

# Septodont Case Studies *Collection*

No. 06 - October 2013

## Focus on:

### **RACEGEL**

GEL RETRACTION MATERIAL  
LEONARD HESS

### **N'DURANCE**

4-YEAR FOLLOW UP OF ANTERIOR RESTORATIONS  
HOLLI CHERELLE RITER

### **BIODENTINE™**

USE UNDER CERAMIC INDIRECT RESTORATIONS  
CHRISTINA BOUTSIOUKIS

### **BIODENTINE™**

APICOECTOMY  
CÉSAR GALLARDO GUTTIERIEZ



# Editorial



Since its foundation Septodont has developed, manufactured and distributed a wide range of high quality products for dental professionals.

Septodont recently innovated in the field of gingival preparation, composites and dentine care with the introduction of Racegel, the N'Durance® line and Biodentine™, which are appreciated by clinicians around the globe.

Septodont created the 'Septodont Case Studies Collection' to share their experience and the benefits of using these innovations in your daily practice.

This Collection consists in a series of case reports and is published on a regular basis.

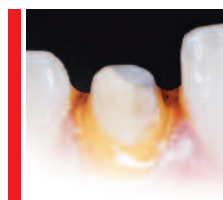
The sixth issue is dedicated to three of these innovations:

Racegel, a unique reversible thermo-gelifiable gel for gingival preparation that creates a dry and clean environment for high quality impressions.

N'Durance®, the first universal composite based on our exclusive Nano-Dimer Technology. N'Durance® unique combination of low shrinkage and high conversion offers extra biocompatibility and durability to your restorations.

Biodentine™, the first biocompatible and bioactive dentin replacement material. Biodentine™ uniqueness not only lies in its innovative bioactive and 'pulp-protective' chemistry, but also in its universal application, both in the crown and in the root.

# Content



## **Racegel : Gel Retraction Material**

Leonard A. Hess

04



## **A four-year prospective study of the use of N'Durance composite, a nano-hybrid resin**

Holli Cherelle Riter

07



## **The direct application of Biodentine™ under indirect ceramic restoration**

C. Boutsiouki, Prof K. Tolidis, Prof P. Gerasimou

13



## **Apicoectomy treated with an active biosilicate cement: Biodentine™**

Dr. César A. Gallardo Gutiérrez

18

# Racegel : Gel Retraction Material

Increasing the success and predictability of fixed prosthodontic

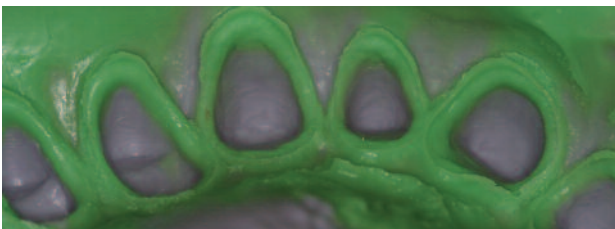
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## Introduction

In fixed prosthodontics, clinically acceptable impressions are an absolute necessity (*Fig. 1*). The laboratory fabricating the restoration is limited in its final quality by the quality of the incoming impression. The unfortunate reality is that most impressions are clinically unacceptable.<sup>1</sup>

Some of the most common errors seen in impressions include tears, bubbles, voids, debris entrapment, tray burnthrough, material/tray separation, and lack of catalyzation of the material.<sup>2</sup> Unfortunately, many of these errors are most evident at the restorative margin. Any lack of detail at the margin forces the laboratory technician to guess during die trimming. This area is highly



*Fig. 1:* An ideal indirect restoration impression. The material is void-free, clear of debris, and exhibits clean capture of the preparation margins.



*Fig. 2:* Racegel is dispensed from a single-barrel syringe. It is colored to allow easy visualization in placement and to aid in verification of its removal.

susceptible to the collection of blood, debris, and lymphatic exudate. Considering the limited hydrophilic nature of most impression materials, issues can quickly compound.

The most predictable way to obtain a quality impression is to start with healthy tissue. Pre-restorative planning should include any necessary periodontal treatment, patient hygiene instruction, and caries control.<sup>3</sup> Different options exist to aid in tissue management. These would include the use of retraction cord, chemical hemostatic agents, a soft tissue laser, and tissue gels or pastes, either alone or in various combinations. Attention should also be given to the position of the osseous crest and the compensating gingival biotype. In a normal crest relationship, the depth from the gingival margin to the bony crest is 3 mm to 4 mm apart. A distance greater than this would indicate a low-crest relationship. Depths of less than 3 mm would be indicative of a high-crest relationship.<sup>4</sup>

Tissue with a low-crest position would be less supported, more flaccid, and more prone to recession as a result of trauma or over-manipulation. Tissue associated with high crestal bone is usually thicker, more fibrous, and more forgiving of damage. However, high-crest bone is at higher risk of biologic width violations.

This article will discuss impression techniques using a new gel retraction and hemostatic aid called Racegel (*Fig. 2*).

The features of the Racegel include:

- Thermodynamic chemistry that provides increasing viscosity in the oral cavity. The thermal effect is reversed when rinsed with water for ease of removal.<sup>5</sup>
- 25% aluminum chloride for optimal control of bleeding and crevicular fluid.
- An orange color for easy viewing during placement and for confirming complete removal.
- Can be used in conjunction with cord or simple control of gingival bleeding.

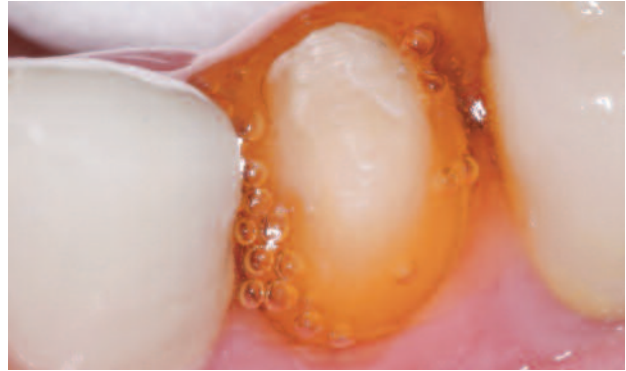
## Case Report no.1

This posterior crown is a common example of a low crest and deep sulcus restorative situation (*Fig. 3*). Because of the sulcus depth, often one cord is not adequate to fully displace the tissue and obtain a quality impression. Instead of traumatizing the tissue with two cords, one small cord was placed and then Racegel was injected into the sulcus. This provided the necessary retraction and hemostasis.

All-ceramic preparation margin designs will often be at the level of the gingival margin (*Fig. 4*). The premolar seen in this figure, which has a normal gingival biotype, can be readied for impression with Racegel as the sole source of retraction.

