. Tuna, F. Oghan (16	7 auricular 3 orbital	-						16	6 auricular 3 orbital 7 orbital and zygoma	-	3,3 3,5 a 5	3
S. Karakoca-Nemli *et al.* (19)	10 auricular 10 orbital		Magnets	Bar-clip				54	26 auricular 28 orbital	-	3,3 2,5 a 4	4 irradiated orbitals
		Auricular	-	10								

Table 3 **–**Retention systems, number of implants and radiation therapy factor..

DISCUSSION

Practitioner choices of extraoral maxillofacial prosthesis implant retention systems.

We have preferred the term “practitioner’s choice” due to the fact that implants may have been placed by a maxillofacial surgeon, and the extraoral prosthesis could be either designed and made by the same practitioner or by, for example a prosthodontist.

Each workgroup presented a different preference regarding the retention methods. In an attempt to surpass the difficulty of comparing different methodologies, the outcomes were expressed in terms of percentage.

Widely commercially available osseointegrated implant retention systems, (bar-clip, o’ring or magnets) were considered in this review, while unique osseointegrated implant retention systems with different design were omitted.

Bar-clip was the choice for all auricular prosthesis by Schoen *et al*. (8), Karakoca *et al*. (11), Visser *et al.* (13), Karayazgan-Saracoglu *et al*. (15) and Karakoca-Nemli *et al*. (19). Hatamleh *et al.* (14) describe bar-clip as the choice for 71% of the auricular prosthesis performed in the UK. Curi *et al*. (18) applied bar-clip for 10.25% of the auricular prosthesis.

For the nasal region, Visser *et al.* (13) employed bar-clip retention in all prosthesis. Karakoca *et al*. (11) chose bar-clip retention for 77.77% of patients. Curi *et al*. (18) report the use of bar-clip retention for only 4.28% of prosthesis in the midface complex.

For orbital region, Karakoca *et al*. (11) chose bar-clip retention for 20% of patients, Hatamleh *et al.* (14) for 4%.

Magnet retention was the choice for all sites by Miles, Sinn and Gion (10). Schoen *et al.* (8) applied them to orbital prosthesis. Scolozzi and Jaques (9) employed magnetic retention for 9.9% of the cases in the orbital region.

Karayazgan-Saracoglu *et al*. (15) report magnet-retention for all nasal and midface prosthesis . Karakoca *et al*. (11) chose magnets for 22.22% of nasal prosthesis. Hatamleh *et al.* (14) report 8% practitioner’s

choice for magnets in the nasal region. Curi *et al*. (18) describe 10.71% magnet retained prostheses in the midface complex.

For the orbital region, Karayazgan-Saracoglu *et al*. (15) chose magnet retention for all cases. Curi *et al*. (18) applied magnets for 85.71% of the orbital prosthesis. Karakoca *et al*. (11) chose magnet retention for 80% of patients. Hatamleh *et al.* (14) describe 32% of practitioner's choices being magnets for the orbital region.

Leonardi *et al*. (12) don't specify the site, but state that 75% of the prosthesis was magnet retained and 25% bar-clip retained.

Regarding implant-supported methods, each one has to fit with practitioner abilities and bone quality. For instance, magnets are less stressful in comparison to bar-clip and may allow longer implant useful life, but it depends on the bone quality prior to the implant installation.

Age of rehabilitated individuals.

Schoen *et al*. (8) worked with individuals from 23 to 86 years old, an average age of 54.5 years. Scolozzi and Jaques (9) worked with individuals from 32 to 87 years old, an average age of 67 years. Miles, Sinn and Gion (10) worked with individuals from 1.5 to 66 years old, an average age of 29.1 years. Visser *et al*. (13) worked with individuals from 8 to 86 years old, average age of 47 years old. Karakoca *et al*. (11) worked with individuals from 10 to 75 years old, average age of 45.4 years old. Karayazgan-Saracoglu *et al*. (15) worked with individuals from 7 to 78 years old, average age of 46.8 years old. Pekkan, Tuna e Oghan (16) worked with individuals from 13 to 62 years old, average age of 37 years old. Benscoter *et al*. (17) worked with individuals from 15 to 77 years old, average age of 46 years old. Curi *et al*. (18) worked with individuals from 9 to 85 years old, average age of 48.2 years old. Karakoca-Nemli *et al*., (19) worked with individuals from 10 to 72 years old, average age of 34.1 years old.

Etiology of facial defects.

