

NONINVASIVE AND STRAIGHTFORWARD TREATMENT OF LOCALIZED TOOTH WEAR WITH HYBRID CERAMIC (PICN): THE ORTHODONTIC-ASSISTED ONE-STEP NO-PREP TECHNIQUE

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There is not one universal material that is perfectly suited to all clinical indications. Each material has advantages and disadvantages that make it more or less appropriate for certain situations. Three families of esthetic materials can be used in dental prostheses: zirconia, glass-ceramics, and CAD/CAM composites. CAD/CAM composites include two subclasses of materials: dispersed filler materials and polymer-infiltrated ceramic network (PICN) material. PICN, or “hybrid ceramic,” consists of a block of glass-ceramic infiltrated with resin polymerized at high temperature and pressure, unlike all other CAD/CAM composites that are conventional glass fillers mixed with resin (**Fig 1**). This manufacturing process is patented by Vita Zahnfabrik and marketed as Vita Enamic as the only PICN material on the market.

Because CAD/CAM composites have the lowest flexural strength of all prosthetic materials, they are only indicated for single-unit restorations. However, they offer other very important benefits. In particular, PICN is an “in-between” material that combines many advantages without the disadvantages of light-cured direct composites and pure ceramics.¹⁻⁶ For example, compared to direct composites, PICN offers a high degree of polymerization and high homogeneity with fewer defects. As a result, the mechanical properties, wear resistance, and chemical stability (water absorption and discoloration resistance) are significantly improved while reducing toxicity (monomer release). Compared to pure ceramics, PICN offers the ability to be milled very thin (allowing no-prep treatment), the ability to deform and absorb occlusal stress in bruxers (its stiffness is similar to that of natural tooth structure, whereas ceramics are too stiff and other composites are too soft), easy adjustment of occlusal and proximal contact points, and easy repair. PICN is also less expensive and less abrasive than lithium-based glass-ceramics and has a “chameleon” effect similar to composites due to the presence of resin—that is, it takes the color of the tooth. Finally, PICN has been shown to develop high bond strength with resin composite cement that is better than other CAD/CAM composites.^{7,8}

These advantages have led to the introduction of the one-step no-prep technique for the treatment of generalized⁹ and localized¹⁰ severe tooth wear. As its name implies, the main features of this technique are that it requires no preparation of the tooth structure and is performed in a single step—that is, there is no phase with provisional restorations. The aim is to restore only the teeth that need to be

restored and to reconstruct the missing tooth structure in a noninvasive way, as recommended by the European consensus on severe tooth wear treatment.¹¹ The technique combines the advantages of direct techniques (noninvasive and one-step procedure, restorations that are easy to repair) and indirect techniques (access to high-performance materials). It is particularly straightforward because there is no preparation of tooth structure or provisional restorations and all restorations are directly bonded within a maximum of 24 hours. Additionally, this approach also includes bruxism management by maxillofacial physiotherapists.



Fig. 1. CAD/CAM composites include two subclasses of materials: dispersed filler materials (*left*), comprised of conventional glass fillers mixed with resin, and “hybrid ceramic” PICN material (*right*), comprising a block of glass-ceramic infiltrated with resin polymerized at high temperature and pressure. Vita Enamic (Vita Zahnfabrik) is the only PICN material currently on the market.

