Laser-assisted re-establishment of Canine Guidance: Esthetic and Functional Reconstruction of Worn Canines

author_Carlos de Paula Eduardo[1], Marina Stella Bello-Silva[2], Karen Müller Ramalho[3], Roberta Marques da Graça Lopes[4], Patricia Moreira de Freitas[5], Brazil

Fig. 1_Initial clinical status. A_Right side view: Loss of canine guidance and presence of contacts on lateral incisors, pre-molars and disto-buccal cusp of the first molar. **B**_Left side view: Loss of canine guidance and occlusal contacts on lateral incisors and pre-molars. A diastema between the upper right canine and lateral incisive caused by the occlusal interference can be noticed.

Fig. 2_ Longitudinal crack in the upper canine caused by intense occlusal forces.

_Introduction

The frequent occurrence of teeth wear and the harmful consequences of tooth surface loss have turned to be one of the greatest concerns among current dentistry issues.[1] Teeth wear may have multiple causes and it is mainly related to the presence of parafunctional habits, such as bruxism.[2,3]

Bruxism is considered a parafunctional activity that include clenching and grinding of teeth during the night or/and day.[4] Clinically, severe tooth surface loss resultant from the attrition between teeth can have detrimental implications, including decreased vertical dimension of the occlusion, deficient masticatory function and loss of muscle tone. In addition, temporomandibular joint dysfunction and impaired esthetic appearance may be also observed.[5]

The treatment of worn dentition includes the esthetic and functional restoration of teeth. Recent developments in adhesive dentistry associated with new technology have enabled the achievement of clinical successful outcomes. Low and high power lasers have been increasingly used during prosthetic treatment. Er:YAG lasers are widely employed during restorative procedures, and its indications include microbial reduction, caries removal, enamel and dentin etching, ceramic conditioning and crown lengthening.[6,7]

This clinical case illustrates the restoration of worn canines in a young bruxer patient with concern to harmonious esthetics and stable function. The re-establishment of the canine guidance with diagnostic waxing and the reconstruction with composite resin using a stent of polyvinyl siloxane is described, as well as the benefits of hard tissue etching with the Er:YAG laser.

_Case Description

A 25-year-old Caucasian woman was referred to

[1] Full Professor, Special Laboratory of Lasers in Dentistry (LELO), Department of Restorative Dentistry, School of Dentistry of the University of São Paulo, Brazil.
[2] PhD Student, Special Laboratory of Lasers in Dentistry (LELO), Department of Restorative Dentistry, School of Dentistry of the University of São Paulo, Brazil.
[3] PhD Student, Department of Stomatology, School of Dentistry of the University of São Paulo, Brazil.
[4] MSc, IPEN - CNEN/SP, Brazil.
[5] Assistant Professor, Special Laboratory of Lasers in Dentistry (LELO), Department of Restorative Dentistry, School of Dentistry of the University of São Paulo, Brazil.

our clinic presenting wear facets on the edges of the upper and lower canines (Fig. 1). The patient reported muscular fatigue in the morning and clenching during the day, and these symptoms were attributed to the patient's parafunctional bruxing habit. The canine guidance was no longer present, and the wear pattern indicated that jaw lateral excursive movements were predominant during bruxism episodes. This fact could also be attested by the presence of a diastema between the upper right canine and lateral incisive (Fig. 1B), as the patient reported that it first appeared after bruxism habit initiated. Since the canine edge was lost due to tooth wear, the canine guidance was substituted by group function guidance, and an intense contact between upper and lower lateral incisors during lateral excursive movements may have caused tooth movement and diastema appearance. The intense strength exerted on the canines during clenching and grinding resulted in the appearance of cracks (Fig. 2), as well as in the loss of tooth anatomy.

Based on clinical observations and considering anamnesis data, the treatment proposed was the recovery of esthetics and function by the direct restoration of canines' anatomy with composite resin and the re-establishment of canine guidance. A hard acrylic occlusal guard was also indicated after restoration phase to protect tooth and restoration surfaces, manage bruxing habit and stabilize occlusion.

_Clinical Procedure

Before restoration procedures, impressions of both arches were taken. To determine the size and shape of the upper and lower canines and the exact amount of lost structure to be reconstructed, a diagnostic wax-up was fabricated (Fig. 3). After the teeth anatomy was rebuilt, the articulator was used to adjust the canine guidance and the correct lateral excursive jaw movements, and also to establish the ideal occlusal relation between both arches. The diagnostic wax-up enabled an ideal association of both esthetics and function.