## Case Report no.2

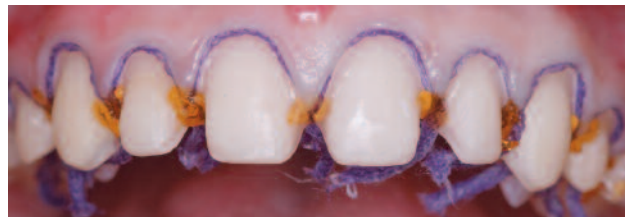
Preoperatively, this case had generalized interproximal decay and decalcification (*Fig. 5*), which resulted in residual interproximal inflammation and bleeding at the preparation visit. Dry cords were placed in the sulcus, and Racegel was placed on the bleeding areas. By controlling the tissue and obtaining a high-quality impression (*Fig. 6*), properly fitting restorations were created that allowed optimal health postoperatively (*Fig. 7*).



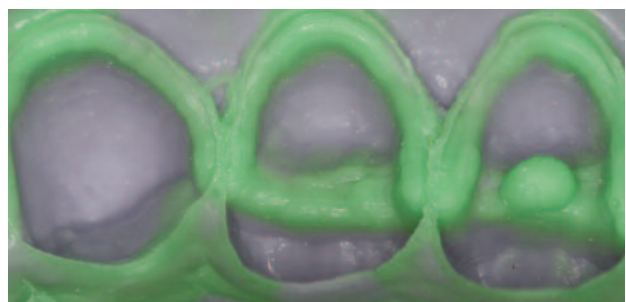
*Fig. 3:* In cases with a thinner gingival biotype, Racegel can be used as the sole source of hemostasis and tissue retraction.



*Fig. 4:* In this case Racegel was being used in conjunction with a packed cord to control gingival bleeding and to aid in tissue retraction.



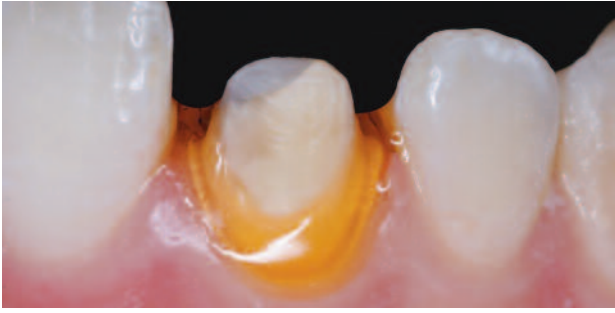
*Fig. 5:* In this multi-unit case, Racegel was used in conjunction with cord to control interproximal bleeding.



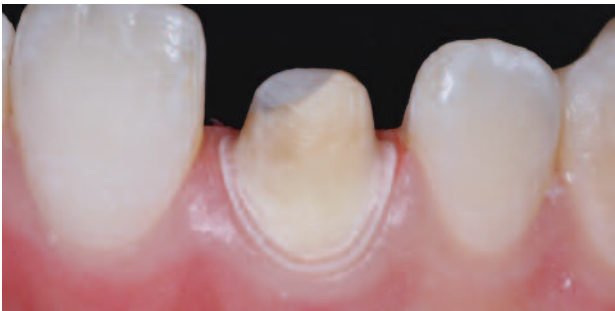
*Fig. 6:* The final impression from the case.



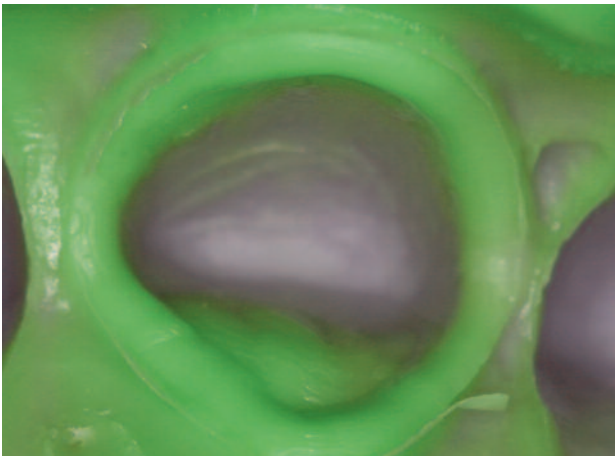
*Fig. 7:* The final lithium-disilicate veneer restorations. Note the healthy tissue response associated with properly fitting restorations.



**Fig. 8:** An anterior crown preparation. This tooth had an average gingival biotype, which allowed the use of Racegel as the sole source of gingival retraction.



**Fig. 9:** The Racegel was rinsed away with no residue, leaving a dry, clearly exposed margin.



**Fig. 10:** The final impression. Note the 360° marginal capture.

## Case Report no.3

This anterior crown preparation was associated with a thin gingival biotype and low bone crest. To keep tissue trauma to a minimum, Racegel was used as the only source of retraction (**Fig. 8**). After 2 minutes of setting, the material was easily rinsed away, leaving a clearly exposed margin (**Fig. 9**). The resulting impression had crisp 360° margins and captured past the margin end point (**Fig. 10**).

## Conclusions

There is no doubt that modern dental materials can improve the efficiency of restorative care. However, there is no replacement for good clinical judgment and proper diagnosis. Only when these types of materials are applied in the proper circumstances will predictability and uncompromised quality complement the efficiency gained.



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# A four-year prospective study of the use of N'Durance<sup>®</sup> composite, a nano-hybrid resin

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The purpose of this study was to evaluate the clinical performance of a new composite resin material, N'Durance<sup>®</sup>, in anterior teeth. Class III, IV, V, diastema closures and facial resin veneers were placed by one operator in the dentitions of the patients recruited to the study. Fifty-two restorations in 30 patients were originally placed, and at the 4-year recall, 26 restorations in 15 patients were evaluated. The results were collected using modified USPHS criteria. The results at four years showed that the majority of the USPHS categories were rated 100% Alpha at the 4-year evaluation, with the exception of color match having 73% Alpha, marginal adaptation 77% Alpha, and Polishability 96% Alpha, indicating satisfactory esthetic qualities and adequate strength and a high retention of N'Durance<sup>®</sup> composite.

## Introduction

Composite filling material is intended to replace missing tooth structure by replicating the look and function of natural tooth structure as close as possible. A desirable composite should be highly esthetic, and functionally strong. In addition, good handling characteristics are important for ease of placement. A highly radiopaque composite is beneficial, as it enhances the operator's ability to differentiate the composite from tooth structure or caries on a radiograph. Finding a composite that satisfies the need for esthetics and durability is a goal for modern dentistry. Changing the quality and size of the filler particles in a composite can affect the esthetic quality and the mechanical property of a composite (Narhi, 2003). Nano- and nano-hybrid

filler particles were developed with the goal of increasing strength of the composite, and improving the esthetics by decreasing the filler size (Ilie N R. A., 2011). The small size of the nano particles, ranging from 1 to 100 nm in diameter, has been reported to contribute to superior mechanical properties, such as low polymerization shrinkage, high flexural strength and low abrasion (Papadogiannis D.Y., 2008). Smaller particles in a composite are shown to have better wear resistance as well as a higher polishability (Van Dijken J., 2011) (Palaniappan S, 2010). Septodont, Confi-Dental Division, released the composite N'Durance<sup>®</sup> that proposes to combine high esthetics with strength and durability by combining nano-hybrid fillers with a new dimer

acid monomer technology (Bracho-Trachonis, 2008). The dimer acid monomer technology helps to reduce shrinkage during polymerization, and it has a higher degree of monomer conversion (Ilie N R. A., 2011), which leads to less uptake of water (Bracho-Trachonis, 2008) (Ilie N H. R., 2011).