Case Report

CLINICAL CASE ANALYSIS

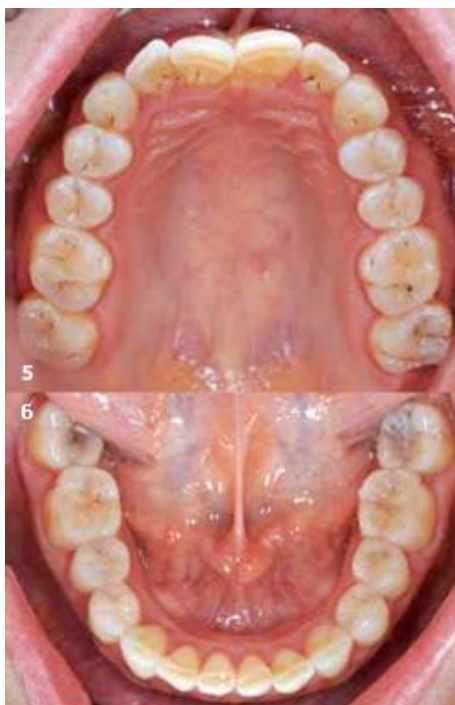
A 40-year-old woman was referred by her general dentist in 2019. Her main complaints were her smile esthetics and a pronunciation problem due to severe anterior tooth wear (Basic Erosive Wear Examination [BEWE] score = 3; ie, dentin exposure with hard tissue loss \geq 50% of the occlusal surface area) in a medium smile line context (**Figs 2 to 4**). In the posterior region, the buccal cusp tips from first premolar to first molar in both arches were worn as well as the palatal cusp tips from first premolar to first molar in the maxilla (**Figs 5 and 6**). The etiology of tooth wear was shown to be mechanical due to bruxing, with the presence of attrition facets. The patient had been treated 7 years previously by a specialist in temporomandibular disorders at the University Hospital (CHU) of Liège, who had fitted her with a night-guard to decompress the joint. The patient was in good general health but reported experiencing migraines as well as neck and back pain at the time of presentation.



Fig. 2. Frontal view of smile.



Figs. 3 and 4. Intraoral views showing severe anterior tooth wear due to bruxism and overcrowding of the maxillary teeth.



Figs. 5 and 6. Occlusal views showing some tooth wear on the buccal cusp tips from the first premolar to first molar in both arches as well as the palatal cusp tips from first premolar to first molar in the maxilla.

Photographs, radiographs, and optical impressions were taken. Regarding the dental status, all teeth were vital, and no tooth mobility was observed (**Fig 7**). The periodontal status revealed plaque-induced gingivitis. The occlusal scheme was Class II with group guidance (**Fig 8**). There was significant overcrowding of the maxillary anterior teeth and no occlusal contact from canine to canine in maximum intercuspation (see **Figs 4, 5, and 8**). The digital smile analysis (Keynote software, Apple) shows the significant loss of structure in the maxillary anterior teeth (**Fig 9**). Note that the cervical position of the teeth and the gingival contours are correct, except for the maxillary right canine, which is too high. The patient was referred to a maxillofacial physiotherapist (a physiotherapist specializing in temporomandibular disorders) for treatment of symptoms associated with bruxism, such as muscle pain.

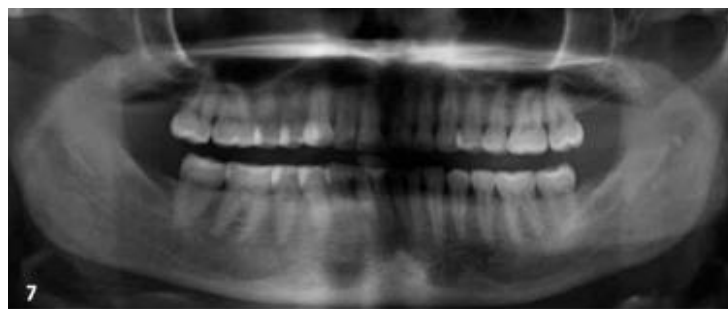


Fig. 7. Pretreatment panoramic radiograph.



Fig. 8. Lateral view showing the Class II occlusal scheme.

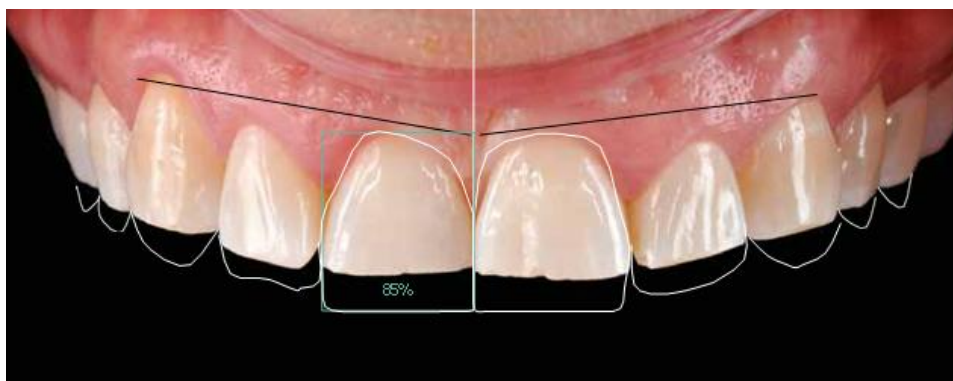


Fig. 9. Digital smile analysis using Keynote software.

