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Management of Maxillary Cluster Implant Failures with Extra-Maxillary Implants: A Clinical Report

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Abstract

Late cluster implant failures can be one of the most devasting outcomes of implant therapy for patients. It can have anatomic, functional, psychological and financial consequences for patients, and sometimes the loss of residual bone can preclude subsequent implant placement. Fortunately, management of cluster implant failures in the maxilla can be mitigated by using implant anchorage from remote sites like zygomatic and pterygoid regions. Few reports exist in the literature that have described the management of cluster implant failure using extra-maxillary implants such as zygomatic and pterygoid implants. This case report describes the management of a female patient with bruxism who experienced late cluster implant failure in the maxilla after 9 years of function with an overdenture. Due to the loss of residual bone, subsequent implant therapy involved the use of bilateral zygomatic, pterygoid and anterior maxillary implants, which were immediately loaded and thereafter used to support a complete arch fixed implant-supported zirconia prosthesis.

Risk factors of late implant failure described in the literature are poor bone quality, smoking, uncontrolled periodontal disease, short and/or small implants, compromised systemic health and parafunctional habits.[1-5] Cluster failure of dental implants is an infrequent occurrence and has been described as the failure of one or more implants in a patient, irrespective of the site.[2,3,5] To further understand cluster failure, cluster patients have also been described further, as a specific high-risk group of individuals in whom cluster implant failure happens.[2] Additionally, "cluster phenomena" has been described as a scientific finding, where a minority of patients in an observed sample, suffer the majority of implant failures.[2] Presently, there is no definitive etiology or consensus in the literature for cluster failure, but one or more factors relating to type of implants, implant sites, patient, clinician, and type of prosthesis have been described in the literature.[1-5]

In one of the first studies on this topic, Schwartz-Arad et al[3] reviewed the failure characteristics of implants among 3609 implants placed between 1997 and 2004 and identified 18 patient, implant and prosthetic causes for implant failure. Out of 99 failures, they found that cluster failure was present in 32.8% of the patients, who accounted for 56.6% of all 99 implant failures. This cluster pattern was evident in both the surgical and prosthetic phase failures, with the common signs for failure being implant mobility (surgical phase) and infection and marginal bone loss (prosthetic phase).[3] In another large sample study published in 2017, Chrcanovic et al[2] reported on 1406 patients with a total of 8337 implants, where each patient had a minimum of 3 implants placed. Of the 592 implant failures, 56% of the failures occurred in less than 5% of the patients in the study. The authors identified factors such as age, smoking, bruxism, antidepressant medications, and medications to reduce gastric acid production as possible patient-related factors associated with implant failure, and the predictive pattern for cluster failure among patients with previous implant failure was simply noted as "highly probable".[2]

For patients with maxillary deficiency or atrophic maxilla, extra-maxillary implants such as zygomatic and pterygoid implants offer a predictable solution, and reduce or eliminate the need for any bone grafting and sinus elevation procedures, and provide a favorable implant distribution for appropriate prosthetic support.[6-8] Branemark advocated anchorage of the

Figure 1 Patient's pretreatment smile with previous complete denture reveals significant wear of all teeth due to bruxism, and compromised esthetics and occlusal plane.

Figure 2 Occlusal view of the mandible shows minor porcelain fracture on tooth no. 19 as well as an uncemented anterior fixed dental prosthesis, all confirming patient's bruxism habit.

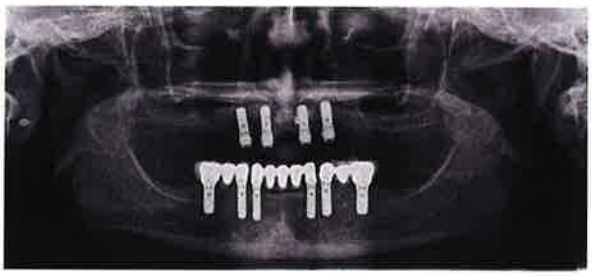

Figure 3 Panoramic radiograph obtained from patient's records 9 years ago before maxillary cluster implant failure shows significant bone loss in all maxillary implants. Note that mandibular implants had stable bone levels.

zygomatic bone as a means to rehabilitate the atrophic maxilla in late 1990s, and since then numerous studies have described survival rates of these implants up to 98% and with immediate loaded zygomatic implants have a lower failure rate than when using delayed loading protocols.[7,8] Pterygoid implants was first advocated by Tulasne in 1989 and employed an increased tilt of implants to engage the dense cortical bone of the pterygoid process of the sphenoid bone, and elimination of any distal cantilevers.[9] The survival rate of roughened surface pterygoid implants has been reported to be 95%.[9]

