

Full-mouth adhesive treatment in bulimia-related dental erosions: a clinical case

Trattamento adesivo di erosioni dentali associate a bulimia: un caso clinico

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ABSTRACT

OBJECTIVES

Dental erosion, which is defined as the gradual but irreversible loss of hard tissue is a major dental issue as it may be linked to systemic diseases such as eating disorders or gastroesophageal reflux (GERD), giving rise to difficulties in diagnosis.

In both pathological forms, the presence of gastric juices in the oral cavity causes the erosion of the palatal surfaces of the upper elements, often associated with variable sensitivity; carious lesions are generally not associated. Erosions associated with gastroesophageal reflux are often associated with mucosal irritation, oral ulcers and altered taste. It may be due to mechanical or chemical causes, which often lead to problems in treatment.

Compared to traditional classifications, the ACE classification sees these lesions divided mainly related to the anterior sector and to the therapeutic intervention strategy. Early diagnosis is crucial to maximize therapeutic alternatives.

The treatment of erosions is closely related to the amount of enamel and dentinal tissue involved as well as to the vertical dimension to be obtained in order to obtain satisfactory aesthetic results for the patient. Best erosion treatment involves a multi-disciplinary team and may range from direct composite reconstructions and fixed prostheses to innovative indirect reconstruction systems that aim at preserving as much tissue as possible. The new CAD/CAM technology offers important advantages in terms of result

forecasting, accuracy, precision and better patient-dentist communication.

The principle aims of treatment are aesthetic rehabilitation, recovery of functional mastication, establishment of the correct vertical dimension and achievement of stable and reproducible outcomes. In this regard, a multidisciplinary treatment that involves various professional figures would seem to guarantee good and predictable results.

MATERIALS AND METHODS

The present clinical report describes the treatment of asymptomatic dental erosion in a patient with eating disorders associated with bruxism and cervical myalgia. The patient requested esthetic rehabilitation without invasive interventions. A multi-disciplinary

approach included esthetic analysis which was followed by posture assessment using a stabilometric platform and a podoscope.

A modified 3-step rehabilitation technique was supported by digital technology. Composite restorations were inserted in the posterior areas and double veneers in the anterior. The outcome was stable and easy to monitor.

RESULTS AND CONCLUSIONS

The main objectives of prosthetic rehabilitation are preserving as much residual dental tissue as possible and achieving stable occlusal rehabilitation with a multidisciplinary approach, involving dentists, physiatrists and posturologists. Treatment depends on careful assessment of postural and temporal-mandibular abnormalities, as well as tooth damage.

A multidisciplinary approach together with the advantages offered by CAD/CAM technology provides acceptable, predictable outcomes when treating dental erosive lesions. It is often particularly problematic to propose in-

vasive therapeutic solutions, in the absence of relevant clinical symptoms.

New technologies, together with adhesive strategies in the prosthetic field, allow the partial overcoming of this problem.

CLINICAL SIGNIFICANCE

The proposed treatment represents a valid alternative to more invasive prosthetic reconstructions and highlights the importance of the multidisciplinary approach to the treatment of dental erosions

KEY WORDS

- CAD/CAM technique
- Dental erosion
- Eating disorders
- Onlays
- Cements

RIASSUNTO

OBIETTIVI

Le erosioni dentali, definibili come la graduale ma irreversibile perdita di tessuto dentale, rappresentano un importante problema clinico per la loro possibile correlazione con patologie sistemiche come disturbi del comportamento alimentare e reflusso gastroesofageo e relativi problemi diagnostici. In entrambe le forme patologiche la presenza di succhi gastrici nel cavo orale determina l'erosione delle superfici palatali degli elementi superiori, spesso associata a sensibilità variabile; generalmente non si associano lesioni cariose. Le erosioni correlate a reflusso gastroesofageo spesso si associano a irritazioni mucose, ulcere orali e alterazioni del gusto. Esse possono essere dovute a cause chimiche o meccaniche, con importanti problematiche di trattamento.

Rispetto alle classificazioni tradizionali, la ACE vede suddivise queste lesioni principalmente legate al settore anteriore e alla strategia di intervento terapeutica. La diagnosi precoce è fonda-

mentale per ottimizzare le alternative terapeutiche.

