

RESTORATION OF PERIODONTALLY COMPROMISED TEETH WITH TOOTH- OR IMPLANT-SUPPORTED PARTIAL ZIRCONIA-CERAMIC FIXED PROSTHESES: THREE-YEAR RESULTS OF A CLINICAL AUDIT



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PURPOSE. To evaluate the clinical outcomes at 3-year follow-up of zirconia-ceramic partial fixed prosthetic restorations of mobile teeth with loss of periodontal attachment. Prostheses were either fitted on natural teeth abutments prepared with a feather-edge finishing line or implant-supported if teeth were not recoverable.

MATERIALS AND METHODS. Subjects with more than 4 mm loss of periodontal clinical attachment level (CAL) and grade 1 to 2 mobility in need, after periodontal therapy, of partial fixed prosthetic restoration supported by either natural teeth or dental implants were included. Teeth were prepared with feather-edge margins. Missing teeth that could not be fitted with a tooth-supported prosthesis were replaced by unsplinted dental implants in association with alveolar crest regenerative procedures when needed. After three to six months of temporization, final impressions were taken, and definitive screw-retained partial zirconia-ceramic fixed prostheses were fitted on either natural teeth or osseointegrated implants. The following outcome measures were evaluated 3 years after definitive prostheses fitting: prosthesis failures, tooth and implant failures, complications and, at teeth only, change in probing depth (PPD), change in bleeding on probing (BoP), and gingival margin recession. A paired t-test was used to evaluate any statistically significant change in PPD between the two time points. The McNemar's test calculator statistic was used to evaluate any differences between BOP before and after therapy.

RESULTS. Twenty patients were retrospectively assessed. In total, 93 periodontally compromised teeth and 36 intermediate-pontic teeth were restored with ceramic fused to zirconia partial fixed prostheses. At 3-year follow-up, only one tooth had been lost due to root fracture. Five abutment teeth had been affected by endodontic complications (pulpitis and/or periapical lesions) and eight ceramic chipping. Three teeth had gingival recession of between 1 and 3 mm. The mean PPD measured around teeth, before cause-related therapy, was 5.2 ± 1.2 mm (95% CI 4.7 to 5.7 mm), which after 3 years had decreased to 2.9 ± 0.8 mm (95% CI 2.6 to 3.2 mm), a statistically significant difference (mean difference 2.3 ± 0.8 mm [95% CI 1.9 to 2.7 mm]; P-value = 0.000). Forty-two% of the teeth (39 out of 93) showed bleeding on probing before cause-related therapy, but this decreased significantly to 12% (11 out of 93) at 3 years after definitive prosthesis delivery (P-value <0.0001).

CONCLUSIONS. Within the limitations of the present clinical audit, partial fixed zirconia-ceramic crowns supported by either natural teeth or implants seem a predictable prosthetic solution for patients with periodontally compromised dentition.

CONFLICT OF INTEREST STATEMENT

This study was not financially supported by any company. Silvio Mario Meloni and Milena Pisano are scientific consultants for 3P Smart Devices (Scalegne, Italy) and Ubgen (Vigonza, Italy). Marco Tallarico is scientific consultant for Ubgen Company.

INTRODUCTION

Periodontal disease is a chronic condition caused by specific pathogens present in dental plaque and leads to inflammatory destruction of tissues supporting teeth¹. Very often this disease is not adequately diagnosed and/or treated, resulting in aesthetic, functional and psychological issues for patients¹. Once the presence of periodontal disease has been ascertained, and staged and graded correctly, the patient should be given non-surgical treatment before, if necessary, resorting to resective or regenerative surgery^{2,3}. The treatment of periodontal disease aims to eliminate the inflammation that has led to the destruction of the periodontal tissues to ensure that patients maintain a correct masticatory function free of symptoms and with satisfactory aesthetics³. The non-surgical treatment of periodontal disease aims to remove the aetiological agents and reduce the risk factors. The end points of this treatment are: supra and sub-gingival plaque control, and reduction of bleeding on probing (BOP) and pocket probing depths⁴. A surgical periodontal treatment may be required in a few cases⁵, with both resective and regenerative techniques aimed at restoring a hygienically maintainable periodontal anatomy^{5,6}.

Once periodontal health has been re-established, the residual dentition may remain impaired and weakened by the loss of periodontal attachment, and could require prosthetic rehabilitation to restore both lost dentition and function by stabilizing mobile teeth⁷. To achieve this, it may be necessary to restore residual dentition with partial fixed prostheses or, where this is not possible, to replace missing teeth with implant-supported prostheses. The clinical periodontal response will be affected by the type of subgingival tooth preparation⁸. In a randomized controlled trial⁹, Paniz et al. found statistically significant differences for BOP and gingival recession, with the feather-edge preparation technique being associated with increased BOP and deep chamfer preparations with increased recessions.