On Table 2, the etiology of facial defects found on each paper is described. Schoen *et al*. (8), Scolozzi and Jaques (9) and Oliveira *et al*. (20) had all cases of neoplastic causes. Miles, Sinn and Gion (10) found the causes distribution of 28.12% congenital, 18.75% neoplastic, 25% trauma, 21.8 % burnts, 3.12% fungal and

6.25% syndromic. Visser *et al.* (13) found the causes distribution of 25.26% congenital, 62.10% neoplastic and 12.63% trauma. Leonardi *et al*. (12) found the causes distribution of 36.36% congenital, 24.24% neoplastic, 24.24% trauma and 21.21% infections. Karakoca *et al*. (11) found the causes distribution of 15.15% congenital, 57.7% neoplastic, 18.18% trauma and 9.09% burnts. Karayazgan-Saracoglu *et al*. (15) found the causes distribution of 7.69% congenital, 78.84% neoplastic and 13.46% trauma. Pekkan, Tuna e Oghan (16) found the causes distribution of 40% congenital, 50% neoplastic and 10% trauma. Benscoter *et al*. (17) found the causes distribution of 12.5% congenital, 62.5% neoplastic and 12.5% trauma. Curi *et al*. (18) found the causes distribution of 8.9% congenital, 76.78% neoplastic and 14.28% trauma.Karakoca-Nemli *et al*. (19) found the causes distribution 30% congenital, 50% neoplastic and 20% trauma.

Implant success rates in non-irradiated areas versus irradiated areas.

Table 3 shows that non-irradiated areas tend to have the best success rates, with no loss of implants as described by Schoen *et al*. (8), Karacoca-Nemli *et al*., (19) and Benscoter *et al.*, (17). Scolozzi and Jaques (9) report no implant loss in either irradiated or non-irradiated areas, while, in contrast, Curi *et al.*, (18) report an implant loss rate of 4.6% in non-irradiated areas but do not consider implant loss in irradiated areas. In non-irradiated areas, implant loss rates found were 2.96% by Visser et al. (13), 3.77% by Karayazgan-Saracoglu *et al.* (15), 3.65% by Oliveira *et al.* (20). In irradiated areas, the implant loss rates found were of 2.66% Schoen *et al.*, (8), 7.4% Karacoca-Nemli *et al*. (19), 8.14% by Visser *et al*. (13), 4.4% by Karayazgan-Saracoglu *et al.* (15), 3.7% by Benscoter et al. (17), and 1.21% by Oliveira *et al.*, (20).

Advantages and Disadvantages of Osseointegrated Systems Compared to Non-Osseointegrated Systems

While the primary scope of this review is extraoral maxillofacial prosthesis implant osseointegrated retention systems, other non-osseointegrated and mixed region retention methods (chemical or mechanical) are cited in some papers. Three of the reviewed papers considered intraoral-extraoral combination implants. Scollozzi and Jacques (2003) include in their results orbit-naso-maxillary regions (intraoral-extraoral combination). In this case, the retention was entirely by bar-clip retention system. Curi *et al.* (2012) consider both magnets and bar-clip retention systems for midface complex regions. Karayazgan-Sarocoglu *et al.* (2010)

employ only magnets for the midface. The advantages and disadvantages of mechanical or adhesive retention over any of the osseointegrated retention systems (o'ring, bar-clip, or magnets) are listed below:

Advantages:

- Less discoloration and degradation of prosthesis on account of not employing adhesives and solvents;
- Quality of life improvement;
- Better effectiveness in fixation providing more security;
- Proper prosthetic positioning;
- Implants may be inserted during or after ablative surgery;
- Longer prosthesis durability;
- Predictable retention;
- Better esthetics and disguise due to thinner rims in the silicon prosthesis;
- High rate of osseointegration success;
- More safety regarding retention, providing a more active life;
- Sportive practice without the concern of sweating and dissolving adhesives;
- Better hygienization;
- Easier follow-up on premature detection of possible recidivism.

Disadvantages:

- Economic factors – higher cost;
- Special laboratories procedures;
- Larger time of conclusion;
- Need of control appointments with practitioners;
- Difficult of cleaning leads to risk of infection;
- Requirement for input from multiple disciplinary specialists;
- Need of new surgical intervention.

CONCLUSION

Given the complexity of the process and wide range of types of mutilation, there is a diverse range of information available on maxillofacial prosthesis retention systems as a result of rather heterogeneous research in this area. However, some consensus of practitioner's preferences can be gleaned from the literature.