In patients with a history of cluster failure, previous reports have advocated placement of new implants at former sites and additional sites.[5,10] However, recent studies on retreatment have shown that implants placed in sites of previous implant failure had inferior survival rates than those of the initial implants, and that the survival rates are consecutively lower with each successive reimplantation at the same site.[11,12] Extra-maxillary implants have not been previously reported for cluster failure patients, and offer the distinct advantage of utilizing a different site, different bone composition and longer implant than previously attempted implant sites. The benefits of cortical bone present in zygomatic and pterygoid sites also offer the opportunity for increased primary stability and immediate loading, to ameliorate the functional and psychological challenges in cluster patients.[6-9]

Therefore, the purpose of this clinical report is to describe the prosthodontic management of a female patient with bruxism and history of cluster implant failure in the maxilla by using bilateral zygomatic and pterygoid implants to support a complete arch fixed implant-supported zirconia prosthesis.

Clinical report

A 59-year-old Caucasian female presented to the prosthodontist, requesting a fixed prosthodontic solution for her edentulous maxilla. The patient had an existing maxillary denture with significant wear and compromised esthetics (Fig 1). The patient, a nonsmoker with hypertension, had no additional contributory medical history. Her dental history indicated that she was a known bruxer and had extensive dental treatment in the past. The patient reported extensive endodontic and prosthodontic treatment for many years before she became edentulous. She received 6 implants (Tissue Level Implants; Straumann) in the mandible 15 years earlier, with 3 segmented fixed dental prostheses which were cement retained. Minor porcelain chipping was present on tooth no. 19. The patient stated that she recently lost her anterior segmented after it became uncemented from the abutments (Fig 2).

The patient stated that she received 4 implants (Tissue Level Implants; Straumann) in the maxilla, a year after her mandibular implants, in order to support a maxillary overdenture on 4 solitary abutments (Locator; Zest Dental Solutions) with palateless/horseshoe design. During subsequent years, the patient had progressive bone loss and 9 years later, had a cluster implant failure of all 4 implants in the maxilla (Fig 3). Since then, the patient had been wearing a maxillary complete denture with continued atrophy of the maxillary ridge (Fig 4). New panoramic radiograph and periapical radiographs and cone beam computed tomographic (CBCT) imaging were obtained. The mandibular implants all had good bone levels and all implants were in function, and deemed osseointegrated (Fig 5). The maxilla however exhibited significant destruction of bone in the former implant sites (Fig 6).

Based on the patient's extensive dental history, clinical and radiographic findings, the patient was diagnosed with an

Figure 4 Occlusal view of the maxilla shows an atrophic ridge with a shallow palatal vault and compromised labial vestibule due to the significant bone loss.

Figure 5 Panoramic image shows the bone loss in the maxilla and the stable bone levels in all mandibular implants.

ACP-PDI class IV edentulous maxilla.[9] Given the patient's desires for a fixed prosthodontic solution, her history of cluster failure, bruxism, and risk assessment for edentulous maxilla, a treatment plan was developed to place bilateral zygomatic and pterygoid implants and additional "reserve" implants in available sites. The CBCT revealed residual bone in the anterior maxillary region around the nasal cavity, to allow apical engagement of implants at the lateral pyriform rim and underneath the floor of the nose just anterior to the incisive canal. The treatment plan encompassed immediate loading of the extra-maxillary implants and incorporation of the anterior maxillary implants if they attained sufficient primary stability. After healing of all maxillary implants, they were planned for being restored with a maxillary complete arch fixed implant supported prosthesis (CAFIP) made of monolithic zirconia. The mandibular anterior segment was planned on being restored with a new cement-retained monolithic zirconia fixed dental prosthesis supported by existing titanium abutments.

First, a new maxillary complete denture was fabricated to optimize esthetics and occlusion. A new interim acrylic resin prosthesis was also made for the mandibular anterior region. Using standardized sterile surgical protocols, bilateral zygomatic and pterygoid implants were first placed (Fig 7). All the extra-maxillary implants achieved bi-cortical anchorage with excellent primary stability. The zygomatic implants (Branemark System Zygoma; Nobel Biocare) were 40 mm in length