ANTERIOR TOOTH ALIGNMENT AND CLINICAL CASE PREPARATION

After being informed of the various orthodontic and surgical options, the patient decided not to modify her Class II skeletal and dental relationships. Therefore, orthodontic treatment was performed only to align the maxillary anterior teeth. Treatment had to be interrupted due to the COVID-19 pandemic. Three sets of aligners (Invisalign, Align Technology) were used (**Fig 10**), but the result was not entirely satisfactory in terms of tooth rotation. This was resolved with 7 months of treatment with brackets and archwires (additional aligners were not chosen for financial reasons). The orthodontic treatment was followed by tooth whitening performed by the general dentist. The patient returned to CHU in 2022 (**Figs 11 and 12**), and restorative treatment began in early 2023.

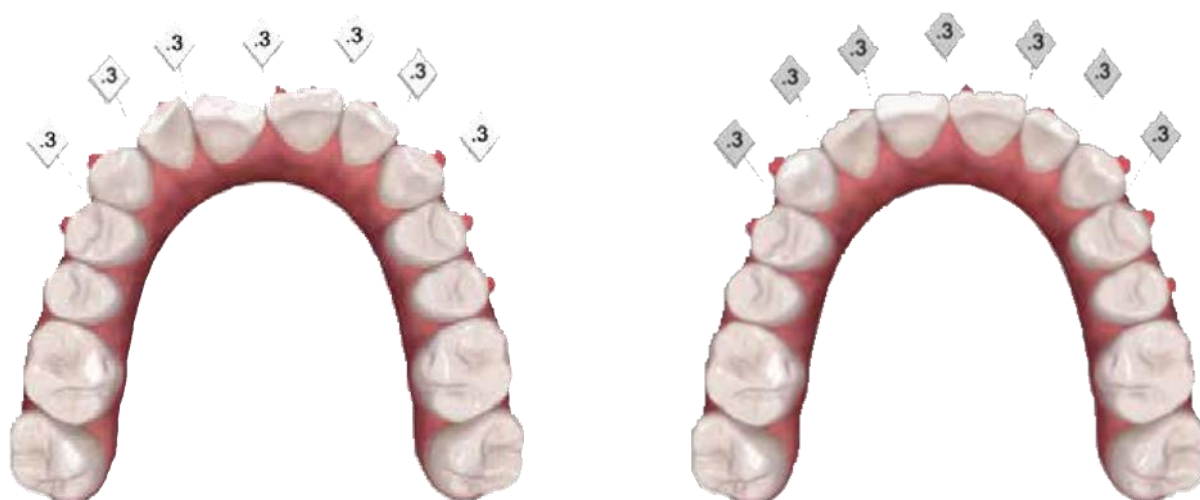


Fig. 10. ClinCheck of the Invisalign treatment to align the anterior teeth. (Orthodontics courtesy of Prof Carole Charavet and Dr Paul Kling, University Hospital of Liège.)



Figs. 11 and 12. Frontal and lateral views after orthodontic treatment.

RESTORATIVE TREATMENT: ANTERIOR NO-PREP PICN RESTORATIONS AND POSTERIOR DIRECT COMPOSITES

No tooth preparation was performed, and an optical impression (Omnicaam, Sirona) was taken directly. An occlusal analysis was then performed using a resin jig and a jaw-tracking system (Modjaw) (Figs 13 and 14). The jig was applied for a few minutes to induce muscular relaxation. The aim is to ensure correct positioning of the mandible, which should be close to the centric relation. A new digital smile analysis was created and sent to the dental laboratory. A digital setup (Ceramill Motion 2 system, Amann Girrbach) was then designed for the anterior teeth based on the estimated amount of lost tooth structure, the digital smile analysis, and the reconstruction of harmonious incisor proportions. This technique results in an empirical estimate of the new vertical dimension of occlusion (VDO) and restorations in supraocclusion.