The reviewed papers do not present consistent evidence of change or development of practice, based on patient response. The papers indeed give a feeling of diversity of preferences favoured in individual centers. The extraoral maxillofacial prosthesis implant retention systems have evolved more due to biological responses from the tissues, and the aesthetical factors than from the patients' preferences. The practitioners abilities and availability of resources also play a big role.

Whenever it is possible to employ osseointegrated implants, they are the first choice because they provide the best retention for extraoral maxillofacial prosthesis. It is important to stress that there is commonly a preferential choice depending on the implant area. For auricular prosthesis, the bar-clip system was the most chosen. In oculopalpebral and nasal regions, either bar-clip or magnets may be selected. The choice is principally governed by two factors: indication and practitioner ability.

There are several choices for the retention of extraoral maxillofacial prosthesis, wherein are also very valuable non-osseointegrated mechanical or adhesive retention techniques. They are the least expensive and present no contraindication.

Future works in maxillofacial prosthetics retention should seek a standardized research design, with common evaluation parameters such as patient reported outcomes (for instance, the World Health Organization Quality of Life Instruments - WHOQOL).

We suggest standardizing analysis through protocols and multicenter studies to overcome the difficulties associated with samples sizes, thereby facilitating the establishment of scientific evidences of different controversial clinical issues helping the development of future systematic reviews for the area.

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REFERENCES

1. Goiato MC, Tabata LF, Archangelo CM, Júnior MM. Uso de Implantes Osseointegrados Associados a Sistemas de Retenção nas Reabilitações com Prótese Bucomaxilofacial: Revisão de Literatura. *Pesquisa Brasileira em Odontopediatria e Clínica Integrada. 2007;7(3).*

2. Antunes AA, de Carvalho RWF, Neto AL, Loretto NRM. [Utilização de Implantes Ósseointegrados para Retenção de Próteses Buco-Maxilo-Faciais: Revisão da Literatura.] Portuguese. *Rev Ci. Traumatol Buco-Maxilo-Fac., Camaragibe, 2008; 8(2):9 – 14.*

3. Cardoso RJA, Gonçalves EAN, editors. *[Oclusäo/ATM/Prótese/Prótese sobre implantes/Prótese bucomaxilofacial]; Occlusion/TMJ/Prosthesis/implant-supported prosthesis/Bucomaxillofacial prosthesis*. Portuguese. Congresso Internacional de Odontologia de Säo Paulo, 20; 2002: Artes Médicas.

4. Fornelli RA, Fedok FG, Wilson EP, Rodman SM. Squamous cell carcinoma of the anterior nasal cavity: a dual institution review. *Otolaryngol Head Neck Surg. 2000;123(3):207-10.*

5. Nadeau J. Special prosthesis. *J Prosthet Dent*. 1968;20(1):62-76.

6. NaBadalung DP. Prosthetic rehabilitation of a total rhinectomy patient resulting from squamous cell carcinoma of the nasal septum: a clinical report. *J Prosthet Dent. 2003;89(3):234-8.*

7. Allen PF, Watson G, Stassen L, McMillan AS. Peri-implant soft tissue maintenance in patients with craniofacial implant retained prosthesis. *Int J Oral Maxillofac Surg. 2000;29(2):99-103.*

8. Schoen PJ, Raghoebar GM, van Oort RP, Reintsema H, van der Laan BF, Burlage FR, et al. Treatment outcome of bone-anchored craniofacial prosthesis after tumor surgery. *Cancer. 2001;92(12):3045-50.*

9. Scolozzi P, Jaques B. Treatment of midfacial defects using prosthesis supported by ITI dental implants. *Plastic Reconstr Surg*. 2004;114(6):1395-404.

10. Miles BA, Sinn DP, Gion GG. Experience with cranial implant-based prosthetic reconstruction. *J Craniofac Surg. 2006;17(5):889-97.*

11. Karakoca S, Aydin C, Yilmaz H, Bal BT. Survival rates and periimplant soft tissue evaluation of extraoral implants over a mean follow-up period of three years. *J Prosth Dent. 2008;100(6):458-64.*

12. Leonardi A, Buonaccorsi S, Pellacchia V, Moricca LM, Indrizzi E, Fini G. Maxillofacial prosthetic rehabilitation using extraoral implants. *J Craniofac Surg. 2008;19(2):398-405.*

13. Visser A, Raghoebar GM, van Oort RP, Vissink A. Fate of implant-retained craniofacial prosthesis: life span and aftercare. *Int J Oral Maxillofac Implants. 2008;23(1).*

14. Hatamleh M, Haylock C, Watson J, Watts D. Maxillofacial prosthetic rehabilitation in the UK: a survey of maxillofacial prosthetists' and technologists' attitudes and opinions. *Int J Oral Maxillofac Surg*. *2010;39(12):1186-92.*

15. Karayazgan-Saracoglu B, Zulfikar H, Atay A, Gunay Y. Treatment outcome of extraoral implants in the craniofacial region. *J Craniofac Surg*. 2010;21(3):751-8.