Four silicone stents were fabricated (one for each canine) with heavy-bodied addition silicone impression material (Ivoclar Vivadent, Schaan, Liechtenstein). The silicone was positioned in the waxed cast, completely involving the canine without the use of impression trays. After material cure, the silicone was removed from the cast and its buccal portion was cut with a #15 blade in the mesiodistal direction and disposed. The incisal margin was preserved in the silicone matrix in order to guide the canine edge reconstruction.[8] After this, the silicone stent was tested in the mouth and its adaptation was checked, as well as the amount of resin to be placed (Fig.4). The tooth color selection was followed, and, as regarding previously bleached teeth, a composite resin for bleached teeth (Venus, Heraeus Kulzer, Armonk, NY, USA) was used.

Fig. 3_Diagnostic wax-up and reconstruction of upper and lower canines.

Fig. 4_Stent of polyvinyl siloxane impression material in position.

The enamel surface was etched with the Er:YAG laser (KEY Laser 2, KaVo, Biberach, Germany) emitting photons at a wavelength of 2.94 µm. The handpiece #2051 was used and parameters were set at 80 mJ, 4 Hz and focused mode (12 mm distance). The irradiation was conducted under water cooling (5 ml/min). The Er:YAG laser was also used to produce a small grove in the area of the canine edge with 120 mJ and 6 Hz in focused mode, so that the adhesion of the restoration to the tooth could be favored (Fig.5). After laser-conditioning, enamel and dentin were further etched with a 37% phosphoric acid for 30 and 10 seconds, respectively (Fig. 6A). The acid was removed with abundant water irrigation during 30 seconds and the enamel was gently dried with absorbent paper. The adhesive system (Clearfil SE Bond, Kuraray, Tokyo, Japan) was applied according to manufacturer's instructions and photopolymerized (Fig. 6B).

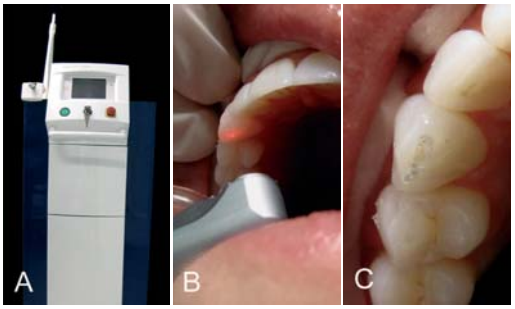

Fig. 5A_Er:YAG laser (KEY Laser II, KaVo).
Fig. 5B_Enamel conditioning of the right canine (Handpiece # 2051, 80 mJ, 4 Hz).
Fig. 5C_Surface aspect after laser conditioning and grove preparation.

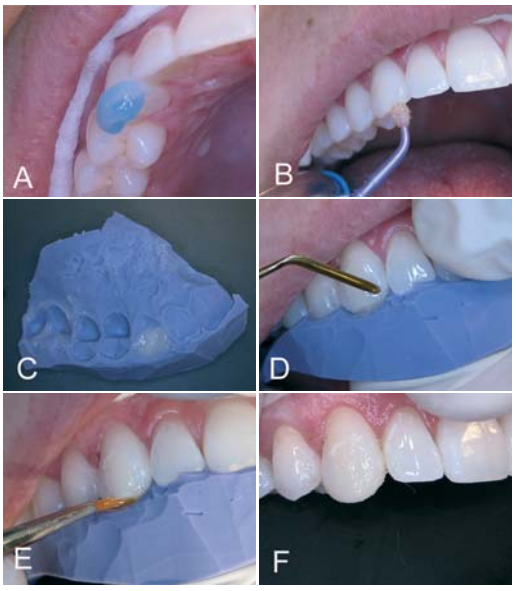

Fig. 6_Steps of restoration procedures.
A_Acid etching of enamel with 37% phosphoric acid after Er:YAG conditioning.
B_Application of the adhesive system (Primer and Bond).
C_Longitudinal section of the polyvinyl siloxane stent and insertion of the translucid resin.
D_Stent in position. Incremental insertion of resin.
E_Placement of resin with a brush (Cosmedent).
F_Restoration after stent removal, before finishing and polishing.

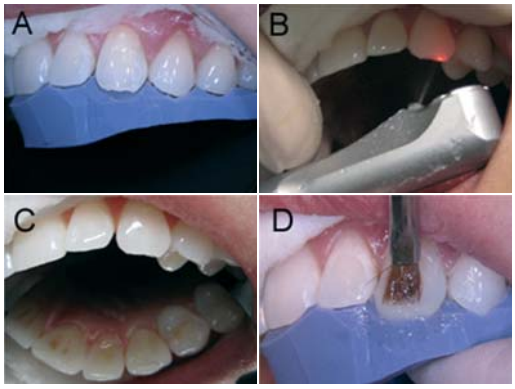

Fig. 7_Procedures repeated in the left side.
A_Stent in position.
B_Enamel conditioning with Er:YAG laser.
C_Surface aspect after laser conditioning.
D_Resin placement.