Fig. 13. Occlusal analysis with use of a resin jig to ensure correct positioning of the mandible.



Fig. 14. Screen capture of the registration of the occlusal relationships with the jig and the Modjaw jaw-tracking system.

For the maxillary anterior teeth, CAD/CAM mock-ups were made in wax and tried in to validate the tooth length (**Fig 15**). Tooth color was registered using the Vita 3D-Master system (Vita Zahnfabrik) and polarized light (**Figs 16 and 17**).

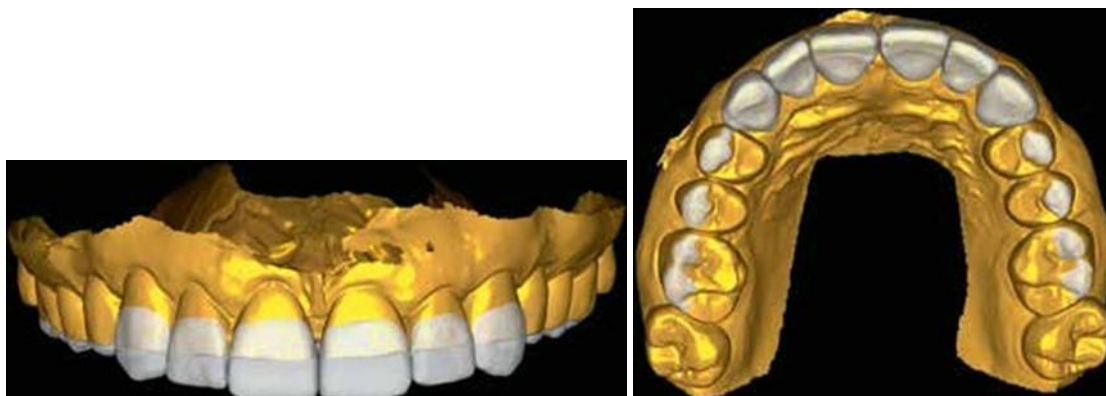


Fig. 15. CAD/CAM wax cast try-in with petroleum jelly to validate tooth length.



Figs. 16 and 17. Tooth color registration using the Vita 3D-Master system and polarized light.

Six maxillary palatal veneers (canine to canine) and four mandibular “chips” (lateral incisor to lateral incisor) were then designed (**Figs 18 to 21**), and multicolored PICN blocks (Vita Enamic multiColor) were milled (Ceramill Motion 2 system) (**Figs 22 to 27**). Multicolored blocks include both a dentin and an enamel layer, which improves the esthetic result because the restorations only need to be polished, not stained (see “Esthetic finishing”). In addition, the manufacturing process of this specific type of block is believed to improve the gloss and wear resistance of the material. It should be noted that the restoration design partially covers the buccal surfaces of the teeth to promote a smooth transition between the material and the tooth. On the palatal surfaces of the maxillary teeth, the coverage was designed to restore the occlusal anterior contacts in maximum intercuspation, which was not possible on the lateral incisors (it would have created a very thick restoration). The restorations were tested in the mouth to validate their design and the new VDO.



Figs. 18 and 19. Digital design for maxillary PICN restorations (canine to canine).



Figs. 20 and 21. Digital design for mandibular PICN restorations (lateral incisor to lateral incisor).





Figs. 22 to 26. Maxillary palatal PICN veneers. The design partially covers the buccal surfaces of the teeth to promote a smooth transition between the material and the tooth. (Lab work for this case performed by Jean-Michel Paulus, Philippe Blanpain, and Ali Khajeh-Veyssi from the Jean-Michel Paulus Dental Lab, Liège.)



Figs. 27. Mandibular PICN “chips”. The restoration design also partially covers the buccal surfaces of the teeth to promote a smooth transition between the material and the tooth.

For the posterior teeth (premolars, first molars, and mandibular canines), a wax-up was made to restore the cusp tips, and a transparent silicone index was made for direct composite molding (Regofix, Dreve Dentamid) (**Figs 28 to 31**).



Figs. 28 to 31. Wax-ups for direct restorations on the posterior teeth and silicone indices for direct composite molding.