Il trattamento delle erosioni è strettamente correlato alla quantità di tessuto smalto e dentinale coinvolto oltre che alla dimensione verticale da ottenere per raggiungere i risultati estetici soddisfacenti per i pazienti. In particolare, esso varia dalle ricostruzioni dirette in composito alle riabilitazioni protesiche fisse fino alle ricostruzioni indirette che hanno come obiettivo la conservazione del maggior tessuto possibile. Le nuove tecnologie CAD/CAM offrono importanti vantaggi in termini di predicibilità del risultato, accuratezza, precisione e comunicazione clinico-paziente.

I principali obiettivi del trattamento sono rappresentati da riabilitazione estetica, ripristino di una corretta funzione masticatoria, definizione di una corretta dimensione verticale e ottenimento di risultati predicibili e verificabili. A questo proposito un trattamento multidisciplinare che vede coinvolte diverse figure professionali sembrerebbe garantire buoni e predicibili risultati.

MATERIALI E METODI

Il presente caso clinico descrive il trattamento di lesioni erosive in una paziente con disturbi del comportamento alimentare, associati a bruxismo e mialgia cervicale. La paziente richiedeva una riabilitazione estetica senza interventi invasivi. Un approccio multidisciplinare consistente in analisi estetica, analisi posturale, eseguita mediante pedana stabilometrica e podoscopio, è stata adottata. Una tecnica 3-step modificata è stata utilizzata con il supporto della tecnologia digitale. Restauri in composito sono stati utilizzati nelle aree posteriori e faccette in quelle anteriori. I risultati si sono dimostrati stabili e monitorabili.

RISULTATI E CONCLUSIONI

Gli obiettivi principali della riabilitazione protesica sono quelli di preservare la maggiore quantità possibile di tessuto dentale e di ottenere una riabilitazione occlusale stabile con un approccio multidisciplinare che coinvolga odontoiatri, fisioterapisti e posturologi. La tipologia di trattamento dipende dalla quantità di tessuto danneg-

giata e dalla valutazione dei danni determinati a livello temporo-mandibolare e posturali. Un approccio multidisciplinare insieme ai vantaggi offerti dalla tecnologia CAD/CAM potrebbe fornire risultati accettabili e prevedibili nel trattamento delle lesioni erosive dentali. Spesso risulta particolarmente problematico proporre soluzioni terapeutiche invasive in assenza di rilevante sintomatologia clinica del paziente. Le nuove tecnologie, insieme alle strategie adesive in ambito protesico, permettono il parziale superamento di questo problema.

SIGNIFICATO CLINICO

Il trattamento proposto rappresenta una valida alternativa a ricostruzioni protesiche maggiormente invasive e mette in risalto l'importanza di un approccio multidisciplinare al trattamento delle erosioni dentali.

PAROLE CHIAVE

- Tecnologia CAD/CAM
- Erosioni dentali
- Disordini alimentari
- Onlay
- Cementi

1. INTRODUCTION

Classification of lesions due to dental erosion, i.e. gradual but irreversible loss of hard tissue, has changed over the years. The standard Basic Erosive Wear Examination (BEWE) records decayed segments in a sextant with the cumulative score guiding treatment. The latest classification, known as the 6 ACE class system, is closely linked to the anterior maxillary teeth. Each class is associated with a line of treatment¹⁻⁷.

Early diagnosis of dental lesions is essential for appropriate treatment before dentine injury and for identifying underlying systemic pathologies⁷. Mechanical abnormalities or extrinsic and/or intrinsic chemical anomalies may cause hard tissue loss. Mechanical abnormalities, known as abrasion due to bruxism or trauma erode teeth horizontally, flattening all occlusal surfaces and the incisal margins⁷⁻⁹. In some cases, bruxism is associated with gastroesophageal reflux (GERD) with symptoms such as burping, unexplained acidity and heartburn, all of which are linked to slow damage to the posterior dentition¹⁰⁻¹².

Erosion is defined as damage due to extrinsic and/or intrinsic chemical anomalies. Extrinsic causes include, for example, excessive daily intake of sugary drinks which determine caries^{13,14}. They are generally circumferential, brownish in color, and prevalently involve palatal surfaces. Erosion due to acidic drinks, on the other hand, like orange and lemon juice, is characterized by structural tooth weakening and vestibular/palatal lesions that are generally not associated with active caries^{15,16}.

The main intrinsic causes of dental erosion are eating disorders like anorexia, bulimia nervosa, and GERD^{11,12}. Anorexia and bulimia, which usually start in adolescence, are associated with a “jet” of gas-

tric juices that erodes the palatal surfaces of the upper arch. The ensuing smooth, light yellow lesions may be associated with the onset of tooth sensitivity¹⁵. Unsurprisingly, there are usually no caries as these patients are very attentive to oral hygiene. Reports diverge on the association of dental erosion due to bulimia with secondary caries, parodontal disease and jaw hinge abnormalities^{11,12,17,18}.

