Evaluation of aesthetic integration between composite restorations and natural tooth in NCCL: a case report

Fabrizio Guerra*, Marta Mazur, Gianna Maria Nardi, Denise Corridore, Debora Pasqualotto, Francesca Rinaldo, Livia Ottolenghi.

Affiliation: Department of Oral and Maxillo-facial Sciences, Oral Diagnosis Unit, "Sapienza" University of Rome, Via Caserta, 6 -00161 Rome, Italy.

*Corresponding author: Fabrizio Guerra, e-mail:fabrizio.guerra@uniroma1.it; Tel.: +39 0649978151

Article history
Received: September 7, 2015
Accepted: September 22, 2015
Published: October 21, 2015

Abstract

NCCL (non carious cervical lesion) is defined as irreversible loss of dental hard tissue that does not involve bacteria. It consists of erosion, attrition, abrasion and abfraction that rarely occur alone. Dentinal hypersensitivity is an early symptom of NCCL. Preventive measures and restorative treatment can avoid the progress of NCCL. This paper reports a case of NCCL treatment with aesthetic purpose. The aesthetic evaluation was made by means of spectrophotometry as a standardized method. Spectrophotometric measurements such as International Commission on Illumination (CIE-Commission Internationale de l'Eclaraige) CIE L a* b* and ΔE between the sound enamel and resin restoration, provide all the information about the outcome of the aesthetic restorative treatment.*

Keywords: *Aesthetic outcome, NCCL, dentinal hypersensitivity, spectrophotometry.*

Introduction

Dental color matching and sensitivity symptoms are the most influential parameters patients use to judge the restoration quality, above all in cervical region of anterior upper teeth treatment. A perfect mimicry of the surrounding teeth and dentinal hypersensitivity control thus become crucial objectives (1).

NCCL (non-carious cervical lesion) define irreversible loss of dental hard tissue by a chemical process that does not involve bacteria. It consists of erosion, attrition, abrasion and abfraction that usually occur variously combined. They generally relate to mechanical (i.e. forceful brushing) and chemical (extrinsic or intrinsic acids) factors. The incidence of NCCL ranges from 5 to 50% in various populations and age groups. (2)

Risk factors for NCCL can be classified into chemical, biological and behavioral factors, such as salivary flow rate, gastroesophageal reflux disease, eating disorders, vomiting, jaw parafunction and bruxism habit, toothbrushing habits, citrus fruits intake, soft drinks consumed (2- 3).

An early symptom of NCCL is hypersensitivity, consistent with the exposure of dentinal tubules. To avoid the progress of NCCL, both preventive measures (i.e. dietary modification, topical fluorides, occlusal splint) and restorative treatment have to be performed.

This case report shows an objective method to evaluate quantitatively the aesthetic and symptomatic outcome after reconstructive composite treatment of NCCL with aesthetic purpose, also considering patient's satisfaction.

Case report

V.G., a female adult patient, 65, with a clinical evidence of NCCL (non-carious cervical lesion), dentinal hypersensitivity on anterior upper sextant and first right premolar, and old incongruent dischromic restorations, attended to our clinic for a routine examination. Prior to treatment, a detailed medical, social and dental history was obtained from the patient. Diet pattern was also achieved. Treatment consent was signed.

We used the Schiff Cold Air Sensitivity Scale, scored as follows, to evaluate dentinal hypersensitivity:

0 =Subject does not respond to air stimulus;

1 =Subject responds to air stimulus but does not request discontinuation of stimulus;

2 =Subject responds to air stimulus and requests discontinuation or moves from stimulus;

3 =Subject responds to air stimulus, considers stimulus to be painful, and requests discontinuation of the stimulus.

The aesthetic outcome was assessed by digital intraoral photographs (Nikon D90) with a macro lens (105 mm Macro lens, Nikon) and a macro flash (R1C1 Macro flash, Nikon) and a calibrated reflectance spectrophotometer (SpectroShade, MICRO, Serial N HDL1407, MHT, Arbizzano di Negrar, Verona, Italy), compared with the thresholds of acceptability and perception.

In order to assess the aesthetic outcome of the treatment, spectrophotometric measurements CIE L* a* b* and ΔE between the sound enamel and resin restoration were performed, thus providing all the information needed.

The CIE L* a* b* values represent lightness–darkness, green–red and blue–yellow color coordinates, respectively. ΔE * is the color difference between two objects, where the higher the value the bigger the difference in color and hence the more perceptible the difference is to human eye (4).

To define the treatment effectiveness, the MHT spectrophotometer software divides the vestibular tooth area into treated and untreated area. For spectrophotometric color matching before and after treatment black (L*=1.6, a*=1.2, b*=-1.0) and white (L*=92.8, a*=-1.5, b*=0.9) backgrounds have been used. [5][6][7]

ΔE have been calculated in each of treated and untreated dental areas to assess the colorimetric measurements variation between the sound enamel and resin restoration, according with the most extensively used color difference formula within dental research: ΔE= $\sqrt{(L_1 - L_2)^2 + (a_1 - a_2)^2 + (b_1 - b_2)^2}$.

