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Ceramics on Implants – Fixed Zirconium Dioxide-Based Restorations in the Rehabilitation of the Edentulous Upper Jaw

Introduction

The use of fixed restorations with an oxide ceramic framework is not only an accepted procedure for natural teeth, but it is also becoming increasingly accepted as a therapeutic option for dental implants.¹⁻³ The cementation of these types of restoration on titanium abutments can now be regarded as an established standard procedure.⁴⁻⁷ With the introduction some years ago of high-strength zirconium dioxide-based abutments, an alternative became available that was of interest from the esthetic perspective⁸⁻¹², as well as in respect of the biocompatibility and stability of periimplant soft tissue¹³⁻¹⁶. Generally speaking, special CAD/CAM technology is required for manufacturing ceramic abutments.¹⁷⁻¹⁹ However, for some time now industrially prefabricated, single-unit and individually modifiable zirconium dioxide frameworks have provided an alternative.

The high clinical potential of zirconium dioxide-based abutments has been shown in a number of studies.²⁰⁻²⁵ Up to now these abutments have been recommended for use in the incisor region.^{8,9,23,26-28} However, results from recent research now also support the utilization of oxide ceramic abutments in the lateral tooth area.^{7,29}

The following report describes the full-mouth rehabilitation with implant-supported prostheses in a clinical application of individualized, industrial prefabricated, single-unit zirconium dioxide abutments in a completely edentulous upper jaw.

Anamnesis

The female patient, who was 39 at the start of treatment, came to us with the request for complete rehabilitation of the upper jaw following periodontal initial therapy. Teeth # 16, 17 and 26 had been extracted during the course of prior treatment about 4 months before. Teeth # 11, 21 and 23 were crowned and blocked and functioned as a bridge abutments for gap # 22. Tooth # 12 had a metal-ceramic crown. Premolars # 14, 15 and 25 were filled with insufficient amalgam (**Fig. 1**). Oral hygiene had improved during prior periodontal treatment and the patient had given up smoking. The probing attachment level of the teeth was 5 mm to 9 mm (**Fig. 2**). A probe of the pockets caused some bleeding (BOP positive). All teeth demonstrated mobility grade III, despite subjective freedom of symptoms for all teeth except # 13 (MG II) and partial blocking. X-rays showed general bone loss, especially of vertical bone. The roots of the remaining upper teeth were shown to be short and conical. There was no indication of functional problems or craniomandibular dysfunctions.



Fig. 1



Fig. 2



Fig. 3

Treatment Planning

The patient wanted to achieve permanent restoration with a fixed bridge. In accordance with SAC-classification the case was categorized as complex.³⁰ Following exhaustive discussions and the consideration of alternative forms of therapy, the upper teeth were considered to be either too loose for long-term conservation or not suitable for inclusion in a fixed concept. Analogous to a conventional concept for the edentulous upper jaw, the insertion of dental implants at # 1, 3, 4 and 6 was planned following extraction.³¹ As, in this case, the patient required a fixed therapeutic bridge for the entire duration of therapy for professional reasons, it was decided to perform an immediate implant placement and immediate provisional restoration, provided there was adequate primary stability of the dental implant.³² Such cases are often associated with the postoperative risk of gradual resorption of the vestibular bone segments, which can result in the loss of tissue volume and esthetic complications. In this case, however, the diagnostic probe of vestibular bone, as well as the form and course of the soft tissue, gave rise to the diagnosis of a thick periodontal phenotype with relatively broad residual vestibular bone lamella so that a less severe recessive trend was to be expected.³³

Surgical Procedure

A prosthetic set-up and a corresponding vertical orientation guide were constructed. Due to the lack of vertical bone height in the region of 16 and 26, two primary stable implants (Straumann® Bone Level Implant RC, Ø 4,8 mm, 10 mm SLActive®) were inserted using internal sinus elevation and augmentation with xenogenic, particulate bone substitute material (Fig. 3). Following a four-month complication-free healing period, the implant was exposed (Fig. 4). In keeping with the prosthetic plan a drilling guide was then constructed on an etched mold. Atraumatic extraction of the teeth was with periosteotomy on the day of operation. Intact vestibular bone lamella was explored without flap elevation. Alveoli were carefully curetted, washed and measured with a probe. Maxillary implant sites were prepared according to the drilling guide (Fig. 5) and primary stable implants were inserted (Straumann® Bone Level Implant RC, Ø 4,1 mm, 10 mm SLActive®). The orientation guide was used to create a tooth-specific vertical distance between the planned margin of the crown and the shoulder of the implant in order to give a harmonious gingival margin (Fig. 6). Empty alveoli were closed with a collagen-hydroxyapatite matrix. Dependent on their size, gaps between vestibular bone lamella and implant were filled with exogenic particulate bone substitute material.