Several studies associated GERD and dental erosion¹⁹ which, indeed is often the first sign of GERD. Enamel erosion, due to gastric juices from the stomach, is often associated with bruxism, itchiness, oral mucosal irritation, mouth ulcers and sour taste.

Prognosis is difficult as the clinical manifestations of erosion range from only aesthetic damage to widespread pain, significant vertical dimension loss and temporal-mandibular abnormalities. Treatment of erosive lesions depends on how much enamel and dentine has been destroyed and how much vertical dimension elevation is required to ensure patient satisfaction^{7,9,16}. It may range from direct composite reconstructions and fixed prostheses to innovative indirect reconstruction systems that aim at preserving as much tissue as possible²⁰⁻²⁴. One of these, the innovative “3 step technique” was devised by Dr. Vailati and the University of Geneva and has been modified in various ways over the years⁴⁻⁷.

Another recent major advance in prosthetic dentistry, CAD/CAM technology, offers advantages in terms of outcome prediction, accuracy, precision and better patient-dentist communication²⁵. In treating cases of dental erosion CAD/CAM technology is associated with a more conservative and less invasive approach than traditional reconstruction techniques.

The present report describes the case of a 27 year old woman whose tooth ero-

sion was classified as ACE 4 (extended palatal dentin exposure with loss of tooth length and facial enamel). Full mouth rehabilitation with the 3-step technique, as supported by digital technology, used posterior direct composite fillings and anterior veneers.

2. MATERIALS AND METHODS

The 27 year old woman, who had been diagnosed with bulimia nervosa in 2015, was receiving psychological care. She was referred to us in 2017, complaining of bruxism, nocturnal grinding, cervical myalgia and incisal erosion which was asymptomatic. The patient requested aesthetic and functional improvements. X-ray evidence at her first appointment showed previous dental care that had not included treating dental erosion.

Digital photographs, alginate full arch impressions, and facebow record were taken. The two casts were placed on a semi-adjustable articulator in the maximum inter-cuspidation position (MIP). As described elsewhere^{2,5,7}, the 3-step technique is based on mouth quadrants, permitting MIP without using the centric relation (CR).

The multi-disciplinary treatment plan for this patient analysed posture, features, occlusion and teeth. Since posture has recently been linked to dental occlusion²⁶ the present study used a stabilometric platform and podoscope to evaluate posture and its post-therapeutic variations in this patient. In a 1 minute examination the stabilometric or force platform analyses oscillations in orthostasis and weight shifts from one foot to the other²⁷. With the dental arches in occlusion and then in the resting position body oscillations and weight distribution were recorded by pressure sensors and tran-