The N'Durance® composite offers good handling characteristics, having a high viscosity and low feeling of stickiness during placement. In addition, it has a high opacity on radiographs, making it easy to differentiate it from tooth structure (*Fig. 1*).

The purpose of this study was to evaluate the clinical performance of N'Durance® composite in anterior class III, IV, V, facial veneers and diastema closure restorations over a four year period of time.



*Fig. 1*

## Materials and Methods

A total of 52 restorations were placed in anterior teeth throughout the anterior dentitions of 30 patients by one dentist at Loma Linda University School of Dentistry. Prior to initiation of the study, the protocol and the informed consent were submitted to and approved by the Institutional Review Board (IRB) of Loma Linda University. Written informed consent was obtained from each subject prior to the placement of the restorations. Healthy adults who exhibited a need for an anterior resin restoration were recruited to the study. Class III, IV, V, diastema repairs and facial veneer resins were included in the study. All restorations were restored with N'Durance® composite resin.

Pre-operative photographs and radiographs of the sites were taken. Shade selection was made prior to starting the procedure using the Vitapan Classical Shade Guide (Vident, Brea, CA). Each cavity was prepared using high speed diamond burs and a conservative preparation design. Any carious tooth structure was removed using steel carbide round burs on a slow speed hand-piece. Isolation was achieved using cotton rolls and saliva evacuation, along with gingival cord

when needed. Rubber dams were not used since all the restorations were placed on anterior teeth where saliva was well controlled. The preparations included etching on enamel and dentin with Gel Etchant (Kerr, Orange, CA), a 37.5% phosphoric etching gel for 20 seconds, and then thoroughly rinsed with water. The excess water was removed. The preparations were bonded with Opti-Bond Solo (Kerr, Orange, CA) and light cured for 20 seconds according to manufacturer's instructions. They were then filled with N'Durance® resin composite with a 1-2 mm incremental technique, curing each increment for 30 seconds. The curing light (with a minimum radiance of 500 mW/cm<sup>2</sup>) was held approximately 1 mm away from the tooth surface during the light activation (curing). The restorations were finished with carbide finishing burs and polished with OptiDiscs (Kerr, Orange, CA), Jiffy Polishing Points and Cups (Ultradent, Salt Lake City, UT) and Jiffy Composite Polishing Brushes (Ultradent, Salt Lake City, UT), as needed.

Restorations were evaluated at the baseline (two weeks after placement), six months, one-year, eighteen months, two-year, three-year and



four-year using the modified United States Public Health Service (USPHS) criteria (Bayne S., 2005). Anatomic form, color match, marginal adaptation, marginal discoloration, surface staining, retention, secondary caries, fracture and polishability were evaluated for each restoration, along with soft tissue health and post-operative sensitivity. The post-operative sensitivity data were obtained by asking each patient to rate their sensitivity

based on a scale of 0 to 10, with 0 having no sensitivity and 10 having extreme sensitivity. Clinical photographs were taken at each of the evaluations, and a radiograph of each site was taken at each of the year evaluations. At the four-year follow-up, 26 restorations in 15 patients were evaluated. The remainder of the patients was either dropped from the study, or unable to be located for the four-year evaluation.

## Results and Discussion

The results for the four-year evaluation of N'Durance® composite are shown in Table 1. All of the 26 restorations that were evaluated were determined to have an Alpha rating in the categories of Anatomic Form, Retention, Marginal Discrepancy, Surface Staining, Secondary Caries and Fracture. Nineteen of the restorations were rated an Alpha in the Color Match category and seven Bravo, showing a slight shade differentiation. The color of the material had not changed since the Baseline. Six of the 26 restorations were rated a Bravo in the marginal adaptation, noting some slight discrepancy present along

the enamel margin, not deemed to require any sort of repair of the margin. The remainder was rated Alpha for marginal adaptation. This is similar to results seen in published comparable composite studies (Van Dijken J., 2011) (Dukic W, 2010). There was one restoration rated as a Bravo in the Polishability category, showing a less than ideally reflective surface. The rest was rated Alpha for Polishability. The polishability of N'Durance® composite was very high at the four-year evaluation, and this seems to be one of the strengths of this product. There was no reported sensitivity with the

### Subject 1



Pre-operative situation



Restoration at baseline



Restoration at 4 years

### Subject 2



Pre-operative situation



Restoration at baseline



Restoration at 4 years

N'Durance® composite restorations at any of the evaluations. In addition, no significant gingival inflammation was observed in relation to the placement of the composite. In the patients that did exhibit gingival inflammation, this was a general condition in the patient's mouth, and not isolated to the areas around the composite restoration.

Composites fail for a multitude of reasons, among these are recurrent caries and fracture

(Watanabe H, 2008). Many studies have been done evaluating the strength and clinical success of composites both in anterior and posterior teeth. Although we are evaluating only anterior teeth in this study, the reasons for failure are similar wherever the composite is placed. There is an indication that the larger the restoration, the higher the likelihood of failure (Moura F, 2011). In particular for anterior teeth it has been reported that class IV composites failed at a

**Table 1 – Clinical Results of Restorations at Baseline and Four-years**

		Baseline	Four-years
<b>Total Restorations</b>		52 (100%)	26 (100%)
<b>Anatomic Form (Wear)</b>	A	52 (100%)	26 (100%)
	B	0 (0%)	0 (0%)
	C	0 (0%)	0 (0%)
	D	0 (0%)	0 (0%)
<b>Color Match</b>	A	39 (75%)	19 (73%)
	B	13 (25%)	7 (27%)
	C	0 (0%)	0 (0%)
	D	0 (0%)	0 (0%)
<b>Marginal Adaptation</b>	A	50 (96%)	20 (77%)
	B	2 (4%)	6 (23%)
	C	0 (0%)	0 (0%)
	D	0 (0%)	0 (0%)
<b>Retention</b>	A	52 (100%)	26 (100%)
	B	0 (0%)	0 (0%)
	C	0 (0%)	0 (0%)
<b>Marginal Discoloration</b>	A	52 (100%)	26 (100%)
	B	0 (0%)	0 (0%)
	C	0 (0%)	0 (0%)
	D	0 (0%)	0 (0%)
<b>Surface Staining</b>	A	52 (100%)	26 (100%)
	C	0 (0%)	0 (0%)
<b>Secondary Caries</b>	A	52 (100%)	26 (100%)
	C	0 (0%)	0 (0%)
<b>Fracture</b>	A	52 (100%)	26 (100%)
	B	0 (0%)	0 (0%)
	C	0 (0%)	0 (0%)
<b>Polishability</b>	A	52 (100%)	25 (96%)
	B	0 (0%)	1 (4%)
	C	0 (0%)	0 (0%)
	D	0 (0%)	0 (0%)

### Subject 3



Pre-operative situation



Restoration at baseline



Restoration at 4 years

### Subject 4



Pre-operative situation



Restoration at baseline



Restoration at 4 years

higher rate than class III composite restorations (Moura F, 2011). So far at the four-year evaluation, the N'Durance® composite has shown very little problems when used for larger class IV restorations, including the larger diastema closures.