The PICN restorations were bonded, and direct restorations (Inspiro, Edelweiss) were fabricated and placed within 24 hours via the one-step no-prep technique.^{9,10} The mandibular teeth were restored on one day and the maxillary teeth on the following day (**Figs 32 to 37**). The Vita Enamic restorations were pretreated according to the manufacturer's recommendations, which consisted of etching the surface with hydrofluoric acid for 60 seconds, followed by cleaning in an ultrasonic bath in ethanol and finally applying a layer of silane (Monobond S, Ivoclar). After the rubber dam was placed, direct composites were realized with the index. Before bonding the PICN restorations, the tooth surface was cleaned with pumice and then treated with a two-step etch-and-rinse adhesive (Adhese, Ivoclar). The restorations were bonded with a composite resin cement (Variolink Esthetic DC, Ivoclar), polymerization was carried out after the removal of any excess material, and the final photopolymerization was performed under a layer of glycerin to prevent the persistence of a polymerization inhibition layer (see **Video 1** of a similar case). Due to the limitations of CAD/CAM milling in terms of thickness, the restorations were slightly overcontoured on the buccal surfaces and their margins had to be polished afterward (see "Esthetic finishing").

Occlusal adjustments were made with an Arkansas stone bur, followed by polishing with silicone polishers. The occlusal adjustments consisted only of equilibrating the occlusal contacts on the anterior maxillary restorations. The technique results in a significant open bite and nonequibrated contacts in the posterior region.