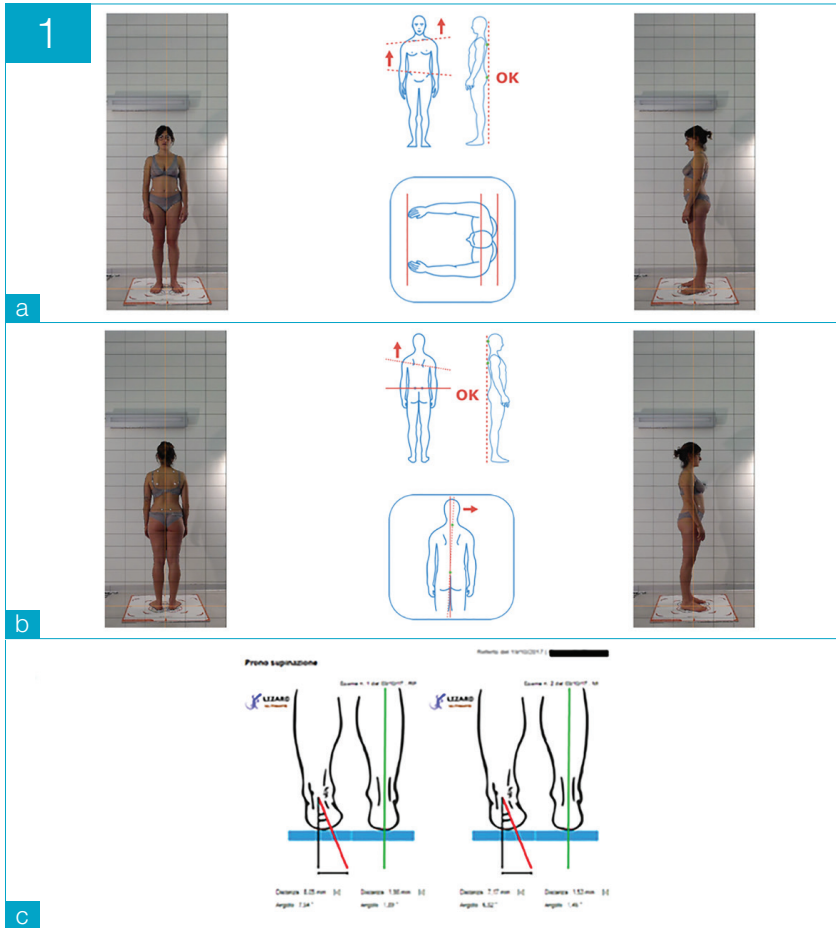


Fig. 1a-c Postural analysis (a, b) at stabilometric platform and podoscope (c)

sferred to a computerized system for analysis. The podoscope, highlighted weight distribution in the foot areas⁽²⁸⁻³⁰⁾. The patient's left shoulder was higher than the right, the right iliac crest was higher, shoulders and shoulder blades were aligned, spine and cervix were normal. Posture was stable on the left; excess right foot rotation was associated with deep dental bite (**fig. 1a-c**).

The patient had an oval face, with a longer lower third, and a wide smile which exposed her gums. The median lines of face and teeth overlapped (**fig. 2a-c**). The first molar class was observed. Oral quadrants 1 and 4 featured a slight cross-bite in the first premolars, vestibular and

palatal tooth erosion. Oral quadrants 2 and 3 harbored a vestibular fracture and erosion. The gingival margin was fine and symmetrical. Incisal erosion was over 2



Fig. 2a-c Dental erosion before treatment: frontal image (a); semi-lateral image (b); esthetic facial analysis (c)

mm (**fig. 3a-d**). Spray stimulation did not trigger pain, indicating the dental erosion was sclerotic.

A smile was designed on a digital photograph using Digital Smile Design programme (**fig. 4a-c**).

In the digital analysis gingival parable examination detected slight asymmetry between 22 and 12. Given the patient's psychological profile and her reluctance to undergo gingival surgery these asymmetries were maintained. Current tooth length was measured. Assessment of three magnification ratios selected a 94% ratio, i.e. a square-shaped tooth, as the most harmonious.

Because of the patient's age and tooth shape before erosion, as seen in a photograph the patient supplied, treatment focused on the two upper central incisors. Tooth lengths, as listed in the smile design photo, were transmitted to the technician for the wax-up. Chalk models were placed in the semi-adjustable articulator. Treatment planning included a 3 mm vertical dimension increase.

Trios 3 (3Shape, Copenhagen, Denmark) digital intraoral scanner images were used to replicate the new vertical dimension, starting from maxillary and mandibular anatomy. When they were overlapped with the digital smile design incisors length increased by another 2 mm, to 5 mm in total.



Fig. 3a-d Upper and lower teeth before treatment: upper and lower frontal arches with aesthetic analysis (a); upper arch with dental erosions (b); upper occlusal plane (c); lower occlusal plane (d)

