ISSN 1862-2879 | Volume 15

Issue 2/19

EDI Journal

European Journal for Dental Implantologists

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BDIZ EDI

Bundesverband der implantologisch tätigen Zahnärzte in Europa e.V.
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Five-year follow-up of immediate restorations with ceramic-reinforced PEEK

A safe and predictable long-term treatment protocol

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Ceramic-reinforced PEEK materials have been developed to improve the shade and mechanical properties of dental restorations. One of these materials is BioHPP (bredent group, Senden, Germany). Abutments are made by overpressing a titanium base with the BioHPP material, resulting in monolithic hybrid abutments with threaded screw-holes in the titanium part for long-term stability and a resilient body made of ceramic-reinforced PEEK. The objective of this article is to present a follow-up and re-evaluation of patients treated with immediate restorations using abutments made of BioHPP, in a five-year follow-up period.

Introduction

Immediate restorations for dental implants are an effective and predictable treatment modality for which there is a broad scientific evidence base. They can be safely included in the practitioner's standard treatment portfolio [1]. Close study of the properties of the new materials has given rise to the development of treatment protocols that are precise and stable; they include the concepts of platform switching and the retention of the initial attachment.

This approach is particularly interesting in the aesthetic zone, where patient expectations are high. To achieve a highly aesthetic result, the dentist must be able to make use of a broad range of solutions that guarantee long-term stability of the restorations, high survival rates and stable peri-implant soft tissues [2]. Among the new materials, PEEK reinforced with ceramic offers very promising results in terms of physical and mechanical properties as well as biocompatibility.

The surface of the material offers excellent conditions for a healthy peri-implant soft-tissue attachment. It is bacteriostatic, lowering the prevalence of peri-implant mucositis. An ideal modulus of elasticity avoids component fracture and allows a progressive transmission of masticatory forces. Finally, the material is highly biocompatible and does not promote irritation or inflammatory reactions [3].

Removing and re-connecting abutments has been shown to be a critical factor in the onset of crestal bone loss and the formation of micro-spaces where pathogenic bacteria can be trapped [4]. In addition, the concept of platform-switching has provided an extra margin of safety for anchoring soft tissue with diameter differentials of approximately 0,2 mm, which is an effective way to stabilize the peri-implant environment [5,6].

This article presents a five-year follow-up and re-evaluation of patients treated with immediate restorations using abutments made of BioHPP, a ceramic-reinforced PEEK material.

Material and methods

Study design

This study evaluated an implant-placement protocol featuring immediate loading of implants using abutments made of ceramic-reinforced PEEK (BioHPP SKY elegance abutment; bredent, Senden, Germany). Of the 48 implants (blueSKY, bredent) placed in healing bone, 32 received SKY elegance abutments (test group) and 16 received titanium abutments (control group).

A randomization scheme was generated using the www.randomization.com website. The Ethics Committee of the University of Murcia (Spain) approved the study protocol, which followed guidelines established by Council Directive 2013/53/EU).

Surgical protocol

The research protocol called for recruitment of subjects from patients referred to the Department of General Dentistry of the University of Murcia over an 18-month period. All patients in need of

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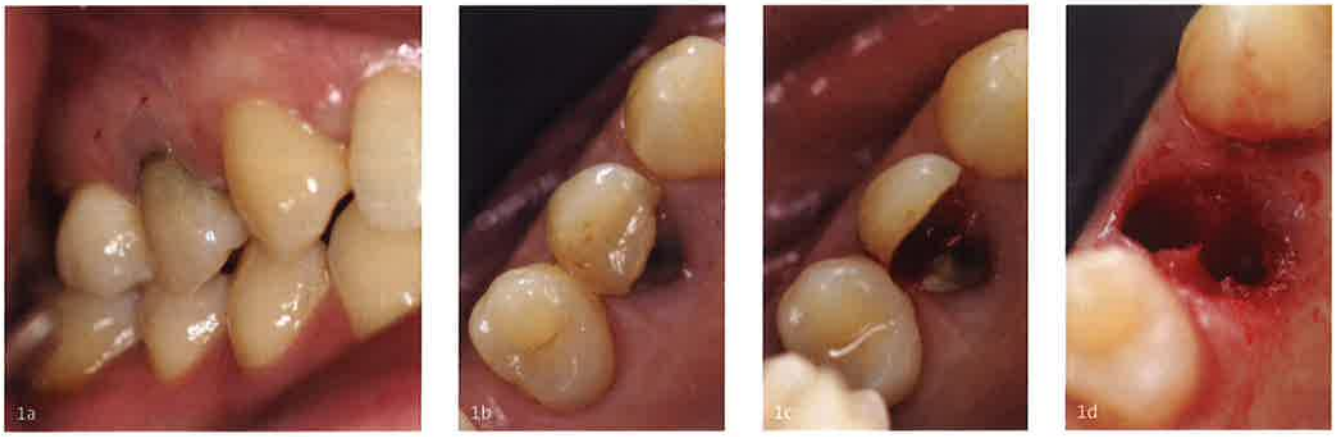
anterior oral rehabilitation that would include the placement of a single implant were invited to participate in the study, which was overseen by the institutional review board.

