Digital smile design as a tool in the planning of porcelain laminate veneers restoration

Desenho digital do sorriso como ferramenta no planejamento de restaurações de facetas laminadas de porcelana

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ABSTRACT

Digital smile design is an important tool for esthetic planning in dentistry as it facilitates ease of communication between professionals and patients. This clinical report has the objective of describing a clinical procedure involving digital smile design for the placement of porcelain laminate veneer restorations. The digital smile design included dental and facial analyzes. The smile curve was drawn and a dental ruler was used to delimitate the spaces between each tooth. An approximate simulation of the smile was generated using Adobe Photoshop software. For esthetic and functional evaluation of the digital plan was created a diagnostic waxing and mock-up. The laminate veneers were made with feldspathic porcelain. Digital smile design was essential for successful planning because it enabled better patient contact with the end result. This case demonstrates the importance of this tool in esthetic dentistry.

Indexing terms: Dental veneers. Operative dentistry. Smiling.

RESUMO

O desenho digital do sorriso é uma importante ferramenta para o planejamento estético em odontologia, pois facilita a comunicação entre profissionais e pacientes. Este relato clínico tem o objetivo de descrever um procedimento clínico envolvendo desenho digital do sorriso para a confecção de restaurações de facetas laminadas de porcelana. O desenho digital do sorriso incluiu análises dentais e faciais. A curva do sorriso foi desenhada e uma régua dentária foi utilizada para delimitar os espaços entre cada dente. Uma simulação aproximada do sorriso foi gerada usando o software Adobe Photoshop. Para a avaliação estética e funcional do planejamento digital foi elaborado um enceramento diagnóstico e mock-up. As facetas laminadas foram confeccionadas em porcelana feldspática. O desenho digital do sorriso foi essencial para um planejamento bem-sucedido, pois possibilitou um melhor contato do paciente com o resultado final. Este caso demonstra a importância desta ferramenta na odontologia estética.

Termos de indexação: Facetas dentárias. Dentística operatória. Sorriso.

INTRODUCTION

Dental treatment addresses the esthetic, emotional and functional requirements of patients [1-7]. Therefore, dental surgeons and laboratory technicians must use all available resources in order to ensure predictability in treatment and to meet patients' expectations. Through the use of images, digital smile design (DSD) allows dental professionals to show the patient what will be achieved with the proposed treatment [2-5,7-15].

Digital smile design allows rehabilitation planning through digital images and imaging software based on the principles of cosmetic dentistry, such as symmetry, golden proportion and width-to-length ratio, in order to achieve a harmonious smile [2,4,5,8-10,12,14-16]. In addition, DSD is a technique that does not damage the dental structure and does not use temporary materials [4].

Prior to the introduction of DSD, the major problem faced by dentists in relation to oral rehabilitation was showing the patient in a non invasive way what was being proposed [4,5,8,13-15]. The present study presents a clinical report of treatment planned with DSD, in which the rehabilitation decisions were made together with the patient prior to any invasive procedures in order to meet the patient's expectations.