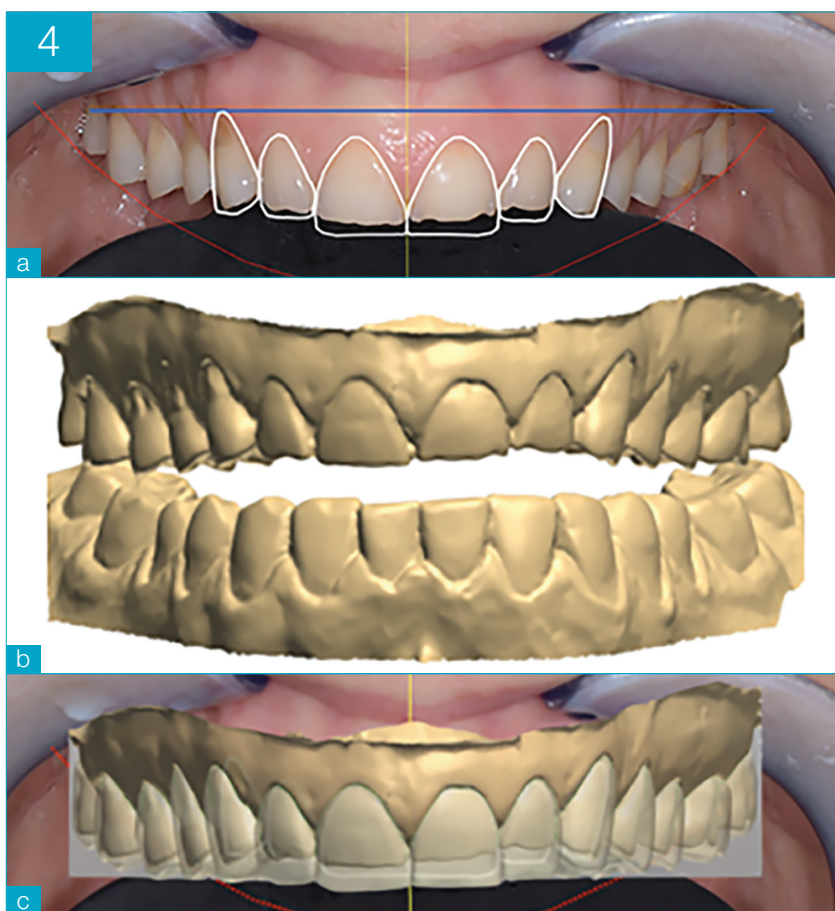


Fig. 4a-c Esthetic analysis: digital smile before treatment (a); digital model (b); digital model with vertical dimension increase (c)

The first step in the vertical dimension increase was an esthetic assessment using an autopolymerising resin mock-up (Luxatemp, DMG, Hamburg, Germany), checked by postural analysis. Sextant II length and phonetics were evaluated in relation to the lower lip. Since the patient feared having a temporary fixed device, which could have prevented her from inducing bulimia, she refused the standard 3-step technique mock-up. Consequently, a removable 0.5 mm thick Snap on Smile in elastic acetablic resin was created by means of the CAD/CAM technique and used for 3 months (**fig. 5a-d**).

Real aesthetics were analyzed digitally, after making the 3-step mock-up. As usual, it extended as far as the upper 2nd premolars without including the occlusal wall. In the laboratory, a wax model was created with the 3 mm vertical dimension increase of the 4 posterior sextants. The first and second premolars were included together with the first molars. Four transparent silicon masks were derived from the wax model. In one session, the masks were used to achieve temporary fillings using a 75 °C composite (EF2, Miccerium, Genoa, Italy). The patient was discharged, as warned, with an open bite for 2 or 3 days but with balanced occlusal contact in the posterior sextants.

When the patient returned for an occlusal check-up she underwent the sextant V increase in incisal margin and vestibular thickness by means of direct composite filling.

The final treatment step was sextant II preparation. As much incisor enamel as possible was preserved to facilitate adhesion. Palatal veneer preparation included dentine sealing, removal of caries and/or previous fillings, incisal margin thickening and inter-tooth opening. Im-

pressions were taken of the upper arch in polyether (Impregum Penta, 3M ESPE, Seefeld, Germany), the lower arch in alginate and the facial arch in oc-

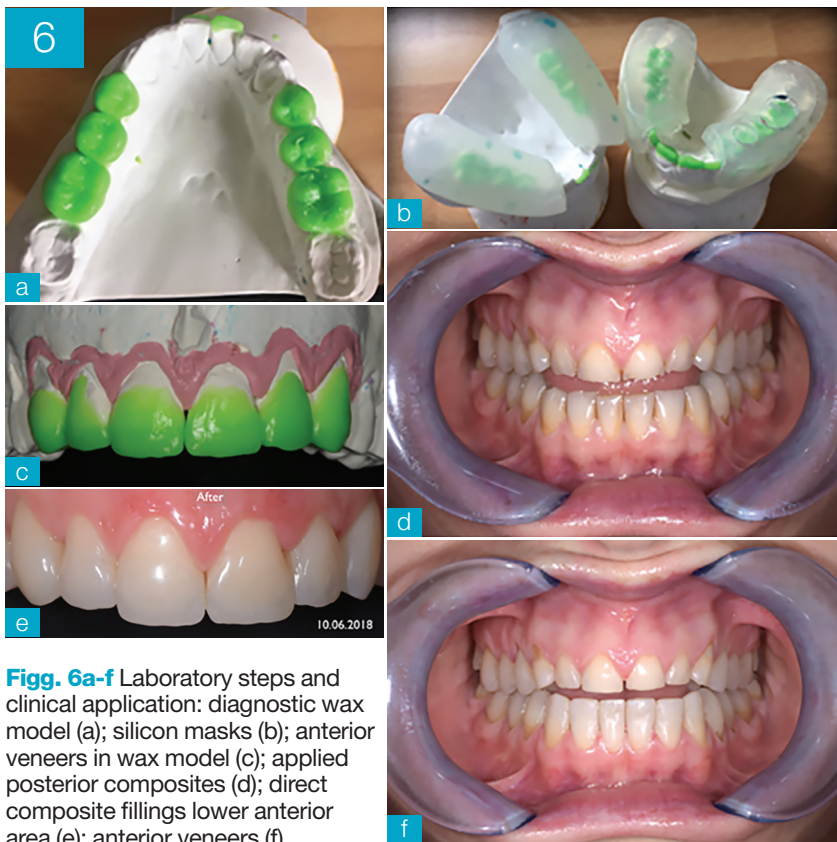
cluding wax. In the laboratory, palatal veneers in stratified composite (Micerium, Genoa, Italy) which was heat-hardened (figg. 6a-f) were extended to co-