The main objective of this clinical audit was to evaluate the outcomes at 3-year follow-up of zirconia-ceramic partial fixed prostheses used to restore mobile teeth with periodontal attachment loss. Prostheses were supported by either natural teeth prepped with a feather edge finishing line⁹ and prosthetic margins 0.5 mm below the free gingival margin, or dental implants.

MATERIALS AND METHODS

Study design

This was a clinical audit conducted 3 years after definitive prosthesis fitting in periodontally compromised patients rehabilitated with either fixed partial prostheses or dental implants. Patients were consecutively treated at a private clinic in Arzachena, Sardinia, from January 2019 to November 2020.

Inclusion criteria

The study sample comprised subjects aged 18 years or older with compromised periodontium and mobility of either grade 1 (perceptible mobility <1 mm in the buccolingual direction) or 2 (mobility >1 mm but <2 mm), in need of prosthetic rehabilitation, after cause-related therapy and, when needed, surgical periodontal therapy.

Patients who presented any of the following criteria were excluded:

- American Society of Anesthesiologists (ASA) class III or IV¹⁰;
- psychiatric contraindications;
- pregnancy or breastfeeding;
- use of alcohol or drugs;
- Smoking more than five cigarettes per day in cases requiring bone regeneration procedure;
- head or neck radiotherapy within 5 years.

Clinical procedures

Patients underwent an objective examination (**FIGS. 1, 2**), and the following periodontal parameters were recorded: periodontal pocket depth (PPD), bleeding on probing (BoP), tooth mobility, degree of furcation in-

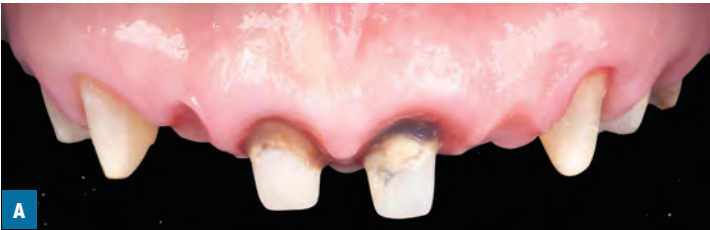


FIG. 1: Pre-treatment picture, frontal view.



FIGS. 2A, B: Pre-treatment picture, upper jaw close-up (A); pre-treatment panoramic x-ray (B).

volvement and gingival margin recession. All patients underwent cause-related therapy with mechanical and manual supra- and sub-gingival scaling and root planing. When needed, root canal therapy was performed, and in the event of unrecoverable teeth, these were extracted. Periodontal reassessment was scheduled 2 months after the completion of cause-related therapy, and then, if necessary, regenerative periodontal therapy was performed using bovine bone substitutes (Re-Bone, Ubgen, Vigonza, Italy) and resorbable bovine pericardium membranes (Shelter, 0.4 mm thick, Ubgen). Mobile or endodontically treated teeth to be used as dental abutments were prepped with feather edge margins (FIGS. 3A, B) and restored with temporary acrylic resin prostheses. Missing teeth that could not be restored with tooth-supported prostheses were fitted with implant-supported prostheses (Cono-in or Conical 3P Implafavourite, Scalgne, Italy), which were not splinted to natural teeth. In cases of atrophic ridges, guided bone regeneration procedures were carried out using 50% autogenous bone and 50% bovine



FIGS. 3A, B: Dental abutment, frontal and occlusal view.

bone covered by bovine pericardium membranes (Shelter, 0.8 mm thick, Ubgen) fixed with titanium pins (3P ImplaFavourite)^{11,12} (FIGS. 4-7). After three to six months of temporization, final impressions were taken and either definitive zirconia-ceramic partial fixed prostheses were fitted on natural abutment teeth or screw-retained zirconia-ceramic crowns on implants (FIGS. 8-12).

Outcome measures

The following outcome measures were assessed:

- prosthesis failure: prosthesis remade for any reason;
- tooth failure: tooth extraction for any reason;
- implant failure: any removal of implants dictated by implant mobility, progressive marginal bone loss, infection or implant fracture;
- complications: ceramic chipping; prosthesis framework fractures; surgical, periodontal or endodontic complications, etc;
- change in probing depth (PPD) on restored teeth: measured in millimetres with a periodontal probe by the same unblinded assessor (M.P.) at baseline, before non-surgical periodontal treatment, and 3 years after definitive prosthesis delivery. Three vestibular and three lingual measurements were made and averaged at tooth level;