It is derived from the CIE-L*a*b* system which approximates uniformed distances between color coordinates while entirely covering the visual color space (4. 8 - 9).

CIE L* a* b* values of enamel and enamel–dentin and ΔE were calculated in each of the observed teeth. [7][8]

A Visual Analog Scale (VAS) assessed the patient's satisfaction with the treatment outcome both from the aesthetic and the dentinal hypersensitivity point of view(10-11). We used two horizontal VAS bar 100 millimeters in length, divided into units ranging from 0 (totally unsatisfied) to 100 (completely satisfied). We provided simple and precise instructions for use and asked the patients to mark precisely on the calibrated horizontal lines the specific degree of aesthetic satisfaction and of the dentinal hypersensitivity improvement.

The Schiff Cold Air Sensitivity Scale for hypersensitivity was calculated: the designated study tooth was isolated from the adjacent teeth (mesial and distal); using a standard dental unit air syringe, the air was directed at the exposed buccal surface of the sensitive tooth for 1s from a distance of approximately 1cm; response to this stimulus was assessed. Dental anamnesis detected dentinal hypersensitivity of grade 1.

Teeth were cleaned with a rubber cup; intraoral photographs and spectrophotometric measurements against black and white backgrounds were taken. One trained operator performed all SpectroShade assessments. Treatment was performed with rubber dam isolation using a light-cured, radiopaque composite resin (Estelite Asteria, Tokuyama Dental Corporation, Tokyo, Japan). The etching was applied on dentin (15s) and enamel (30s), the excess material was removed using air-water syringe for 20 s. Topical application of chlorhexidine with cotton roll and of an enamel-dentin bonding agent were performed.

Afterwards, we started restoring the teeth with a first 0.5 mm layer of fluid composite, the residual cavity was restored with horizontal layers of Estelite Asteria body shade A3B and B3B, to achieve good color integration of the restorative material. The last layer was reconstructed using Estelite Asteria NE.

Every layer was light-cured for 20s, the last layer light-curing was performed under glicerine. The restorations were refined and polished and the dam was removed. At a week later follow-up spectrophotometric measurements and intraoral photographs were taken. Finally, the Schiff Cold Air Sensitivity Scale was calculated and the VAS questionnaire was handed to the patient.

Results

In this case report, ΔE values between the sound enamel and resin restoration before treatment ranged from 2.9 to 4.8, with a mean of 3.7. ΔE values after restorative treatment ranged from 0.9 to 1.4, with a mean of 1.1.

Before the restorative treatment the hypersensitivity Schiff index was on average 1, after the treatment it was 0.

Patient's satisfaction of the aesthetic treatment measured with the VAS scale ranging from 0 to 100 was 70. Regarding dentinal hypersensitivity, the VAS score was 40 before treatment and 80 at a week follow-up after treatment.

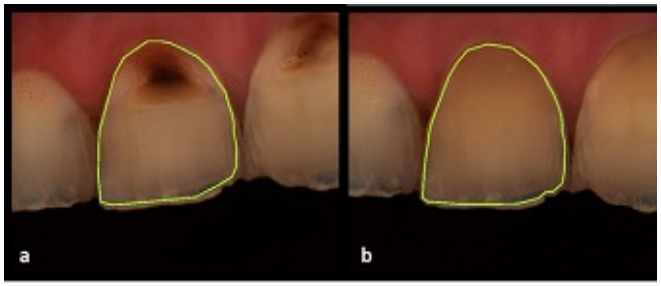

Figure 1. Spectrophotometric images before (a) and after (b) treatment on the right upper incisor.

Discussion

Color perception and/or acceptation is subjective and it can vary significantly among people. The determination of a color difference between two objects is of little clinical value without an understanding of the magnitude of color difference that is visually detectable (perceptibility threshold - PT) and the magnitude that constitutes an unacceptable alteration to dental aesthetics (acceptability threshold - AT) (4,12).

Spectrophotometry is the golden standard in tooth color assessment in vivo as in vitro; the spectrophotometer reproducibility is 80% while human observers did not surpass 65% (2,13).

Numerous studies have been based on how much color change is considered perceptible and/or acceptable(4) ·Following Ruyter IE et al(14), an in vitro study, for example, has been cited 233 times on the Web of Science and refers AT=3,3. The article of Ardu S. [15], an in vitro study refers PT=1,1. This finding suggests that a color difference between two areas with a ΔE lower than 1.1 cannot be detected by the human eye, with a ΔE Figure 3. Clinical evaluation of the aesthetic outcome before (a) and after (b) treatment.between 1.1 and 3.3 it can be detected but is still considered clinically acceptable, while with a ΔE greater than 3.3 the color difference is noticeable to the naked eye (7).