ver the incisal margin with flat mesial and distal surfaces.

Using a rubber dam, veneers and dental surfaces were pre-treated before the veneers were cemented in place by means of a dental colored UD2 composite heated to 75 °C (Micerium, Genoa, Italy). Veneer placement started with central incisors and the anterior bite contact was recovered (figg. 7a-d).



Figg. 5a-d Snap on Smile procedure: digital image (a); resin model (b); articulator test (c); *in vivo* application (d)



Figg. 6a-f Laboratory steps and clinical application: diagnostic wax model (a); silicon masks (b); anterior veneers in wax model (c); applied posterior composites (d); direct composite fillings lower anterior area (e); anterior veneers (f)

3. RESULTS AND DISCUSSION

In this complex case the patient refused to collaborate and the demanding 3-step technique had to be modified to suit her needs. This modified approach is less time-consuming, is associated with reasonable costs and tooth maintenance as treatment was non-demolitive^[2,3,8-11]. Even some time after the end of treatment, occlusion can be adjusted to balance bite muscles and posture^[22,24]. The major disadvantage is that our modified approach, like the 3-step technique, required high-level dental expertise and skills in achieving accuracy and precision at each step, which are crucial to success. Moreover, few dental surgeries are, at present, equipped with digital CAD/CAM technology^[25].

The digital Snap on Smile instead of the mock-up was our first addition to the 3-step technique. Although the Snap on Smile was less reliable esthetically, it provided just as stable an occlusion as the mock-up. Its main advantage was that its insertion and removal was under the patient's control which ensured she adopted a better attitude towards it.

In patients with dental erosion the vertical dimension increase has long been controversial. Too little is associated with prosthesis failure and too much is linked to impaired smile design, discomfort,

adaptation issues and/or damaged tempo-mandibular articulation^[22,24,25,31-34].

Since the vertical dimension increase was incorporated into the Snap on Smile, its stability and mandibular positioning could be monitored. Monitoring was based on postural analysis data, which was another addition to the standard 3-step technique. It ensured correct mandibular placement before, during and after treatment while preventing the onset of dysfunctional complications which might have contributed to treatment failure.

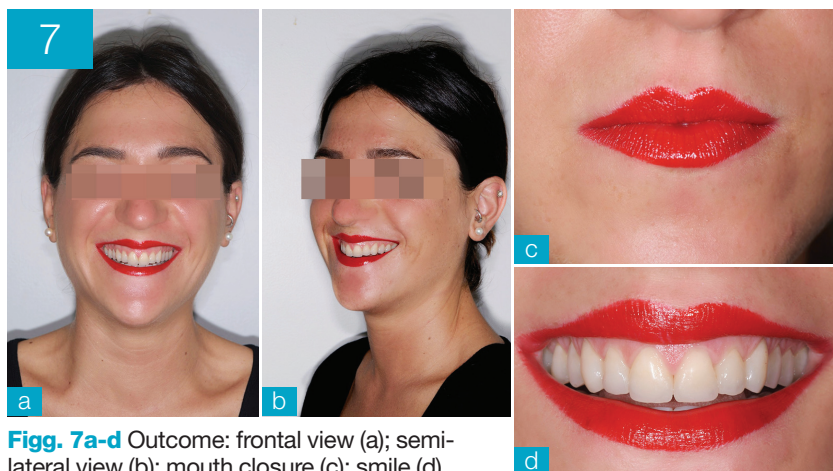


Fig. 7a-d Outcome: frontal view (a); semi-lateral view (b); mouth closure (c); smile (d)

4. CONCLUSIONS

Since dental erosions are often related to systemic diseases they present a major, usually under-estimated, problem in clinical dentistry. Delay in seeking treatment may be due more to the patient's reluctance to undergo invasive interventions than to slow disease evolution. Genoa University's 3 step technique has long provided a major step forward in balancing treatment quality against loss of healthy dental tissue.