Secondary caries has also been identified as one main reason for failure in previous composite studies (Ferracane, 2013). There were no signs of any secondary caries detected in this study. There was some slightly noticeable ditching along the margins of a few of the restorations. No repair was needed to the margins. Marginal adaptation is highly correlated to the polymerization shrinkage of a composite (Baracco B, 2013). The decrease in the Alpha scores for the marginal adaptation category is similar to related studies (Baracco B, 2013) (Van Dijken J., 2011). The esthetics of the N'Durance® composite was very high. At the four-year evaluations, the polishability was excellent. For all but one restoration, the polishability remained in the highest evaluation category, indicating a high shine replicating the enamel surface. This is one of the most pleasing characteristics of the N'Durance® composite. The polished surface of the restorations at the four-year evaluation was similar to the baseline evaluations. This is likely contributed to the small size of the particulates, which would allow

for a higher shine. Photos of some of the restorations are included in this article.

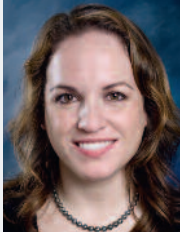
The handling characteristics of N'Durance® composite are very good. The stickiness of a composite can be manipulated by altering both the filler content and changing the monomer formulations (Al-Sharaa K, 2003). A composite that is too sticky when applying it can create voids by pulling back from the preparation as it sticks to the dental placement instrument (Al-Sharaa K, 2003). N'Durance® composite has a high viscosity feel to it, as well as the quality of not sticking to the instruments during placement, so that the restoration can be easily shaped and formed.

In this study, we were able to evaluate 26 of the original 52 restorations that were placed. This is a 50% drop out rate, which appears to be high for this type of study. Most of the dropped subjects were due to their moving out of the area or being unreachable. A couple of subjects were dropped due to case selection not meeting the study parameters; another two subjects were withdrawn from the study due to their tooth bleaching that occurred during the study, thus affecting the color match outcome. A higher retention rate would have been desirable but was unachievable in this situation.

# Conclusion

Within the limitations of this study, it can be concluded that, N'Durance® composite is a favored choice for anterior resin restorations,

having both high physical properties and excellent esthetics after four years.



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Holli Riter is a full time faculty member at Loma Linda University School of Dentistry. She graduated from the School of Dentistry in 1998 and worked for several years in private practice. She joined the faculty full time as an assistant professor in 2005, and later joined the Center for Dental Research in 2007. She enjoys both working with students as they learn dentistry and working in dental research, with a focus on esthetic materials. She is an active member of the International and American Association of Dental Research, the Academy of Cosmetic Dentistry, and the Academy of Operative Dentistry.

## Acknowledgements

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# The direct application of Biodentine™ under indirect ceramic restoration

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## Introduction

Restoring posterior teeth with missing cusps is always a challenge. Onlay restorations are usually stratified when greater tissue loss is observed, therefore rejecting direct restorations while still demanding a conservative treatment (Walmsley AD, 2007). These clinical situations always involve the dentin-pulp complex. In an effort to excavate carious dentin and differentiate between infected and affected dentin (Tolidis and Boutsiouki, 2012) cavity margins are sometimes placed in close proximity with the dental pulp. The situation becomes more severe, in cases when estimated remaining dentin thickness is smaller than 1.5 mm and pulp protection is necessary. Beside choosing the correct material and technique, it is crucial that restoration margins should not allow any microleakage, facilitating pulp healing. Beside conservative preparation and superior esthetics, ceramic onlays offer advantages such as seal of the dentin-pulp complex, higher bond strength and reduced postoperative sensitivity (Walmsley AD, 2007). Besides, marginal leakage in ceramic restorations is minimized, due to the thin layer of resinous cement, allowing for reduced poly-

merization shrinkage or thermal volumetric changes.

Traditional pulp protection methods include the use of liners, varnishes and bases under restorations, in order to insulate pulp from exterior stimuli, allowing for self-healing process to progress. An ideal pulp protection material should compensate for dentinal tissue loss, simultaneously stimulating tissue regeneration and a good pulp response. Base materials are designed to compensate for larger tissue loss. However, when a bioactive material was needed, calcium hydroxide was available as a liner, which should be followed by the placement of a base material, such as glass ionomer cements (Walmsley AD, 2007). Addition of Portland cement and mineral trioxide aggregate (MTA) in the dental armamentarium, has extended the capabilities of pulp healing. Although biocompatibility, tissue regeneration and induction of dentin bridge formation have been clarified, handling characteristics of calcium-based cements are still under investigation, since moisture levels, condensation technique, optimum pressure during condensation and setting time are impor-

tant factors determining the clinical outcome (Rao et al. 2009). Setting time of MTA, which extends up to more than 2 hours, makes a second patient visit mandatory, for the placement of the final restoration. There is no data in the recent literature, indicating that an indirect restoration can be fabricated over MTA, without the mediation of a conventional base material. Biodentine™, a comparable tri-calcium silicate, has been developed as a dentine substitute in deep cavities, possessing similar mechanical properties with dentin, therefore superior to MTA. Biodentine™ is biocompatible and is biologically active in contact with dentin, exhibiting very good results in deep carious lesions and pulp capping in adults (Biodentine™ scientific file). The material sets in 12 minutes and can be used as a long-term temporary restoration. Thanks to the comparable mechanical properties with dentin, Biodentine™ can be used under indirect restorations, acting as a base, nonetheless following the initial manufacturer's instructions (Shala et al. 2012). However, handling procedure after initial setting has been recently revised. Biodentine™ was initially suggested to allow for at least 48 hours before preparation of its surface for a direct or indirect restoration. If the material had not been fully set, the soft surface could not be easily prepared, the matrix would have been vulnerable to an acid attack (during etching) and the mechanical properties would probably deteriorate. Recently material instructions have

been revised by the manufacturer, recommending safely the immediate preparation of Biodentine™ after its 12-minute set. Its superior in vitro performance, compared with conventional base materials (glass ionomer cements and flowable composite resins) under direct composite resin restorations bonded with self-etch bonding system, proved that immediate restoration is harmless to the cement (Tolidis et al. 2013) (Fig. 1) and that its mechanical properties are comparable to conventional base materials (Yapp et al. 2012). It could further be assumed, that continuation of setting process of Biodentine™, allows for absorption of polymerization shrinkage stresses from the overlying composite resin, resulting in preservation of excellent marginal seal and minimized microleakage (Tolidis et al. 2013) (Fig. 1).