Fig. 4



Fig. 5



Fig. 6

Immediate Restoration with Therapeutic Restoration

Owing to their axial alignment and torque some of the implants were unsuitable for integration into the provisional bridge. After placement of the impression posts a closed polyether tray impression was made. The implants were then closed with gingival formers and the maxillomandibular relationship was recorded using the adjusted vertical guide. The provisional plastic abutment (PEEK, Straumann) was fitted onto a cast at tooth positions # 1, 4 and 6 in keeping with the pre-operative set-up, and the temporary plastic PMMA bridge was then constructed and formed. Twelve hours after the operation the abutments were screwed into the patient's mouth (Fig. 7), closed and the occlusally adjusted plastic bridge was reversibly cemented (Fig. 8). In order to facilitate restoration of the soft tissue contour the bridge was not

removed for eight weeks. During the following six-week contouring phase the basal area was individually customized using plastic.

Permanent Restoration

A jaw print was used to prepare an individual impression tray in the laboratory. Following removal of the therapeutic bridge (Fig. 9) eight screw impression posts were individualized one by one by means of an auto-polymerizing PMMA copy of the provisional abutment (Fig. 10). Once all impression posts had been screwed to the osseointegrated implants the final impression was then made using a polyether compound. The abutments were subsequently screwed onto the completed master cast and the temporary bridge was mounted. The securely attached lower jaw cast and master cast were then



Fig. 7



Fig. 8



Fig. 9



Fig. 10



Fig. 11



Fig. 12

cephalically mounted into the articulator. It was also possible to cross-mount a cast of the provisional bridge toward the lower jaw. The abutments and bridge were inserted into the patient's mouth. After that, the fitting and individualization of the zirconium dioxide abutments was done in the laboratory (Fig. 11). The patient was able to choose between a straight abutment and one angled at 15°, in white or a dentine-like color (Straumann® Anatomical IPS e.max® Abutment). Final processing was completed in the laboratory with turbines and water-cooling. To remove the surface tension caused by the grinding process, implant abutments fitted entirely using grinders were subject to a 15-minute long regeneration firing at a temperature of 1 050 °C. Where necessary abutments were waxed-up to ensure a neat fit into the emergence profile and then extruded with a suitable lithium disilicate ceramic

(IPS e.max® ZirPress) (Fig. 12). A clinical trial fitting was then carried out and a pickup impression made to show the final contours of the soft tissue. It was at this stage that the four three-unit zirconium dioxide (zerion® von Straumann® CARES® CAD/CAM) bridges were constructed and manufactured. After successful trial fitting (Fig. 13) the two anterior structures were veneered using the layering technique (IPS e.max® Ceram), whereas the posterior frames were extruded using IPS e.max® ZirPress to achieve a mechanical high-strength veneer (Fig. 14). The completed abutments were placed using an insertion wrench, screwed onto the implant and tightened to 35 Ncm. The result was a favorable effect on the peri-implant soft tissue (Fig. 15). Once the screw channels had been closed the bridges were provisionally and reversibly cemented with a material that contains silicon, minimal occlusal



Fig. 13



Fig. 14



Fig. 15



Fig. 16



Fig. 17



Fig. 18



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adjustments were made and the structure was regularly examined. After a period of four weeks the preimplant soft tissue was healthy and free of irritation (Figs. 16, 17). Due to the extensive trial phase with the therapeutic bridge only minimal adjustments were required. Abutments were examined to ensure that they were still stable and firmly in place. Once the channels had been closed and the insides of the pillar crowns cleaned with a dental sandblaster, self-adhesive composite cement was used for permanent cementation (Figs. 18, 19). Frequent examinations were conducted in the follow-up days (Fig. 20). As the patient continued with treatment for the lower jaw, she could be examined regularly. Twelve months later the preimplant soft tissue was stable (Fig. 21). All full-ceramic abutments and restorations were without complication. X-rays showed no indication of changes to the periimplant bone levels (Fig. 22). The patient was highly satisfied with both the esthetics and the function (Fig. 23).



Fig. 19



Fig. 20



Fig. 21

Conclusion

The application of ceramic abutments, especially in combination with full-ceramic restorations, has the potential to achieve highly esthetic and biocompatible restorations. The benefits for the incisor area could be clinically confirmed in a number of studies conducted in recent years. There are currently no long-term results for the application of this type of structure in the lateral tooth area. However, first experiences appear promising. The production of single-unit zirconium dioxide abutment usually requires complex CAD/CAM technologies. The case presented here is an excellent demonstration of treatment with industrially prefabricated, individualized ceramic abutments in both the front and lateral tooth areas.

Acknowledgements

The author would like to thank Dr. William Martin, Dr. Dean Morton and Dr. James Ruskin for inspiring the clinical realization of this case.

The literature references can be downloaded here: www.straumann.com/boeckler.pdf

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Fig. 22



Fig. 23