Additional inclusion criteria were sufficient bone height and width to allow the placement of implants with a minimum diameter of 4.1 mm and a minimum length of 10 mm, and an occlusal pattern that allowed for bilateral stability. Study participants were required to present with at least 3 mm of soft tissue vertically to establish an adequate biologic width and to reduce bone resorption. Exclusion criteria included severe maxillomandibular skeletal discrepancies, uncontrolled diabetes, haemophilia, metabolic bone disorders, a history of renal failure or radiation treatment in the head or neck region, ongoing chemotherapy, pregnancy, drug or alcohol abuse, poor oral hygiene, insufficient bone volume at the recipient site and the need for bone augmentation prior to implant placement.

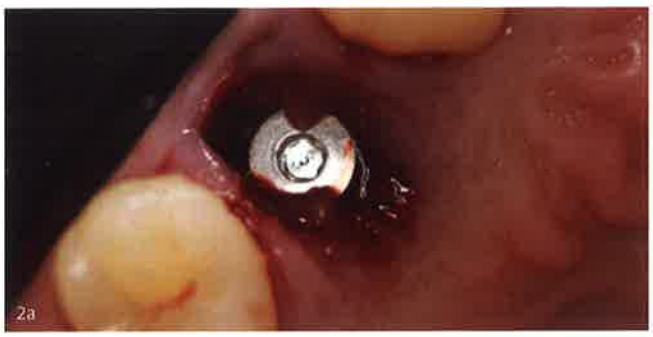
- *Surgical procedure*: A full-thickness incision was made with a No. 15c blade, combining an intrasulcular with a crestal incision in the palatal area. A flap was elevated and the bone was exposed using periosteotome. A blueSKY implant (bredent) was placed using the manufacturers prescribed placement protocol. The site was sutured with simple interrupted sutures with a 4-0 polypropylene element.
- *Postsurgical care*: All patients (AINE) received ibuprofen 400 mg once every eight hours for three days as anti-inflammatory treatment, and chlorhexidine digluconate gel 0,12 % once every twelve hours for two days after surgery.
- *Implants*: 48 blueSKY implants (bredent) 3.5–4 mm in diameter and 10–12 mm in length were placed crestally in the premolar region of the maxilla.
- *Abutments*: 48 BioHPP SKY elegance abutments were connected at the time of implant placement (immediate loading). These abutments are hybrid abutments with a body made of BioHPP moulded directly onto the titanium base without a gap. These abutments must be placed only once in immediate-restoration cases, since they combine the properties of a temporary and a definitive abutment; in other words, it is not necessary to change abutments.
- *Restorations*: All crowns were Cerec (Dentsply Sirona, Bensheim, Germany) crowns made from the definitive material cemented with self-curing RelyX universal cement (3M Espe, Seefeld, Germany). All the implants were restored using a platform-switching protocol. Figures 1 to 4 show an example case.