The combination of both innovative procedures (Shala et al. 2012, Tolidis et al. 2013, Yapp et al. 2012) has been applied to the following case report. A large dental tissue loss was restored with a ceramic restoration, directly after dentin was substituted by Biodentine™.

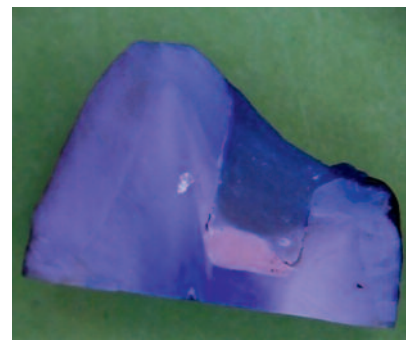


Fig. 1



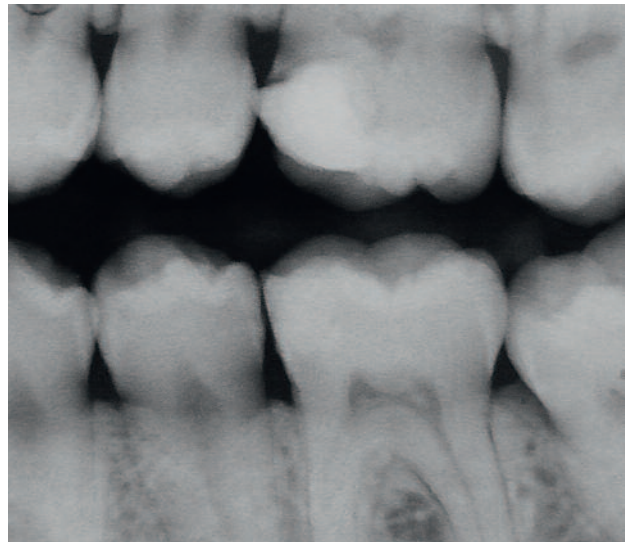
Fig. 2

## Case Report

A 27-year-old female patient presented in the dental clinic for a routine dental examination. The patient had excellent oral hygiene and a few, minor restorations. During clinical examination, special attention was given to the first maxillary molar, due to a Class II composite resin restoration with bad anatomy and appearance and signs of secondary caries at the cervical margin (Fig. 2). Bite-wing radiographs were taken to complement the examination of the suspected first molar and check for initial

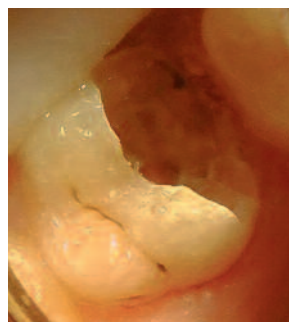
caries in mesial and distal areas of all posterior teeth. Secondary caries was found in the radiograph under the existing composite resin restoration and restoration margins were not acceptable. Moreover the radiograph revealed an initiated osteolysis at the bone crest of the supporting bone between the second premolar and the first molar, probably owing to an incorrect contact point which allowed for food debris accumulation (*Fig. 3*). Therefore it was decided to replace the restoration. Tooth vitality testing (cold) was positive.

Composite resin was removed under local anesthesia with a cylindrical high speed bur with water spray irrigation and secondary caries was clinically, directly confirmed. During composite resin removal, the mesial palatal cusp broke due to great undermining by caries (*Fig. 4*). Caries was removed by means of an excavator and a low speed round bur. At the mesial area, caries extended below the gingiva, therefore local gingivectomy with an electrotome took place in order to increase visibility. Cavity was finished with unsupported enamel prisms removal and resulted in a greater tooth loss, both in extent and in depth, than initially planned. Taking into account the subgingival extent of the cavity mesially and the amount of tooth substance loss, including cusps, it was decided to restore the tooth with an onlay, by substituting the lost dentin and protecting the young vital pulp with an appropriate material. The patient was concerned about esthetics and longevity of the restoration and since she was not a bruxist, a ceramic onlay restoration was regarded as the treatment of choice. Biodentine™ was chosen as a dentin substitute and pulp protection under the ceramic restoration. Restoration margins were prepared with a high speed cone bur with rounded edge, the remaining distal cusps were occlusally reduced in order to attain 2-mm space for the ceramic and an additional mesio-distal groove was prepared to provide mechanical stability to the restoration. Margins were rounded to avoid stress concentration on the restoration and on the tooth. Proximal walls were flared 10-12° in total, 6° for each wall, using the appropriate cone-shaped diamond bur, paying

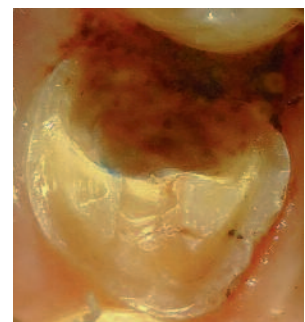


*Fig. 3*

extra care to avoid undercuts (*Fig. 5*). Biodentine™ placement fully covering the prepared cavity, waiting at least 48 hours with Biodentine™, acting both as dentin substitute and as a temporary restoration, before continuing the restorative process at the next patient visit would be the conventional procedure. Based on previous experimental studies (Yapp et al. 2012, Tolidis et al. 2013), it was decided to immediately continue with the restoration process, after Biodentine™ placement and setting. Biodentine™ was applied, right after the cavity was formed. Biodentine™ was placed in a 2-mm thick layer at the deepest part of the cavity located mesially, covering the undercuts on the pulpal wall, was condensed and was protected from moisture and allowed to set for 12 minutes according to the manufacturer's instructions. Subsequently, Biodentine™ surface was finished with a low-speed carbide bur. Dentinal walls of the onlay preparation, which were covered with cement, were finished with a low-grit high-speed diamond