As used in the present case, CAD/CAM technology with the Snap on Smile, was associated with progress in prosthetic dentistry, in terms of outcome prediction and better patient-dentist interaction.

This clinical report describes dental erosion therapy in a patient with eating disorders, using a modified 3-step rehabilitation technique. With composite restorations in the posterior areas and double veneers in the anterior, the outcome was durable and easy to follow-up. ■

CONFLICT OF INTEREST

The authors confirm that are no known conflicts of interest associated with this publication.

FUNDING FOR THE STUDY

The authors did not have significant financial support for this work that could have influenced its outcome.

INFORMED CONSENT

For the publication of the case, including photos, the consent of the patient was obtained. This clinical study adheres to guidelines in the Declaration of Helsinki of 1975, as revised in 2013.

REFERENCES

- Bartlett D, Ganss C, Lussi A.** Basic Erosive Wear Examination (BEWE): a new scoring system for scientific and clinical needs. *Clin Oral Investig* 2008;12(1):S65-8.
- Vailati F, Belser UC.** Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. Part 3. *Eur J Esthet Dent* 2008;3(3):236-57.
- Johansson AK, Omar R, Carlsson GE, Johansson A.** Dental erosion and its growing importance in clinical practice: from past to present. *Int J Dent* 2012;2012:632907.
- Vailati F, Carciofo S.** Treatment planning of adhesive additive rehabilitations: the progressive wax-up of the three-step technique. *Int J Esthet Dent* 2016;11(3):356-77.
- Vailati F, Belser UC.** Classification and treatment of the anterior maxillary dentition affected by dental erosion: the ACE classification. *Int J Periodontics Restorative Dent* 2010;30(6):559-71.
- Nunn JH, Gordon PH, Morris AJ, Pine CM, Walker A.** Dental erosion-changing prevalence? A review of British National childrens' survey. *Int J Paediatr Dent* 2003;13(2):98-105.
- Vailati F, Carciofo S.** CAD/CAM monolithic restorations and full-mouth adhesive rehabilitation to restore a patient with a past history of bulimia: the modified three-step technique. *Int J Esthet Dent* 2016;11(1):36-56.
- Passos VF, Melo MAS, Park J, Strassler HE.** Current concepts and best evidence on strategies to prevent dental erosion. *Compend Contin Educ Dent* 2019;40(2):80-6.