16. Pekkan G, Tuna S, Oghan F. Extraoral prosthesis using extraoral implants. *Int. J Oral Maxillofac Surg*. 2011;40(4):378-83.

17. Benscoter BJ, Jaber JJ, Kircher ML, Marzo SJ, Leonetti JP. Osseointegrated implant applications in cosmetic and functional skull base rehabilitation. *Skull Base*. 2011 Sep;21(5):303-8.

18. Curi MM, Oliveira MF, Molina G, Cardoso CL, De Groot Oliveira L, Branemark P-I, et al. 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(7):1551-7.

19. Karakoca-Nemli S, Aydin C, Yilmaz H, Sarisoy S. Stability measurements of craniofacial implants by means of resonance frequency analysis: 1-year clinical pilot study. *Int J Oral Maxillofac Implants*. *2012 Jan-Feb;27(1):187-93.*

20. Oliveira JA, Abrahao M, Dib LL. Extraoral implants in irradiated patients. *Braz J Otorhinolaryngol*. *2013 Mar-Apr;79(2):185-9.*

21. Abu-Serriah M, McGowan D, Moos K, Bagg J. Extra-oral craniofacial endosseous implants and radiotherapy. *International journal of oral and maxillofacial surgery*. *2003;32(6):585-92.*

22. Granström G. Craniofacial osseointegration. *Oral diseases*. *2007;13(3):261-9.*

23. Gentile P, Nicoli F, Caruso R, Gravante G, Cervelli V. Alternative strategy to reconstruct the nose after excision: extra-oral implant anchored to bone. *British Journal of Oral and Maxillofacial Surgery*. *2009;47(1):50-1*.

24. Gumieiro EH, Dib LL, Jahn RS, Santos Junior JF, Nannmark U, Granstrom G, et al. Bone-anchored titanium implants for auricular rehabilitation: case report and review of literature. *Sao Paulo Med J. 2009;127(3):160-5.*

25. Goiato MC, Santos DM, Danelon M, Pesqueira AA, de Carvalho Dekon SF, Fajardo RS. Hyperbaric oxygen: therapy for patients with maxillofacial implants? *J Craniofac Surg*. *2009;20(5):1519-22.*

26. Federspil PA. [Implant-retained craniofacial prosthesis for facial defects.] German. *GMS Curr Top Otorhinolaryngol Head Neck Surg*. *2009;88:S125-38.*

27. Ihde S, Kopp S, Gundlach K, Konstantinović V. Effects of radiation therapy on craniofacial and dental implants: a review of the literature. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. *2009;107(1):56-65.*

28. Greig AV, Jones S, Haylock C, Joshi N, McLellan G, Clarke P, et al. Reconstruction of the exenterated orbit with osseointegrated implants. *J Plast Reconstr Aesthet Surg*. *2010 Oct;63(10):1656-65.*

29. Federspil PA. [Craniofacial prosthesis for facial defects]. German. *HNO*. *2010 Jun;58(6):621-31*; quiz

30. Goiato MC, dos Santos DM, de Carvalho Dekon SF, Pellizzer EP, Santiago JF Jr., Moreno A. Craniofacial implants success in facial rehabilitation. *J Craniofac Surg. 2011 Jan;22(1):241-2.*

31. Goiato MC, dos Santos DM, Haddad MF, Moreno A. Rehabilitation with ear prosthesis linked to osseointegrated implants. *Gerodontology. 2012;29(2):150-4.*

32. Sharma A, Rahul GR, T Poduval S, Shetty K. Implant-Supported Auricular Prosthesis - An Overview. *Journal of Oral Implantology*. *2012.* [Epub ahead of print] PMID:22913280

33. Cordeiro PG, Disa JJ, editors. *Challenges in midface reconstruction. Seminars in surgical oncology*; 2000: Wiley Online Library.

34. Barber, A.J.; Butterworth, C.J.; Rogers, S.N. Systematic review of primary osseointegrated dental implants in head and neck oncology. *British J Oral Maxillofac Surg. 2011;49: 29–36.*