For teeth restoration, a thin layer of composite resin (T3, Venus, Heraeus Kulzer) was inserted in the silicone matrix, covering the whole palatal face of the restoration (Fig. 6C). The matrix was positioned in the mouth and the resin was polymerized for 20 seconds. This thin layer of translucid resin aimed to provide support for restoration building and initiate the construction of the translucid incisal edge. The reconstruction of the dentin portion (Fig. 6D) was followed with an opaque composite resin (SBO, Venus, Hereaus Kulzer), and the enamel portion was rebuilt (Fig. 6E) with a final layer of an enamel composite resin (A1, 4 Seasons, Ivoclar Vivadent). The same procedures were conducted for all upper and lower canines (Figs. 7 and 8).

The resin excesses of the cervical area were removed with a #12 blade. The occlusal contacts were adjusted, and the canine guidance was carefully re-established. Finishing and polishing procedures were conducted with polishing discs, interproximal abrasive strips and polishing pastes (Sof-Lex Pop-On, 3M ESPE, St. Paul, MN, USA; Enamelize, Cosmedent, Chicago, IL, USA). Right after restoration conclusion, the patient was given hard acrylic occlusal guard to protect restoration from further wear and to manage bruxing habit. Canines' reconstruction using direct resin restoration enabled the achievement of both harmonious esthetics and adequate function (Figs. 9 and 10).

At 1-year follow-up, the patient reported that the occlusal splint was not used as oriented. This fact could be clinically observed, since worn facets were again present in the restorations of both upper and lower canines (Fig. 11). The resin lost during bruxism episodes resulted in the exposition of the opaque resin used for the reconstruction of the dentin portion. This follow-up outcome is of extreme importance, since it indicates that adhesive procedures, including enamel etching with Er:YAG laser, were capable of providing the restoration with sufficient adhesion, so that it could tolerate the intensive occlusal charges generated during bruxing without any failure. Since adhesion was successful, the clinical consequence of continuous grinding during one year was the composite restoration wear. In spite of this, the canine guidance was still present, and the patient was oriented to effectively use the occlusal splint to avoid further wear and the need of a new restorative procedure. The presence of guidance was responsible for the closure of the diastema between the upper right canine and lateral incisive, and this could be observed one year after restoration (Fig. 11).

_Discussion

Tooth surface loss may be caused by erosion, abrasion, attrition and abfraction.[2] Clinical observations indicate that these factors seem to generally act in combination.[3] Attrite between teeth are frequently observed during parafunctional habits. In the present clinical case, this fact was responsible for causing wear facets in the upper and lower canines.

The restoration of the worn canines was indicated with the aim of re-establishing dentition function by the recovery of the canine guidance. Esthetics recovery was also targeted; however, it should be achieved as a consequence of the correct association between adequate functional reconstruction and strict application of restorative concepts. Indirect restoration of worn teeth with ceramic crowns is frequently reported in the literature.[9, 10] The direct technique was chosen for the present case, especially because of its conservative approach. A ceramic crown was considered an invasive treatment to be provided to a young woman presenting healthy teeth, and it would be indicated only in case of pre-existing wide restorations in the teeth to be reconstructed.

Since bruxing habit does not cease after teeth restoration,[11, 12] the night wear of the occlusal splint was indicated in order to prevent the restorations from further wear, as well as to manage bruxing habit and stabilize occlusion. Despite emphatically ori-

Fig. 8_Procedures repeated in the lower canines.
A_Surface aspect after enamel conditioning with Er:YAG laser.
B_Resin accommodation in the empty space of the stent.

Fig. 9A_Right lateral movement before restoration. Contacts on lateral incisors, premolars and molars can be noticed.
Fig. 9B_Left lateral movement before restoration, with contact on lateral incisors and premolars.
Fig. 9C_After the reconstruction of right canine guidance, an adequate space was created between antagonist incisors, premolars and molars during lateral movement.
Fig. 9D_Space between antagonist incisors, premolars and molars during left lateral movement after the reconstruction of canine guidance.

Fig. 10_Final clinical status. The patient was oriented to use an acrylic occlusal guard to preserve the results.

Fig. 11_At 1-year follow-up, wear of the restorations was caused by the misuse of the occlusion guard. Restorations adhesion to teeth was sufficient to tolerate occlusal stress and the canine guidance was still present in both **A)** right and **B)** left sides. The re-establishment of the canine guidance was also responsible for the closure of the diastema.

ented, the patient did not use the occlusal splint and that lead to the continuing restoration wear. This fact was important to allow the observation of restorations behavior under intense occlusal stress. After one year, restoration adhesion to laser-etched enamel proved to be successful. The intense charges exerted during bruxing events were sufficient to cause loss of resin substance, but not to detach it. The use of Er:YAG laser for enamel etching has proved to provide adequate bonding resistance, since the laser is capable of creating a micro-rough surface that favors the mechanical adhesion of resin to enamel.[13-15] In case the patient had been provided with ceramic crowns, the misuse of the occlusal guard might have caused fracture of restoration, or even of teeth. Thus, the successful adhesion played an important part in the present case, since the permanence of the resin restoration during the following bruxing episodes was crucial to protect the teeth from further wear, without jeopardizing its resistance.