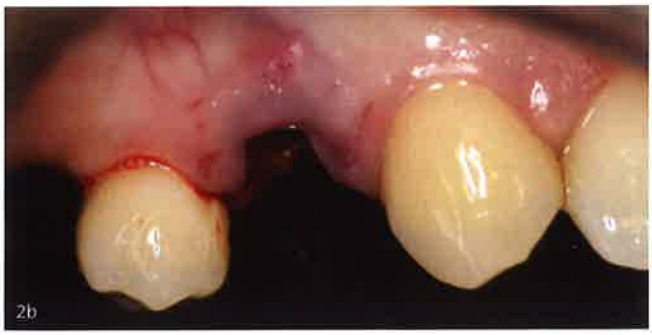
Analysis

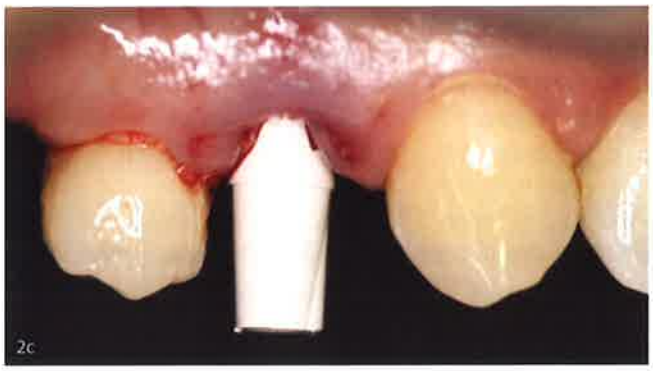
- *Follow-up period*: All measurements were taken five years after implant placement and compared with baseline data.
- *Radiological analysis*: Standardized radiographs were taken by m[illegible] of a one-position paralleling s[illegible] and analyzed using ImageJ sc[illegible] (Wayne Rasband, USA). The di[illegible] between platform and the po[illegible] first bone contact was recorded.
- *ISQ stability analysis*: Stability measurements were made at baseline to assess whether the implants were sufficiently stable to permit immediate loading. An ISQ value of 65 was assumed as the minimum value required. ISQ values were taken using Osstell Mentor (Osstell, Göteborg, Sweden).
- *Mucogingival analysis and clinical findings*: The bleeding index for the implants was recorded by special peri-implant probing. Post-insertion loss of peri-implant mucosa and any height loss were also recorded. Values for bleeding on probing (0 = no bleeding, 1 = bleeding) were recorded at one, three and five months. The depth of insertion was measured with a conventional plastic probe by the same examiner. The results represent the means of six measurements.
- *Statistical analysis*: Values were recorded as means ± standard deviation and as medians. A non-parametric Friedman test was applied to compare samples values. The level of significance was set at $p < 0.05$.

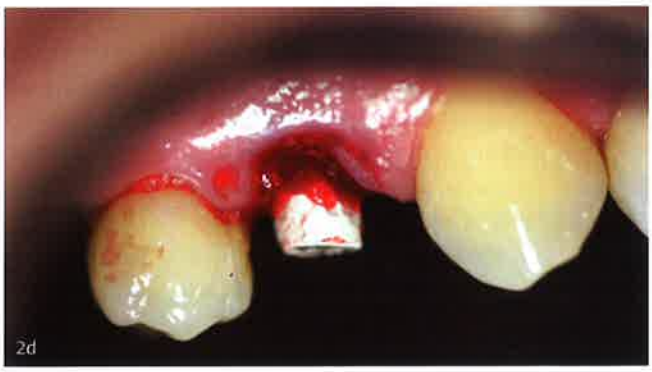


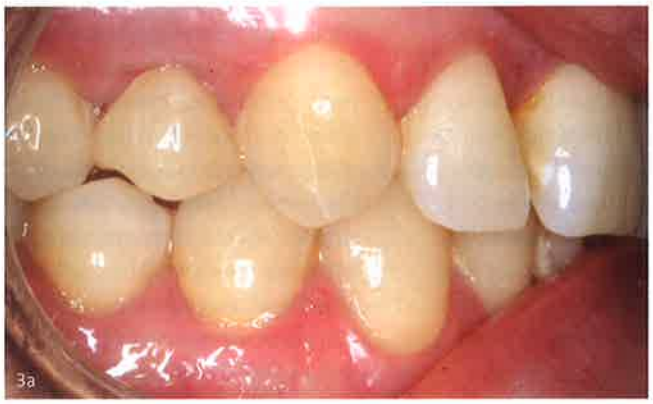
1a to d | Case example: Preoperative image with vertical fracture of the tooth. Tooth extraction with odontosection.

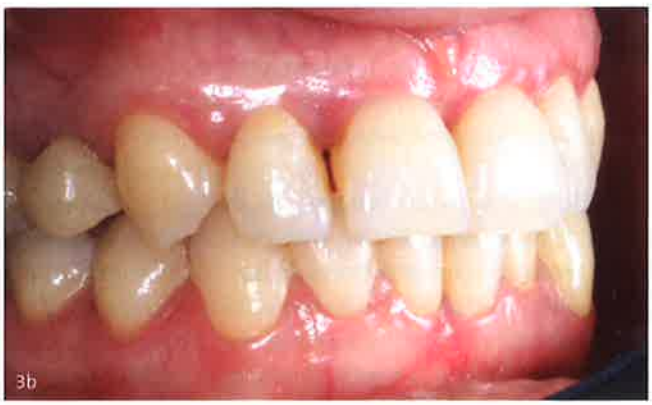












2a to d | Case example: Images of implant positioning at crestal level, attachment placement and milling.
3a and b | Control image at one year and five years after surgery.