In this case report the ΔE mean of 1.1, calculated from the spectrophotometric measurement CIE L* a* b* to assess the colorimetric variation between the sound enamel and resin restoration after treatment, indicate that after this restorative treatment there is no significant difference in color between the treated area and the untreated one, showing the aesthetic integration of the composite (**Figure 1-3**).

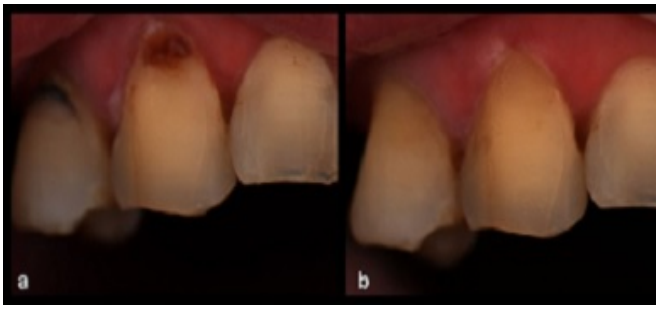

Figure 2. Spectrophotometric images before (a) and after (b) treatment on the right upper canine.

Figure 3. Clinical evaluation of the aesthetic outcome

before (a) and after (b) treatment.

Conclusions

In the reported case, spectrophotometric analysis and clinical documentation show considerable improvement in aesthetic outcome with adequate integration of the composite restoration, in reduction of dentinal hypersensitivity and with the patient's certified satisfaction as regards both the aesthetics and dentinal hypersensitivity.

We reserved the rehabilitation of incisal third after gnathological treatment, focusing on canine guidance restoration and adequate vertical dimension recovery.

References

1. Gómez-Polo C, Gómez-Polo M, Celemin-Viñuela A, Martínez Vázquez De Parga JA. Differences between the human eye and the spectrophotometer in the shade matching of tooth color. J Dent. 2014 Jun;42(6):742-5.
2. Gandara BK1, Truelove EL. Diagnosis and management of dental erosion. J Contemp Dent Pract. 1999 Nov 15;1(1):16-23.
3. Young, A., Amaechi, B. T., Dugmore, C., Holbrook, P., Nunn, J., Schiffner, U., Ganss, C. Current erosion indices—flawed or valid? Summary.Clinical Oral Investigations, 2008;12(Suppl 1), 59–63.
4. Khashayar G, Bain PA, Salari S, Dozic A, Kleverlaan CJ, Feilzer AJ. Perceptibility and acceptability thresholds for color differences in dentistry. J Dent. 2014 Jun;42(6):637-44.
5. Ardu S, Braut V, Gutemberg D, Krejci I, Dietschi D, Feilzer AJ. A long-term laboratory test on staining susceptibility of aesthetic composite resin materials. Quintessence Int 2010;41:695-702.
6. Ardu S, Gutemberg D, Krejci I, Feilzer AJ, Di Bella E, Dietschi D. Influence of water sorption on resin composite color and color variation amongst various composite brands with identical shade code: An in vitro evaluation. J Dent 2011;39(Suppl 1):e37-44.
7. Guerra F, Mazur M, Rinaldo F, Ottolenghi L. Spectrophotometric analysis of Icon® treatment outcome in two celiac siblings with developmental defects of enamel, a case report. J Res Dent 2015; 3 (3). In press.
8. Ardu S, Feilzer AJ, Devigus A, Krejci I. Quantitative clinical evaluation of aesthetic properties of incisors. Dent Mater 2008;24(3):333-40.
9. CIE ICoI. Colorimetry: official recommendations of the international commission on illumination. Paris: Bureau Central de la CIE; 1971.
10. Marsh-Richard DM, Hatzis ES, Mathias CW, Venditti N, Dougherty DM. Adaptive Visual Analog Scales (AVAS): a modifiable software program for the creation, administration, and scoring of visual analog scales. Behav Res Methods. 2009 Feb;41(1):99-106.
11. Cho H-L, Lee J-K, Um H-S, Chang B-S. Aesthetic evaluation of maxillary single-tooth implants in the aesthetic zone. Journal of Periodontal & Implant Science. 2010;40(4):188-193.
12. Douglas RD, Steinhauer TJ, Wee AG. Intraoral determination of the tolerance of dentists for perceptibility and acceptability of shade mismatch. J Prosthet Dent. 2007 Apr;97(4):200-8.
13. Horn DL, Bulan-Brady J, Hicks ML. Sphere spectrophotometer versus human evaluation of tooth shade. J Endod. 1998 Dec;24(12):786-90.
14. Ruyter IE, Nilner K, Moller B. Color stability of dental composite resin materials for crown and bridge veneers. Dent Mater. 1987;3:246–51.
15. Al-Harbi A1, Ardu S, Bortolotto T, Krejci I. Effect of extended application time on the efficacy of an in-office hydrogen peroxide bleaching agent: an in vitro study. Eur J Esthet Dent. 2013;8(2):226-36.