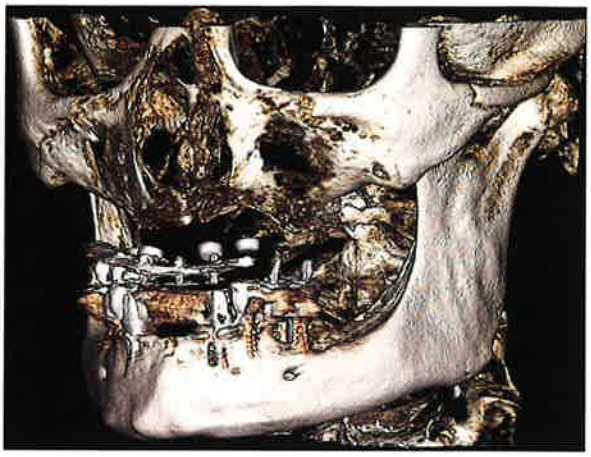

Figure 6 Cone beam computed tomographic imaging shows the amount of alveolar bone destruction in the maxilla due to the cluster failure 9 years earlier, and continued bone resorption. The zygomatic bone and pterygoid plates showed favorable anatomy.

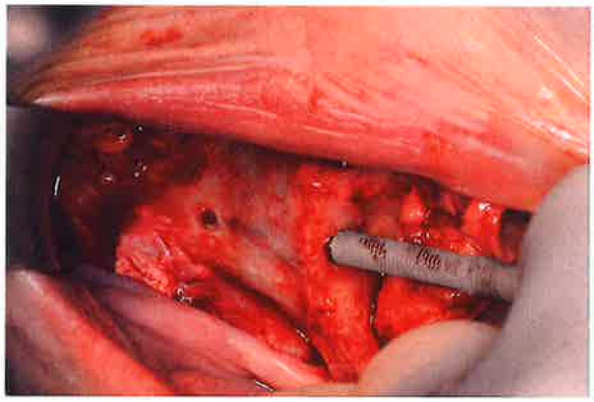

Figure 7 Image showing surgical placement of right zygomatic implant.

and the pterygoid implants (NobelSpeedy Groovy; Nobel Biocare) were 20 mm in length and all implants were 4 mm in diameter. Thereafter, the anterior maxillary implants (NobelSpeedy Groovy; Nobel Biocare) were placed at sites 6, 11 and the maxillary midline. The implants at site 6 and 11 were 15 mm long and the maxillary midline implant was 13 mm long (Fig 8). As all the implants had excellent primary stability, a decision was made to incorporate all implants for immediate loading. Appropriate abutments (multi-unit abutments; Nobel Biocare) were then placed. The new maxillary complete denture was used for producing the conversion prosthesis by a chairside technique.[13] An occlusal device was also provided to the patient due to her bruxism habit.

During the healing period, the patient experienced 2 fractures of the conversion prosthesis which was repaired intraorally using autopolymerizing resin. The healing of all the implant surgical sites were uneventful. After a healing period of 4 months, the conversion prosthesis was removed and all 7 implants demonstrated no mobility or clinical signs of any infection and therefore all dental implants were deemed to be osseointegrated.

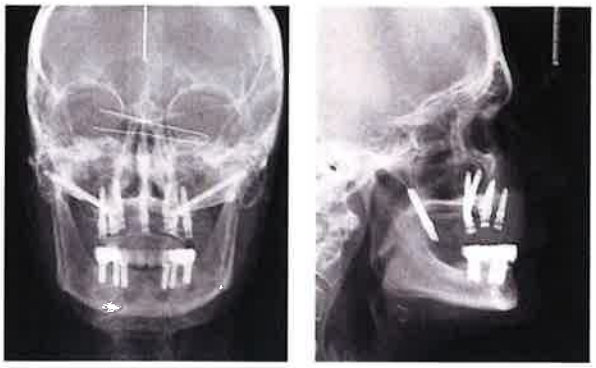

Figure 8 Immediate postsurgical radiographic image showing optimal placement of bilateral zygomatic and pterygoid implants as well as the anterior maxillary implants engaging the bone around the nasal cavity.

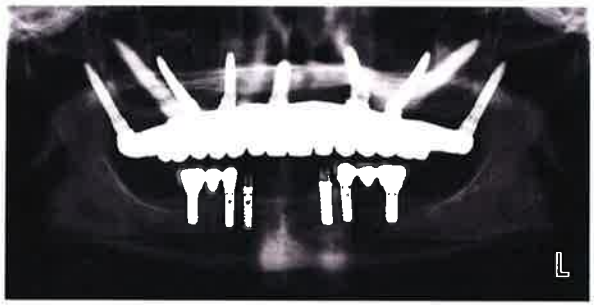

Figure 9 Posttreatment panoramic radiograph taken after insertion of the maxillary zirconia prosthesis to confirm accurate seating of the prosthesis over the abutments.