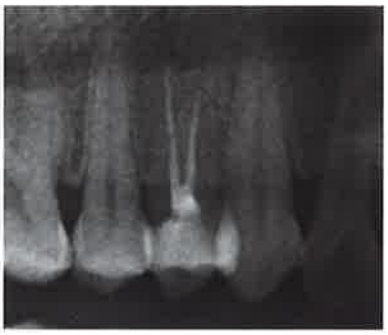
Results and discussion

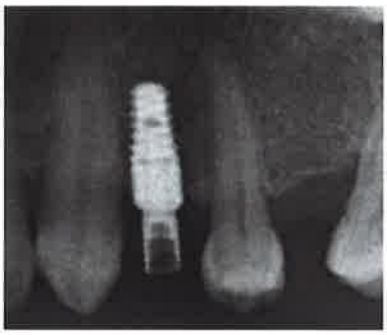
General findings

Visual and clinical inspections showed good stability of the tissues, no attachment loss of the soft peri-implant tissue, and a very low prevalence of inflammation or bleeding on probing. All patients were greatly satisfied with their treatment results and with the speedy procedure. In addition, patients judged the fact that the treatment could be completed in a single phase as a great advantage.

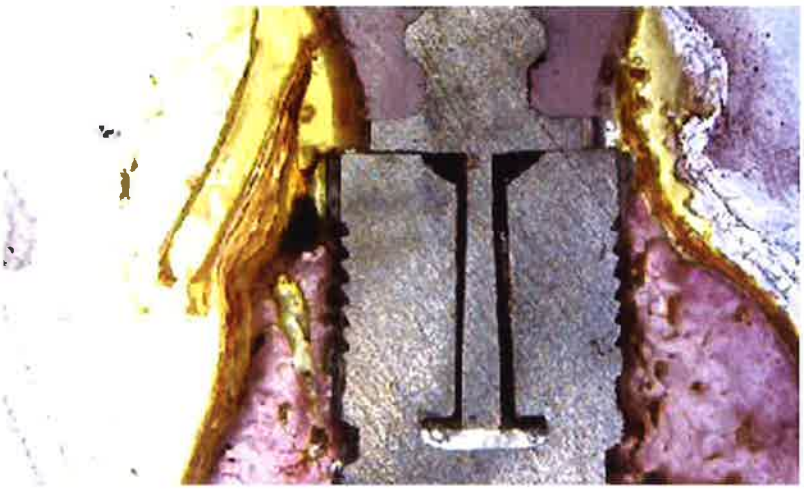
		5 months	5 years	P value
First bone contact to platform (mm)	Mean ± Sd	1.17 ± 0.87	1.21 ± 0.63	0.23
ISQ value (%)		71.43 ± 3.01		0.12
Bleeding on probing (0–1)		0.06 ± 0.02	0.10 ± 0.01	0.14
Insertion lenght (mm)		4.11 ± 1.02	3.96 ± 1.36	0.11

Table 1 Linear measurements on the radiological analysis and clinical values analyzed. Comparison between control at five months and five years. Significant differences for $p < 0.05$





4a and b | Radiological control at five months and five years.



5 | Image obtained from a project of experimental analysis in animals (tissue preservation by means of Elegance abutment, 2018).

Analyses

A comparison of the results (Table 1) showed no significant differences between the measurements at baseline (five months) and the five-year follow-up. The radiological analysis showed similar values at five months (1.17 ± 0.87) and at five years (1.21 ± 0.63). Nor did the results for bleeding on probing exhibit any significant differences ($p = 0.14$). The depth-of-insertion results were also similar at five months (4.11 ± 1.02) and at five years (3.96 ± 1.36).

The combination of an abutment that does not have to be removed and the hybrid ceramic-reinforced PEEK material yields excellent results. The preservation of crestal bone and the good peri-implant soft-tissue attachment are demonstrated in Figure 5.

Conclusions

With the limitations of this clinical study, it can be concluded that the technique of immediate loading ceramic-reinforced PEEK abutments is predictable and stable over time from an aesthetic and clinical point of view.

The type of material used, together with the single-phase treatment concept produced excellent clinical and aesthetic results. Combined with the results of experimental studies, whose histological images corroborate the present results, it can be said that the protocol presented here is a safe and predictable long-term treatment protocol. ■

The references are available at www.teamwork-media.de/literatur

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