*Fig. 4*



*Fig. 5*

bur taking extra care (Fig. 6). In cases when the clinician decides to continue with the restorative process directly after Biodentine™ setting, either with a direct or with an indirect restoration, it is safer to prepare Biodentine™, if needed, with low speed burs, to avoid complete removal of the cement from the cavity (Tolidis et al. 2013). Retraction cord was placed in the gingival sulcus at the mesial area, where the preparation extended subgingivally and impression was taken with vinyl-poly-siloxane (Fig. 7). Shade A2 was chosen for the ceramic restoration, matching the neighboring and opposite teeth of the young patient. The preparation was covered with a temporary light-cured material (Fig. 8), which is easily removed at the delivery appointment with an explorer. During the second patient visit, the ceramic onlay was tried in using special carrying sticks to prevent loss or damage to the restoration while handling (Fig. 9). Ceramic restoration was glazed. Before cementation, the inner surface was cleaned with 37% phosphoric acid applied for 30 seconds (Fig. 10), followed by the application of a silane primer according to the cementation technique. Self-etching bonding agent was applied on the tooth structure, avoiding the area covered by Biodentine™ and the resto-

ration was adhesively cemented with a dual-cure resinous cement, in order to increase retention (Fig. 11). Excess resinous cement was removed with an explorer and contact points were checked with dental floss. The restoration was light cured for 40 seconds from each side and occlusion was checked with occlusion paper and properly adjusted in maximum intercuspation and in mandibular moves. Visible margins were also finished with fine cone-shaped diamonds and silicon points. Patient was instructed for daily oral hygiene and was advised to avoid biting on hard objects or food at the area of restoration. No post-operative sensitivity or other symptoms appeared. The patient was followed-up in 6 months (Fig. 12, 13, 14). Intraoral examination, radiographs and pulp vitality testing proved the success of the material choice and of the restoration process. Reactionary dentin formation is evident when comparing the two radiographs (Fig. 3 and Fig. 14). Last but not least the mesial restoration and the tooth margins were visually checked in high magnification photograph (Fig. 13) as well as clinically with an explorer, confirming that the radiolucency shown in this area in the radiograph seems to be of no importance.

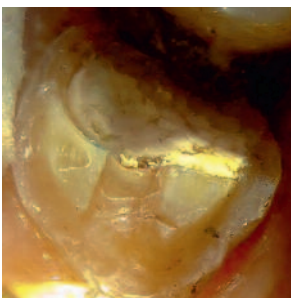


Fig. 6

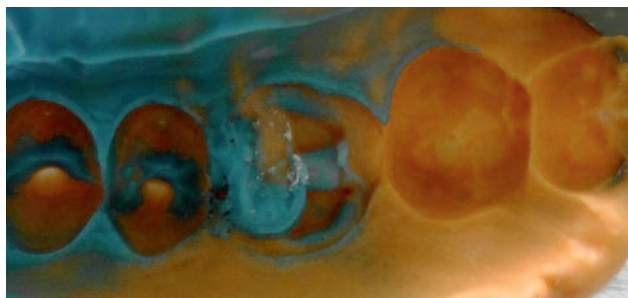


Fig. 7

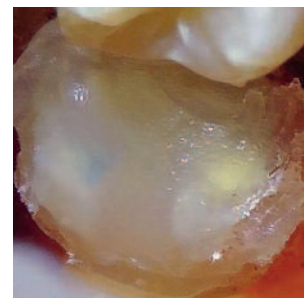


Fig. 8



Fig. 9



Fig. 10





Fig. 11



Fig. 12



Fig. 13

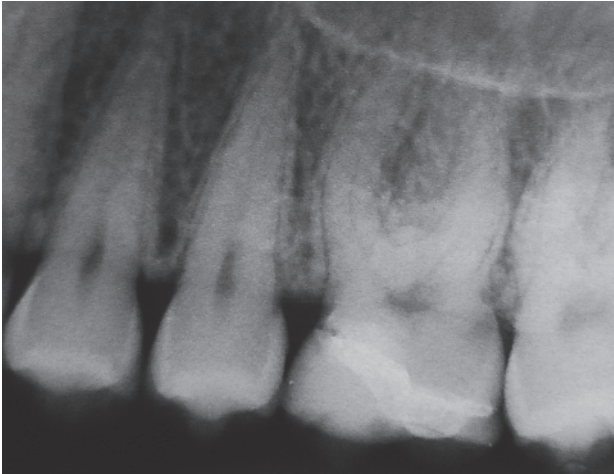


Fig. 14

## Conclusion

By utilizing this innovative approach, number of patient visits was reduced and the compromised first maxillary molar was treated indirectly, providing an esthetic restoration with long-term survival. Since it has been experimentally exhibited that direct application of the restorative material over Biodentine™ is effective and time-consuming, this case report represents the extension of this treatment idea in indirect ceramic restorations. It should be however emphasized, that Biodentine™ needs extra care in handling when restored directly.



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She participates in dental conferences and has published 23 scientific articles.

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# Apicoectomy treated with an active biosilicate cement: Biodentine™

Case report of a tooth Apicoectomy, endodontically treated with a retrograde filling material based on an Active Biosilicate cement, Biodentine™ Septodont.

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## Introduction

In clinical practice, we encounter complex procedures that often involve errors in the development of the endodontic treatment, both in the preparation and the obturation, and which lead to the persistence of the periapical lesion via the migration of antigens in the region.

The alternative we then have is retreatment, which is not indicated in cases of complex over-obturations or teeth that have been restored with posts, which complicates the procedure and could result in the loss of the tooth due to fracture or perforation.<sup>1</sup>

In the case we present below, we saw that the conditions for a successful retreatment were unfavorable, we thus decided to perform periapical surgery.

Periapical surgery consists in the exposure of the periapical zone and the removal of the affected tissue followed by a retrograde restoration consisting in the apical preparation of a cavity and its filling to ensure a hermetic seal and prevent percolation.<sup>2</sup>

Endodontics has made great progress in the last decade in the development of new equipments, new instruments, advances in imaging and the development of new materials.<sup>1</sup>

In this case among the new materials we used Biodentine™ developed by Septodont, as a new class of dental material that combines high mechanical properties and biocompatibility, with a calcium silicate (Ca<sub>3</sub>SiO<sub>5</sub>)-based formulation, which is a proven dentin replacement material whenever dentin has been damaged.<sup>3</sup>

## Case Report

A 48 years old female patient without pertinent medical history came to the consultation with pain in tooth 12, she mentioned having been treated a year ago.

We observed in the clinical examination that the tooth has a ceramic metal crown. No increase in the tissue volume was observed at the vestibular level (*Fig 1*), there is no sign of fistula, pain manifestation on palpation and vertical percussion.



Fig. 1



Fig. 2

The X-ray examination showed that the ceramic metal crown was not sealed at the cervical level, through the radiotransparency of the crown filling we noticed a fiber post, with absence of filling in the entire lumen of the canal prepared for the post, we also observed an over-obturation of approximately 3 mm and extravasation of the sealing cement, located in a radiotransparent area compatible with a chronic periapical process. (Fig 2)

a flap of the total thickness, with two discharge incisions resulting in a rectangular flap. The zone was detached with a periosteal elevator without evidence of vestibular bone fenestration. (Fig 3)

Once the zone to be treated was exposed, we performed an osteotomy with a No. 10 round surgical bur, once we reached the periapical zone we carried out the

curettage, the over-obtuated material and the surrounding granulomatous process was removed, and washed abundantly with saline solution to verify the removal of all the pathological tissue. The apicoectomy was performed with a fissure bur, creating as little bevel as possible and following the direction of the apical process. The apical chamber was prepared with a round bur following the direction of the root canal, at a 3 mm depth, it was thoroughly washed with saline solution and the cavity was dried with paper cones. (Fig 4)

## Treatment Plan

After the evaluation of the patient's conditions we recommended:

- 1- A surgical treatment, thus planning the exeresis of the extravasated material and the granulomatous tissue, apicoectomy with retrograde restoration,
- 2- Secondly, we recommended a new crown restoration with adequate cervical seal.