9. **Jordão MC, Ionta FQ, Bergantin BTP, Mendonça FL, Santos NMD et al.** Influence of mandibular and palatal intraoral appliances on erosion *in situ* study outcome. *J Appl Oral Sci* 2019;27:e20180153.
10. **Nielsen S, Moller-Madsen S, Isager T.** Standardized mortality in eating disorders: a quantitative summary of previously published and new evidence. *J Psychosom Res* 1998;44(3-4):413-34.
11. **Steinberg B.** Women's oral health issues. *J Calif Dent Assoc* 2000;28(9):663-7.
12. **Dynesen AW, Gehrt CA, Klinker SE, Christensen LB.** Eating disorders: experiences of and attitudes toward oral health and oral health behavior. *Eur J Oral Sci* 2018;126(6):500-6.
13. **Godoy de Oliveira PT, Somacal DC, Júnior LHB, Spohr AM.** Aesthetic rehabilitation in teeth with wear from bruxism and acid erosion. *Open Dent J* 2018;12:486-93.
14. **Pedrao AMN, Andrews Portes L, Padilha Gomes E, Figueira Teixeira FC, da Costa Pereira A, de Oliveira NC.** Erosive tooth wear and dietary patterns: a clinical study. *Oral Health Prev Dent* 2018;16(2):145-51.
15. **Ngoc CN, Donovan TE.** Education about dental erosion in U.S. and Canadian dental schools. *J Dent Educ* 2018;82(12):1296-304.
16. **Mulic A, Árnadóttir IB, Jensdóttir T, Kopperud SE.** Opinions and treatment decisions for dental erosive wear: a questionnaire survey among Icelandic dentists. *Int J Dent* 2018;2018:8572371.
17. **Chockattu SJ, Deepak BS, Sood A, Niranjan NT, Jayasheel A, Goud MK.** Management of dental erosion induced by gastro-esophageal reflux disorder with direct composite veneering aided by a flexible splint matrix. *Restor Dent Endod* 2018;43(1):e13.
18. **Lutovac M, Popova OV, Macanovic G, Kristina R, Lutovac B et al.** Testing the effect of aggressive beverage on the damage of enamel structure. *Open Access Maced J Med Sci* 2017;5(7):987-93.
19. **Picos A, Badea ME, Dumitrascu DL.** Dental erosion in gastro-esophageal reflux disease. A systematic review. *Clujul Med* 2018;91(4):387-90.
20. **Tulek A, Saeed M, Mulic A, Stenhagen KR, Utheim TP et al.** New animal model of extrinsic dental erosion - Erosive effect on the mouse molar teeth. *Arch Oral Biol* 2018;96:137-45.
21. **Shitsuka C, Ibuki FK, Nogueira FN, Mendes FM, Bönecker M.** Assessment of oxidative stress in saliva of children with dental erosion. *Einstein (Sao Paulo)* 2018;16(2):eAO4203.
22. **Magne P.** Immediate dentin sealing: a fundamental procedure for indirect bonded restorations. *J Esth Restor Dent* 2005;17(3):144-54.
23. **Sato T, Takagaki T, Baba Y, Vicheva M, Matsui N et al.** Effects of different tooth conditioners on the bonding of universal self-etching adhesive to dentin. *J Adhes Dent* 2019;21(1):77-85.
24. **Green JI.** Prevention and management of tooth wear: the role of dental technology. *Prim Dent J* 2016;5(3):30-3.
25. **Lancellotti V, Pagano S, Tagliaferri L, Piergentini M, Ricci A et al.** Individual 3-dimensional printed mold for treating hard palate carcinoma with brachytherapy: a clinical report. *J Prosthet Dent* 2019;121(4):690-3.
26. **Rios D, Oliveira GC, Zampieri CR, Jordão MC, Dionisio EJ et al.** Resin-based materials protect against erosion/abrasion-a prolonged *in situ* study. *Oper Dent* 2019;44(3):302-11.
27. **Julià-Sánchez S, Álvarez-Herms J, Burtscher M.** Dental occlusion and body balance: a question of environmental constraints? *J Oral Rehabil* 2019 Apr;46(4):388-97.
28. **Scharnweber B, Adjami F, Schuster G, Kopp S, Natrup J, Erbe C, Ohlendorf D.** Influence of dental occlusion on postural control and plantar pressure distribution. *Cranio* 2017 Nov;35(6):358-66.
29. **Omorczyk J, Bujas P, Puszczalowska-Lizis E, Biskup L.** Balance in handstand and postural stability in standing position in athletes practicing gymnastics. *Acta Bioeng Biomech* 2018;20(2):139-47.
30. **Kuryliszyn-Moskal A, Kaniewska K, Dziecioł-Anikiej Z, Klimuk PA.** Evaluation of foot static disturbances in patients with rheumatic diseases. *Reumatologia* 2017;55(2):73-8.
31. **Prowse A, Pope R, Gerdhem P, Abbott A.** Reliability and validity of inexpensive and easily administered anthropometric clinical evaluation methods of postural asymmetry measurement in adolescent idiopathic scoliosis: a systematic review. *Eur Spine J* 2016 Feb;25(2):450-66.
32. **Balloni S, Locci P, Lumare A, Marinucci L.** Cytotoxicity of three commercial mouthrinses on extracellular matrix metabolism and human gingival cell behaviour. *Toxicol in vitro* 2016;34:88-96.
33. **Pagano S, Coniglio M, Valenti C, Lombardo G, Costanzi E et al.** Biological effects of resin monomers on oral cell populations: descriptive analysis of literature. *Eur J Paediatr Dent* 2019;20(3):224-32.
34. **Saeidi Pour R, Engler MLPD, Edelhoff D, Prandtner O, Frei S, Liebermann A.** A patient-calibrated individual wax-up as an essential tool for planning and creating a patient-oriented treatment concept for pathological tooth wear. *Int J Esthet Dent* 2018;13(4):476-92.