The definitive prosthodontic treatment commenced with a final impression of the 7 maxillary implants, which was made using polyether impression material (Impregum Pentasoft; 3M ESPE) after rigidly connecting all impression copings. Thereafter, using routine prosthodontic protocols, maxillomandibular relationships and trial denture procedures were accomplished to fabricate screw-retained milled prototype prosthesis (interim acrylic resin prosthesis) using CAD/CAM technology.[14]

The prototype prosthesis was then tried in to confirm fit, occlusion and esthetics, and minor adjustments were made as needed. After obtaining the patient's verbal and written approval, the prototype was returned to the laboratory, where it was copy-milled from a solid blank of presintered zirconia. The zirconia prosthesis was subsequently veneered with porcelain only at the gingival region, finished and bonded to prefabricated titanium cylinders and returned to the clinician. The mandibular zirconia prosthesis for the anterior segment was also fabricated. The zirconia prosthesis was inserted over the 7 implants and passive fit was reconfirmed after tightening with prosthetic screws in a diagonal fashion. All screws were then torqued to 15 Ncm per manufacturer's instructions and a panoramic radiograph was taken (Fig 9). The screw access channels were filled with polytetrafluoroethylene tape and sealed with composite resin (Fig 10). Then the zirconia fixed dental prosthesis for the anterior mandibular segment was cemented using standard prosthodontic protocols (Fig 11). The patient was very pleased

Figure 10 Occlusal view of the maxillary zirconia complete arch fixed implant supported prosthesis (CAFIP) inserted in the mouth.

Figure 11 Occlusal view of the mandible after cementation of a new zirconia fixed dental prosthesis in the anterior region. Minor polishing of the chipped porcelain at site no. 19 was done without replacement of the restoration.

Figure 12 Posttreatment smile of the patient with improved teeth positions and occlusal plane.

with the outcome of her treatment (Fig 12). She was provided a new occlusal device and lifelong professional and at-home instructions. At a 1-year follow-up, all implants in the maxilla were stable and the patient continued to remain satisfied with her treatment.

Discussion

Extra-maxillary implants can offer a significant advantage for patients with a history of cluster failure due to severe atrophy. The procedure offers a predictable solution with shorter treatment times and less surgical morbidity compared to the alternatives of onlay grafting and sinus elevation procedures.[6-9] Another advantage is the opportunity to immediately load the implants and drastically improve patient satisfaction.[7,8] In the patient presented in this report, despite her bruxism and previous history of cluster failure, the authors opted for immediate loading because the 4 extra-maxillary implants all engaged dense cortical bone and achieved high primary stability. The primary stability was excellent for the anterior maxillary implants as well. Immediately loaded zygomatic implants are especially indicated and have a lower failure rate compared to delayed loading protocols.[7,8] Additionally, in this patient, due to her atrophied ridge from previous cluster failure, alveoloplasty was necessary to create a wider bony platform for many of the implants. All of this would have made it virtually impossible for the patient to wear a functioning complete denture during the healing period.

It is remarkable to note that in this case report, the history of cluster implant failures (accompanied by progressive bone loss) was restricted to the maxilla, despite the patient receiving the same brand of dental implants and being treated by the same clinician in the past. All mandibular implants had 15 years of survival with minimal bone loss. This could be due to local factors in bone architecture between the maxilla and mandible and direction of forces resulting from bruxism. Another purported reason is due to the patient's previous maxillary overdenture being supported by solitary abutments and a horseshoe design. All of these factors may have resulted in independent occlusal overloading of the implants. It is expected that with a new zirconia CAFIP, the rigid splinting of all implants may mitigate this issue. Monolithic zirconia CAFIP bonded to titanium cylinders are reported to have high survival rates up to 99.3% with minimal technical complications over a 5 year period.[14]

From available evidence in the literature, it is assumed that patients with history of implant failure are likely to be of higher risk of cluster failure.[1-5] To the author's best knowledge, there are no reports in the literature on the management of cluster failures with extra-maxillary implants, and it is unknown if the extra-maxillary implants bear the same risk for any subsequent failure in the future in such patients. It is probable that these implants may survive in the long term because of the distinct composition and embryological origin of the zygomatic and sphenoid bone compared to the alveolar bone. Nevertheless, until additional substantial clinical evidence is available, cluster failure patients should be educated and cautioned that if future implant failures also occur in extra-maxillary implants, they may need to resort to a complete denture.

Summary

This case report described the management of a female patient with bruxism who experienced late cluster implant failure in the maxilla after 9 years of function with an overdenture. Due to the loss of residual bone, subsequent implant therapy involved the use of bilateral zygomatic, pterygoid and anterior maxillary implants which were immediately loaded and thereafter used to support a complete arch fixed implant-supported zirconia prosthesis.

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