The successful outcomes obtained in the present case are attributed not only to the correct diagnosis and clinical conduction, but also to the treatment planning. The technique performed included a meticulous examination in mounted casts, a simulation of the adequate canine guidance with diagnostic waxing, and a reliable reproduction of the planned restoration in mouth with the use of the silicone matrix. This accurate technique was associated with high technology for better clinical results, such as enamel conditioning with Er:YAG laser. Consequently, the outcome achieved was harmonious esthetics with the re-establishment of adequate dentition function.

_Conclusion

The re-establishment of the canine guidance with a combination of diagnostic wax-up, polyvinyl siloxane stent, and enamel conditioning with the Er:YAG laser, enabled the adequate reconstruction of worn canines with composite resin, resulting in harmonious esthetics and recovery of function. _

References

[1] Kato T, Thie NM, Montplaisir JY, Lavigne GJ. Bruxism and orofacial movements during sleep. Dent Clin North Am 2001; 45: 657–684.
[2] Kelleher M, Bishop K. Tooth surface loss: an overview. Br Dent J 1999; 186: 61–66.
[3] Eccles JD. Tooth surface loss from abrasion, attrition and erosion. Dent Update 1982; 9: 373–374, 376–378, 380–371.
[4] Okeson J. Orofacial pain: guidelines for assessment, diagnosis and management Chicago: Quintessence Publishing, 1996.
[5] Guttal S, Patil NP. Cast titanium overlay denture for a geriatric patient with a reduced vertical dimension. Gerodontology 2005; 22: 242–245.
[6] Eduardo C. Lasers in Prosthodontics and Esthetics, In: Gutknecht N, ed. Proceedings of the 1st International Workshop of Evidence Based Dentistry on Lasers in Dentistry. Berlin: Quintessence Publishing Co, 2007: 183–204.
[7] Eduardo C, Freitas P, Gaspar L. The State of the Art of Lasers in Esthetics and Prosthodontics. Journal of Oral Lasers Applications 2005; 3: 1–6.
[8] Behle C. Placement of direct composite veneers utilizing a silicone buildup guide and intraoral mock-up. Pract Periodontics Aesthet Dent 2000; 12: 259–266; quiz 268.
[9] Gow AM, Hemmings KW. The treatment of localised anterior tooth wear with indirect Artglass restorations at an increased occlusal vertical dimension. Results after two years. Eur J Prosthodont Restor Dent 2002; 10: 101–105.
[10] Malkoc MA, Sevimay M, Yaprak E. The use of zirconium and feldspathic porcelain in the management of the severely worn dentition: a case report. Eur J Dent 2009; 3: 75–80.
[11] Dao TT, Lavigne GJ. Oral splints: the crutches for temporomandibular disorders and bruxism? Crit Rev Oral Biol Med 1998; 9: 345–361.
[12] Ekfeldt A, Karlsson S. Changes of masticatory movement characteristics after prosthodontic rehabilitation of individuals with extensive tooth wear. Int J Prosthodont 1996; 9: 539–546.
[13] Gutknecht N, Esteves-Oliveira M. Laser for Hard Tissues, Cavity Preparation and Caries Removal In: Gutknecht N, ed. Proceedings of the 1st International Workshop of Evidence Based Dentistry on Lasers in Dentistry. Berlin: Quintessence Publishing Co, 2007.
[14] Esteves-Oliveira M, Zezell DM, Apel C, et al. Bond strength of self-etching primer to bur cut, Er,Cr:YSGG, and Er:YAG lased dental surfaces. Photomed Laser Surg 2007; 25: 373–380.
[15] Eduardo C, Bispo L, Jaeger R, Matson E. Conditioning of the enamel with Er:YAG laser and phosphoric acid. Tensile bond strength and scanning electron microscope, International Congress on Lasers in Dentistry Brussels: International Society for Lasers in Dentistry, 2000: 12.

_Acknowledgements

The authors would like to express their gratitude to CNPQ (Grants No.303798/2005-0 and No.552210/2005) and FAPESP.

_contact laser

Prof Dr Carlos de Paula Eduardo
LELO—Special Laboratory of Lasers in Dentistry
Av. Prof. Lineu Prestes, 2227. São Paulo,
SP – Brazil. 05508-000
Phone/Fax:
+55-11/3091-7645
E-mail: cpeduard@usp.br