## Treatment

We started the treatment with infiltration anesthesia in the zone with 2% Lidocaine. The incision was made with a No. 15 scalpel blade, vertically away from the radiotransparent zone. We obtained

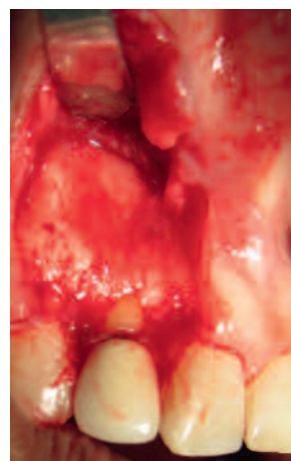


Fig. 3



Fig. 4

Septodont's Biodentine™, an active biosilicate-based retrograde obturation material was prepared according to the manufacturer's instructions, mixing 5 drops of the liquid (Aqueous calcium chloride and excipients solution) with the powder

(tricalcium silicate) for 30 seconds in the Henry Schein amalgamator Model: HS-1. (Fig 5, 6)



Fig. 5



Fig. 6



Fig. 7

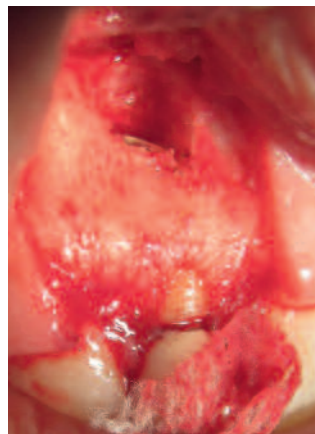


Fig. 8

We then placed the appropriate amount of material in the prepared cavity and condensed it, after 12 minutes, completely isolated from fluids, according to the manufacturer's recommendation (Fig 7), the excess was removed. (Fig 8)

We placed Genox® Org Genius-Baumer bovine liophylized bone in the cavity to fill-in the bone defect. (Fig 9)

We closed with 3-0 black silk suture, and treated with amoxicillin plus clavulanic acid 500 mg, every 8 hours for 7 days and ibuprofen 400 mg every 8 hours for 4 days, as well as recommending a 0.12% Chlorhexidine Gluconate mouth wash 3 times a day for 7 days. A control X-ray was taken. (Fig 10)

## Discussion

It was decided to perform the periapical surgery because it was impossible to eliminate the over-obtured material and the surrounding material in any other way.<sup>1</sup>

Many materials have been used for retrograde restoration, such as:

- Cohesive gold, which has very good properties. However the very long working time involved is a major disadvantage.
- Gutta-percha, which does not have an acceptable sealing degree and is affected by the compaction given as well as the humidity of the zone.

-Zinc phosphate and eugenol cements, which have a high level of solubility and irritation of the surrounding tissue.

-Resin modified ionomers which release monomers on polymerization provoking persistent toxicity in the zone, and whose ionomeric part has a high solubility and therefore is not recommended for this type of treatment.<sup>4</sup>

Thus, the most commonly used



Fig. 9

material and with the greatest number of literature references is silver amalgam, which is known for its mercury toxicity, it can tattoo the surrounding tissue with corrosion and the seal is poor as it depends on a retentive preparation. Another material which is increasingly used is MTA (Mineral Trioxide Aggregate), which is a mixture of small hydrophilic particles of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicon oxide, whose biocompatibility has been widely demonstrated, as well as the ability to induce the precipitation of calcium phosphate at the level of the periodontal ligament propitious to the formation of surrounding bone repair<sup>5</sup>. On the other hand the seal it forms in the cavity is superior to other materials, improving with time due to the absence of solubility, thus preventing percolation. The main problem with MTA is that it is hard to handle and to position in the retrograde cavity especially when they are small or thin. Another disadvantage is the setting time which can last up to 4 hours after its application, with the possibility of degradation during this period.<sup>6</sup> After this overview, we conclude that there is no ideal material for retrograde restoration, for this reason Septodont developed Biodentine™ as a new class of dental material that can



Fig. 10

combine high mechanical properties and biocompatibility, with a calcium silicate ( $\text{Ca}_3\text{SiO}_5$ )-based formulation, which is a proven dentin replacement material whenever dentin has been damaged. Following what we presented above concerning the disadvantages of the materials previously used, Septodont tries to improve the clinical times by adding to the active biosilicate settling accelerators and softeners, as well as a faster and safer preparation with exact amounts for a predictable mixture in pre-dosed capsules to be used in a mixing device, which makes it more practicable and safe to use.<sup>7, 8</sup> Calcium hydroxide forms as part of the chemical hardening reaction of Biodentine™.<sup>9</sup> The metal impurities observed in "Portland cement" silicates are eliminated in the manufacture of Biodentine™ biosilicate. The hardening reaction is the hydration of the tricalcium silicate, which produces a calcium silicate and calcium hydroxide gel. Precipitates similar to hydroxyapatite are formed in contact with phosphate ions.<sup>10</sup> An evaluation of the dentin-Biodentine interface showed micro-structural changes in the dentin, and revealed an increase in the carbonate content of the dentin interface, suggesting the intertubular diffusion of mineral from the biosilicate hydration products creating a hybridization zone.<sup>11</sup>

# Conclusion

The material has acceptable properties guaranteeing the quality of the mixture by its pre-dosing, resulting in an easy to handle homogeneous composition.

The biocompatibility advantages of active biosilicate are known which gives us a high safety margin of periapical biological response.

The disadvantage observed in the retrograde restoration was a low radiopacity of the material in comparison with amalgam, which complicates the evaluation of the quality of the obturation seal.

The first results observed in clinical practice are highly promising.