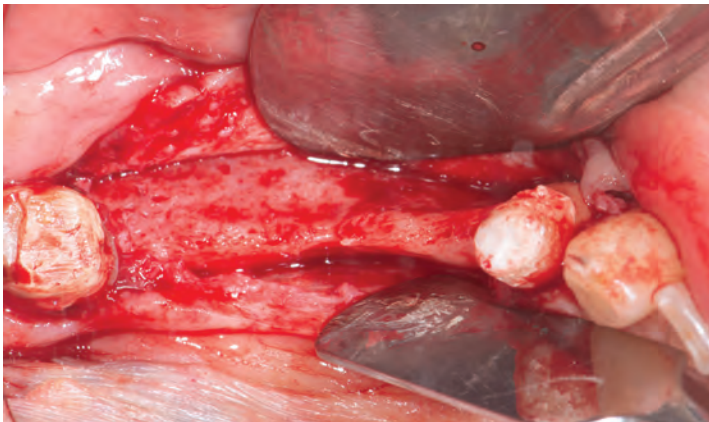


FIG. 4: Edentulous area with alveolar crest resorption left lower jaw.

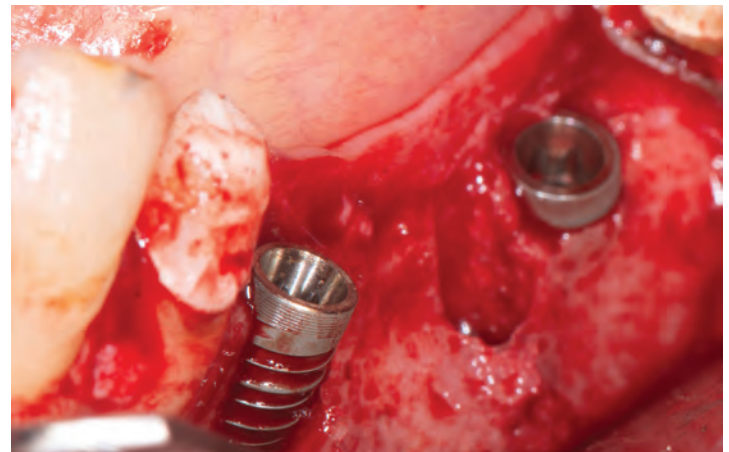


FIG. 5: Implant installation with threads dehiscence.



FIG. 6: One-stage alveolar reconstruction with 50% bovine bone and 50 % autogenous bone.

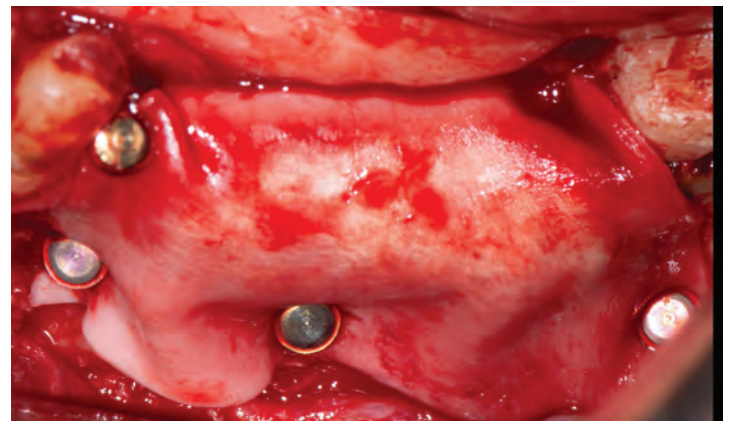


FIG. 7: Bovine pericardium membrane after fixation.



FIG. 8: Definitive zirconia-splinted crowns, model.



FIG. 9: Definitive full-arch zirconia-ceramic dental prosthesis, close-up.



FIG. 10: Definitive zirconia-ceramic screw-retained implant-supported crowns on reconstructed ridge.



FIG. 11: Follow-up 3 years after final prosthesis delivery.

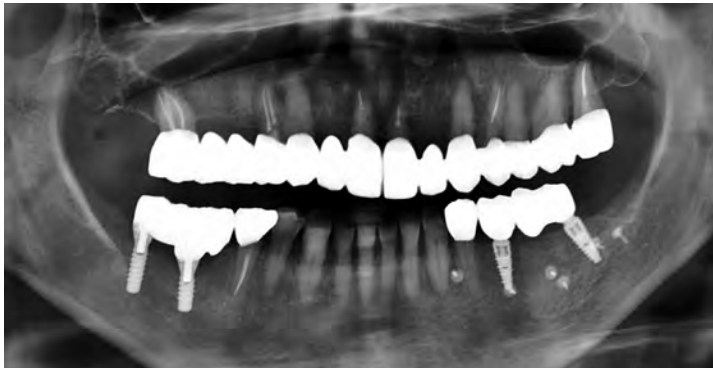


FIG. 12: 3-year follow-up panoramic x-ray.