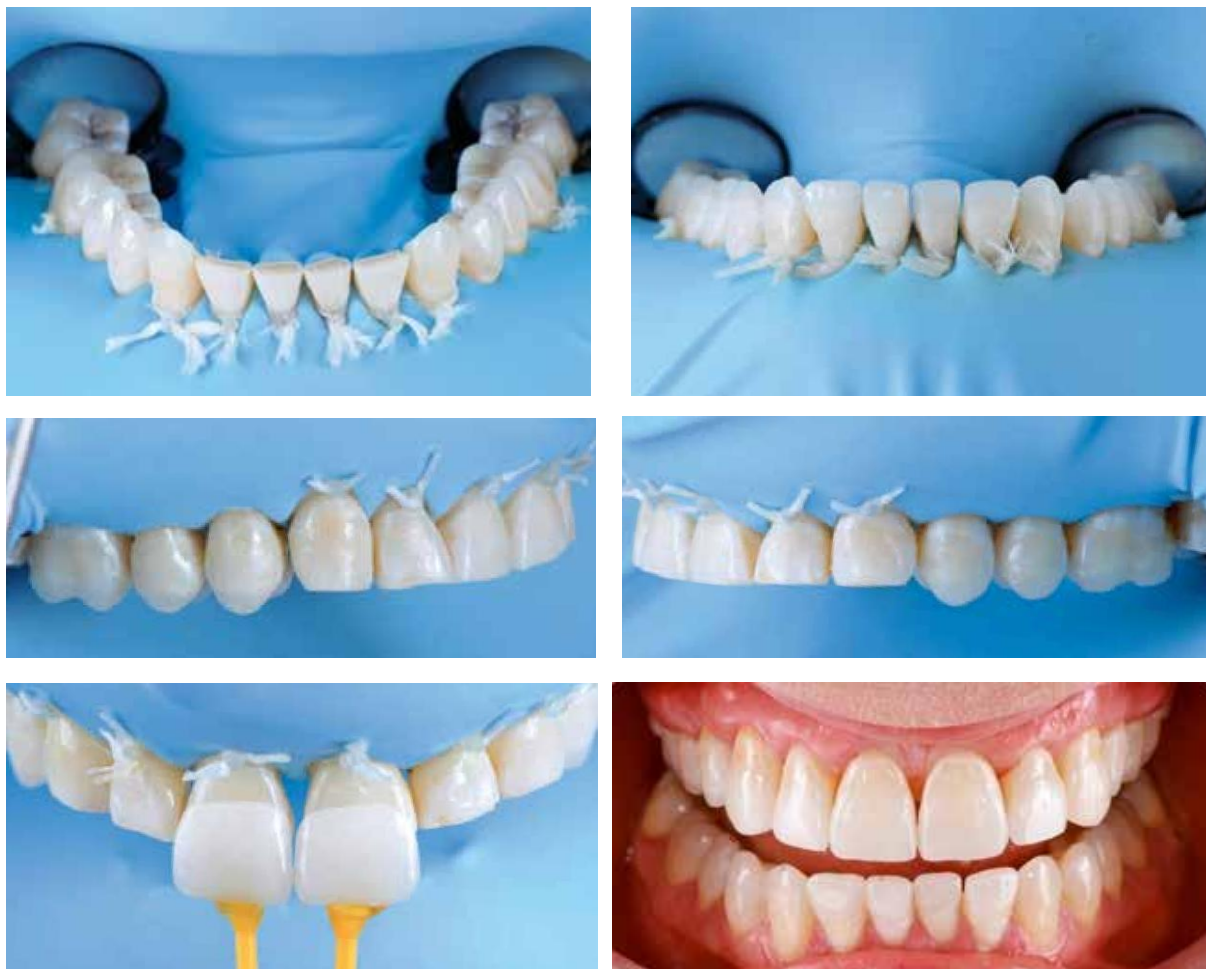


Fig. 32. After direct composite molding (Inspiro) to restore the buccal cusp tips of the mandibular premolars and first molars.

Fig. 33. After bonding of the mandibular PICN restorations from lateral incisor to lateral incisor. The diastema would be closed orthodontically.

Fig. 34 and 35. After direct composite (Inspiro) molding to restore the buccal and palatal cusp tips of the maxillary premolars and first molars. The border between the teeth and the composite is marked by the dehydration of the tissues due to use of the rubber dam.

Fig. 36. Bonding of PICN restorations on the maxillary central incisors.

Fig. 37. Frontal view just after restorative treatment and rubber dam removal. This treatment was realized within 24 hours in two appointments. Due to the limitations of CAD/CAM milling in terms of thickness, the restorations are slightly overcontoured on the buccal surfaces, and their margins had to be polished afterwards.

Video 1 :

<https://youtu.be/p1QSOo82VzY?is=CQ22mOkqJR8r4M43>

SIMPLE ORTHODONTIC EXTRUSION

One week after bonding, orthodontic metal buttons (Curved Caplin Hook, Eurolia Orthodontics) were placed on the molars. Maxillomandibular elastics (number 7, mean force 128 g, Dentaurum) were prescribed between all buttons to be worn 24 hours a day, except during eating, drinking, and brushing, to close the posterior open bite (**Figs 38 to 41**). Each elastic was changed twice a day. An elastic orthodontic chain was also placed on the mandibular incisors for 5 days to close the diastema, after which a permanent retainer was placed to maintain the anterior tooth positions. After 3 months, the posterior occlusion of the first molars was restored (**Figs 42 to 44**), and after 4 months, the occlusal contacts were fully restored (**Figs 45 and 46**). The premolars, which were in slight infraocclusion, were subjected to passive eruption.



Figs. 38 and 39. The restorative treatment of the teeth resulted in significant open bite and nonequibrated contacts in the posterior region.



Figs. 40 and 41. Simple orthodontic extrusion of molars with orthodontic metal buttons and maxillomandibular elastics. An elastic orthodontic chain was placed on the mandibular incisors for 5 days to close the diastema. (Orthodontic performed by Dr Jean-Claude Bernard, University Hospital of Liège.)



Figs. 42 to 44. After 3 months, the posterior occlusion of the first molars was restored.



Figs. 45 and 46. After 4 months, the occlusal contacts were fully restored. The premolars, which were in slight infraocclusion, were subjected to passive eruption.

ESTHETIC FINISHING

The margins of the restorations were polished to remove slight overcontours and to establish a knife-edge finish to ensure a smooth transition between tooth and restoration. The Vita Enamic technical polishing set includes a prepolishing and a high-gloss silicone polisher (**Video 2**). Classic feldspathic ceramic polishers combined with buffalo hair polishers with polishing paste can also be used as an alternative. It should be noted that polishing gives a more durable esthetic result than glazing and staining with dedicated light-curing composites. This result is enhanced by the use of a multicolored PICN block (Vita Enamic multiColor). If necessary, the labial margin can be masked with a direct composite after a slight chamfer has been made over the finish line. In the present case, the patient was very satisfied with the esthetic result, even in the mandibular incisors where the transition was not visible during speech (**Figs 47 to 49**). **Figures 50 to 52** show the patient's smile after treatment.