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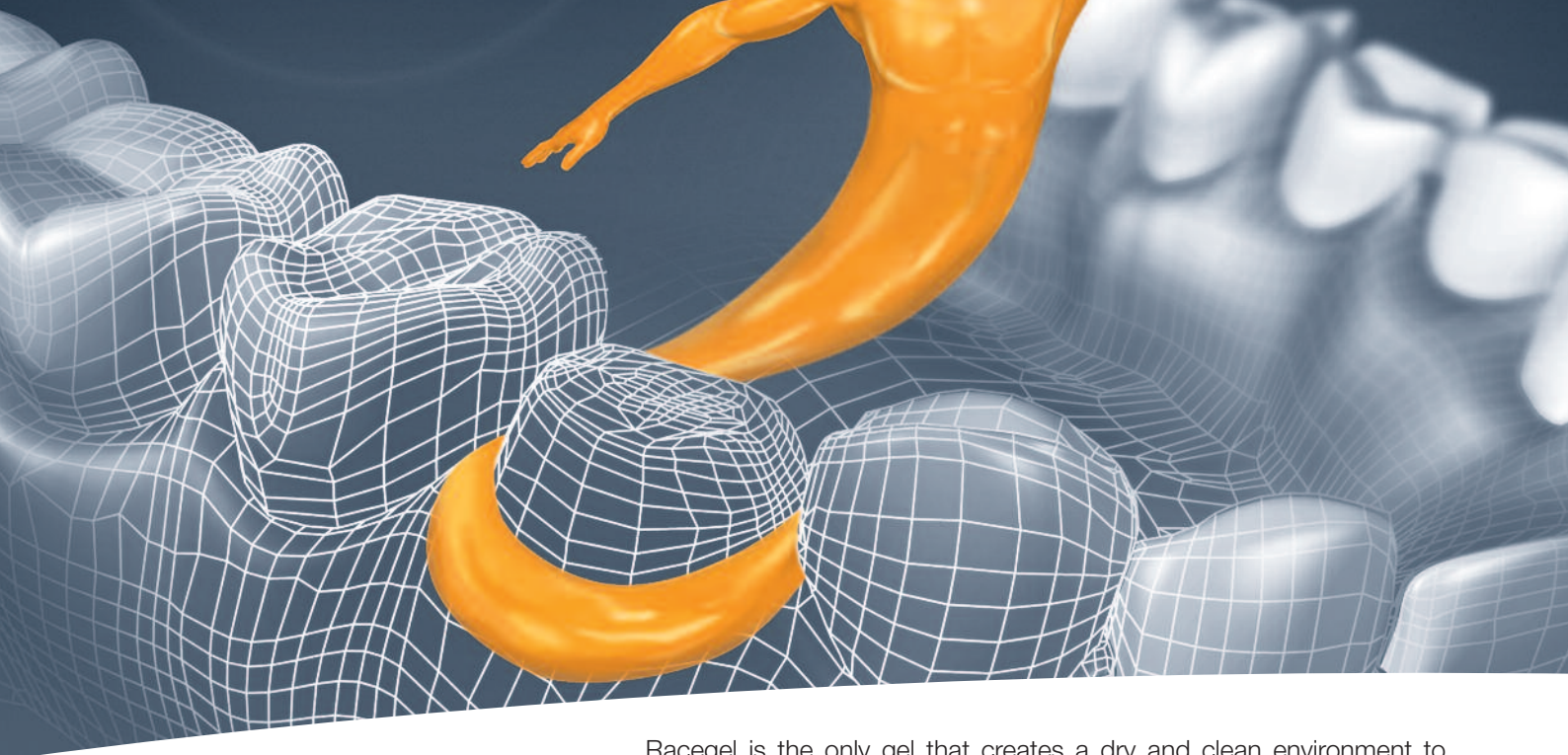
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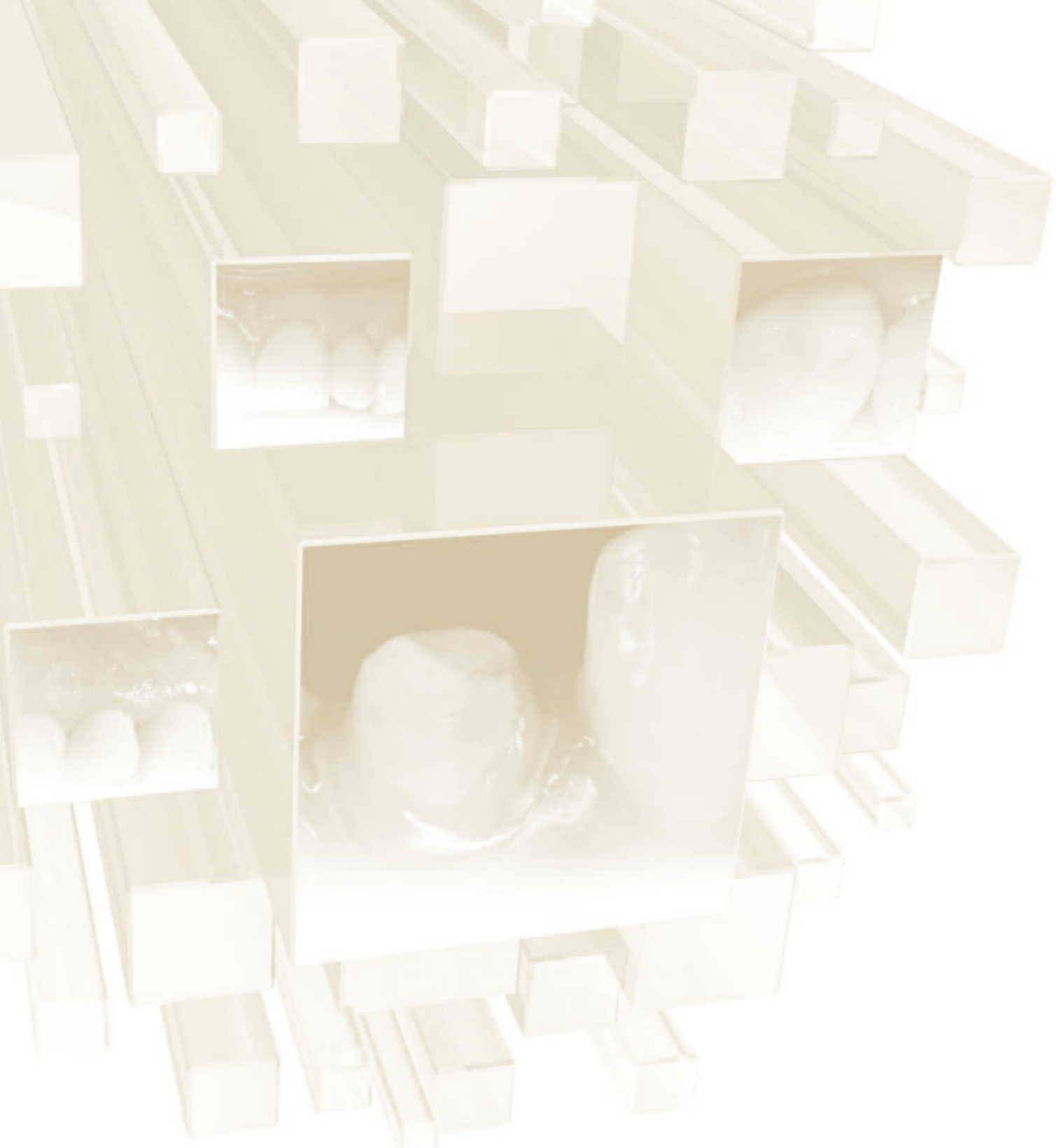
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