- presence (yes or no) of bleeding on probing (BoP) at the periodontally compromised natural teeth: measured with a periodontal probe by the same unblinded assessor (M.P.) at baseline, before non-surgical periodontal treatment, and three years after definitive prosthesis delivery. Three vestibular and three lingual sites were evaluated per tooth. BoP was considered positive when detected at 1/6 sites or more;
- recession of the gingival margin at restored teeth: measured at 3-year follow-up with a periodontal probe as the distance in mm between the free gingival margin and the cervical margin of the restoration by the same, not blinded, assessor (M.P.). The highest value measures at each tooth was considered.

Statistical analysis

All data analysis was carried out according to a pre-established analysis plan. The tooth was the statistical unit of the analyses. A dentist with expertise in statistics (M.T.) analysed the data. A paired t-test was used to evaluate any statistically significant change in PPD between the two time points (continuous outcome). A McNemar's test calculator was used to evaluate any differences between BOP before and after therapy (dichotomous outcome). Statistical significance was set at $p < 0.05$.

RESULTS

Twenty patients were retrospectively assessed (eight males and twelve females, average age 62.3 years). No patient dropped out. All patients underwent periodontal cause-related therapy, and in two cases also regenerative periodontal surgery. The follow-up was 3 years after definitive prosthesis delivery. In total, 93 periodontally compromised teeth and 36 intermediate-pontic teeth were restored with ceramic fused to zirconia partial fixed prostheses. Seventeen implants (Cono-in or Conical 3P) were installed in eight patients. In particular, five implants were inserted in two ridges reconstructed with 50% autogenous bone and 50% bovine bone covered by bovine pericardium membrane (Shelter 0.8 mm thick, Ubgen).

In total, one abutment tooth was lost due to root fracture. It was extracted and not restored. Endodontic complications such as acute pulpitis and/or periapical lesions were recorded at five prosthetic teeth (four acute pulpitis and one chronic peri-apical inflammatory lesion). Those complications were resolved via root canal therapy, without removing the prostheses. In total, eight ceramic chips occurred. These were resolved via rubber smoothing. No other complications were recorded.

The mean PPD before cause-related therapy was 5.2 ± 1.2 mm (95% CI 4.7 to 5.7 mm), and after 3 years had decreased to 2.9 ± 0.8 mm (95% CI 2.6 to 3.2 mm), the difference being statistically significant (mean difference 2.3 ± 0.8 mm [95% CI 1.9 to 2.7 mm]; P -value < 0.0000). Forty-two% of the sites (39 out of 93) showed positive bleeding on probing before cause-related therapy, but this significantly decreased to 12% (11 out of 93) at 3 years after definitive prosthesis fitting (two-tailed P -value < 0.0001). Three teeth showed gingival recession of between 1 and 3 mm.

DISCUSSION

The objective of this clinical audit was to evaluate the clinical outcome of zirconia-ceramic prostheses on mobile, periodontally compromised dentition or implants in cases of unrecoverable teeth. The results show that 3 years after prosthesis fitting, the periodontal tissue did not show any particular sign of distress since, only 3.3% presented gingival recessions, 12% of the sites bled on probing, and the mean pocket probing depth was less than 3 mm.

Traditionally, metal-ceramic fixed prostheses, partially or completely layered with feldspathic ceramic are considered the gold standard¹¹. However, in our cases, porcelain fused to zirconia prostheses were associated with few, readily treatable complications, and the loss of only one abutment tooth.

Pjetursson et al.¹³, in a systematic review, reported a significantly higher incidence of caries in abutment teeth restored with densely sintered zirconia fixed prostheses than metal-ceramic prostheses. Significantly more framework fractures were reported for reinforced glass ceramic (8.0%) and glass-infiltrated alumina-based (12.9%) prostheses than metal-ceramic (0.6%) and densely sintered zirconia fixed dental prostheses (1.9%) over 5 years of function. In a randomized controlled trial comparing metal-ceramic *versus* zirconia-ceramic prostheses with a follow-up of 5 years, Suarez et al.¹⁴ reported a survival rate of 100% in both groups, and success rates of 80% (zirconia group) and 100% (metal-ceramic group), respectively. No biological complications were observed. Minor chipping was found on 20% of the zirconia restorations. No differences in periodontal parameters were recorded.

There are several limitations associated with the present study, namely its retrospective nature, the small sample size, the relatively short follow up, and the lack of a control group. However, to the best of our knowledge, it is the first report documenting the use of partial fixed zirconia-ceramic prostheses used to

splint mobile, periodontally compromised teeth. This treatment solution appears to presents aesthetic advantages over metal-ceramic periodontal prosthesis in terms of prosthetic margin recession. RCTs to confirm this hypothesis and determine whether this kind of prosthetic rehabilitation is predictable over time are warranted.

CONCLUSIONS

Within the limitation of the present clinical audit, zirconia-ceramic partial fixed prostheses on mobile periodontally compromised teeth seem to be a predictable prosthetic solution, even in the presence of implant supported crowns.

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