Video 2 :

<https://youtu.be/N94oxKnWqYA?is=1Wl1hhK9mEWvWpF8>



Fig. 47. Frontal views of the maxillary teeth before and after treatment.

Fig. 48. Frontal views of the mandibular teeth before and 15 months after treatment. Because the transition between the teeth and restorations was not visible during speech, the patient did not want to proceed to buccal junction masking with direct composite.



Fig. 49. Frontal views before and after treatment.



Figs. 50 to 52. Patient's smile after treatment.

PATIENT-RELATED OUTCOMES

The patient was very satisfied with the esthetic and functional results of the treatment, the speed of delivery without the need for provisional restorations, as well as the comfort and esthetics of the PICN material. The patient was also very satisfied with the short duration of orthodontic extrusion and its associated functional and esthetic handicap. Finally, the patient appreciated the noninvasive aspect of her treatment (**Fig 53**), as reported in a previous publication on the orthodontic-assisted one-step no-prep technique.¹⁰

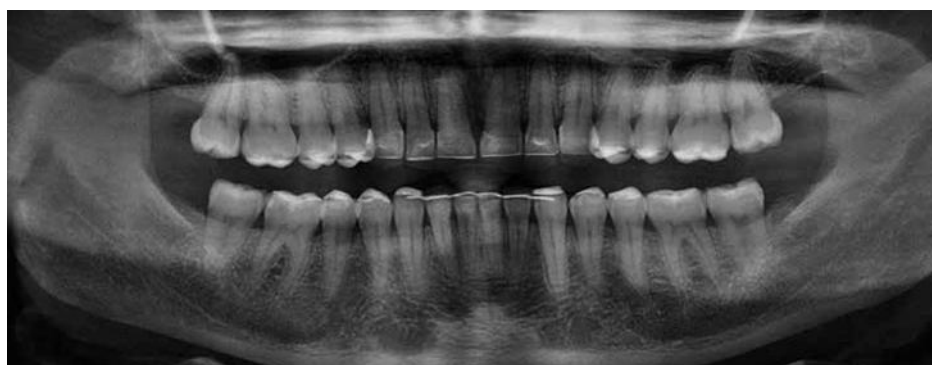


Fig. 53. Posttreatment panoramic radiograph showing the noninvasiveness of the treatment

FOLLOW-UP

After treatment, an acrylic occlusal splint (for the maxillary anterior teeth) was fabricated to protect the teeth from any bruxing and act as an orthodontic retainer (**Fig 54**). Unfortunately, the patient did not keep her appointment with the maxillofacial physiotherapist and still needs bruxism treatment; she has been remotivated in this direction. The direct composite on the maxillary right second premolar and molar had to be repaired after 15 months, likely because the awake bruxism habit was still very present, which highlights the importance of therapeutic education for patients in the context of their disease. However, the PICN restorations, which exhibit higher mechanical properties, were performing very well at this follow-up. The patient was also sent to a dental hygienist to improve plaque control, which was still not ideal. **Figures 55 and 56** show the stability of the occlusal contacts 15 months after cementation.



Fig. 54. Frontal view of acrylic occlusal splint in place.



Figs. 55 and 56. Occlusal views showing the stability of the occlusal contacts 15 months after bonding.

Conclusion

The Hippocratic oath says, “First, do no harm.” Noninvasive but also efficient and economical dentistry should be the future standard in dentistry, as in medicine. Teamwork and new technologies allow us

to move in this direction. With this in mind, both dental technicians and dentists should develop their own knowledge of dental materials to understand their respective advantages and disadvantages in each clinical situation, knowing that there is no universal material. PICN material (hybrid ceramic) is well suited for single-unit, no-prep restorations, especially in the presence of occlusal stress, and represents an “in-between” material that combines the advantages of both direct composites and pure ceramics in this context.

Acknowledgments

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Amélie Mainjot is married to the founder of the company MaJEB, which contributes to the development of PICN materials.

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