CASE REPORT

A 23 year-old Caucasian woman dissatisfied with the appearance of her teeth visited the Restorative Dentistry Clinic of the Dental School of the Universidade Federal de Minas Gerais (UFMG). All procedures were conducted following informed consent.
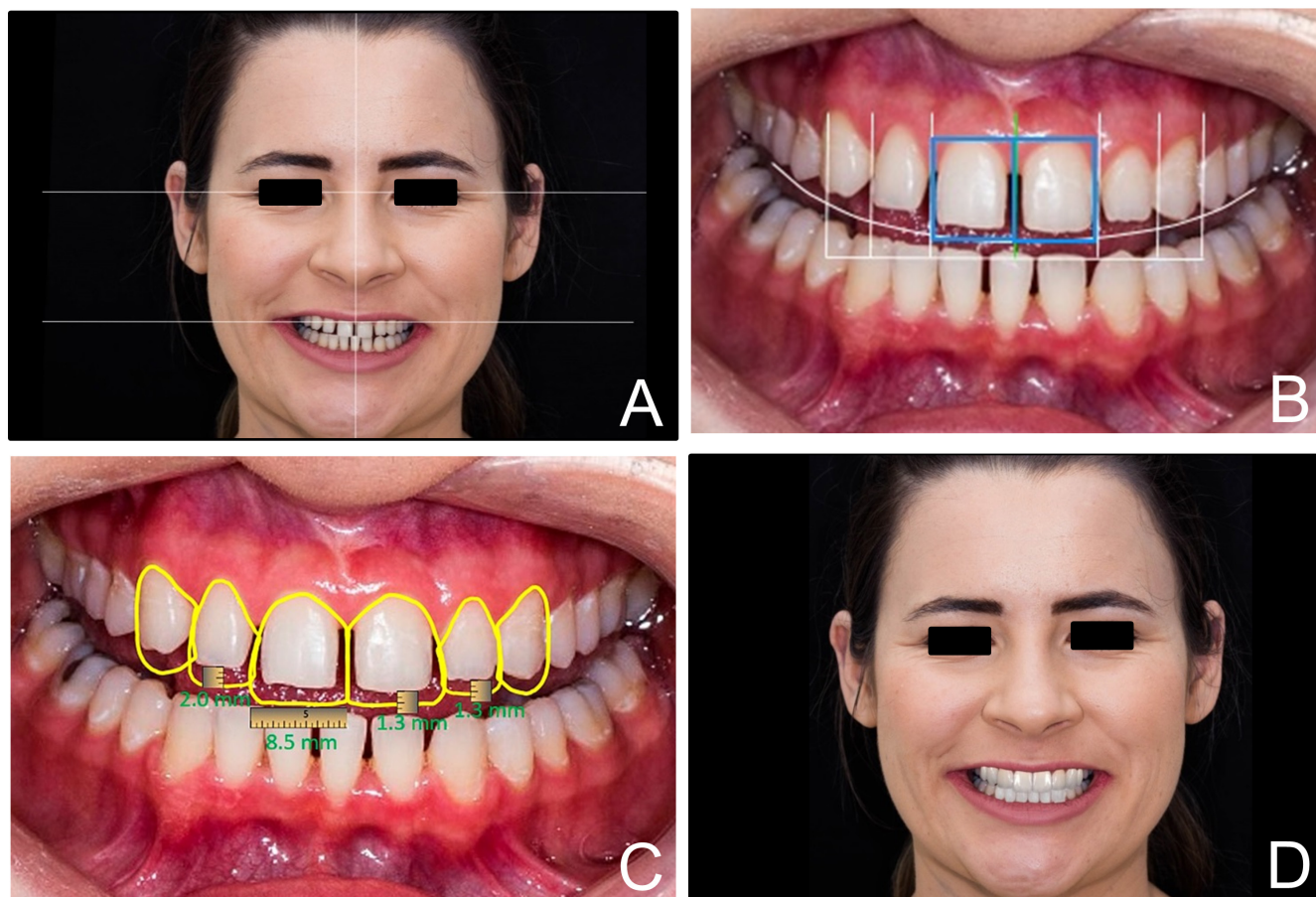

Figure 1. Virtual treatment planning with digital smile design (DSD). (A) Full-face photograph with horizontal (bipupillary and intercommissural lines) and vertical (facial midline) reference lines. (B) The design of the dental profile is guided by the facial lines (facial midline and lower lips) and by the relationship of the rectangles. (C) Design showing the proposed changes to the length of tooth no. 12 (lengthen 2.0 mm), no. 21 and no. 22 (lengthen 1.3 mm), and to the width of the central incisors (8.5 mm). (D) Simulation of the smile using Adobe Photoshop software.

Photographs were taken, and these were used for digital planning and to produce a preview of the final treatment result. Photographs were taken in forced smile, with retractors and at 12 o'clock position to evaluate the distance between the teeth and the vermilion of the lip [2,4].

The DSD started with three-line tracing including facial midline and bipupilar lines to verify correct angulation of the photographs and the intercommissural line, which showed slight lip asymmetry (figure 1A). The smile curve was then drawn taking into account the shape of the lower lip, and a dental ruler was used to delimitate the spaces between each tooth. The drawn lines were transferred to the photograph with retractors (figure 1B).

From analysis of photographs, it was decided that the ideal width-to-height ratio of the maxillary central incisors was 80%. Afterwards, the limits of each tooth were drawn to ensure that the esthetics of the smile were harmonic (figure 1C).

Finally, an approximate simulation of the smile after treatment was generated using Adobe Photoshop software (Adobe Systems, San Jose, CA, USA), as shown in figure 1D.

The patient presented good oral hygiene (absence of dental plaque) and absence of periodontal pocket. However, she has a local condition that favors the formation of calculus, requiring close monitoring to preserve periodontal health.

It was proposed that eight laminate veneers would be placed along the upper arch from the first right premolar to the first left premolar, and six laminate veneers along the lower arch from right canine to left canine.

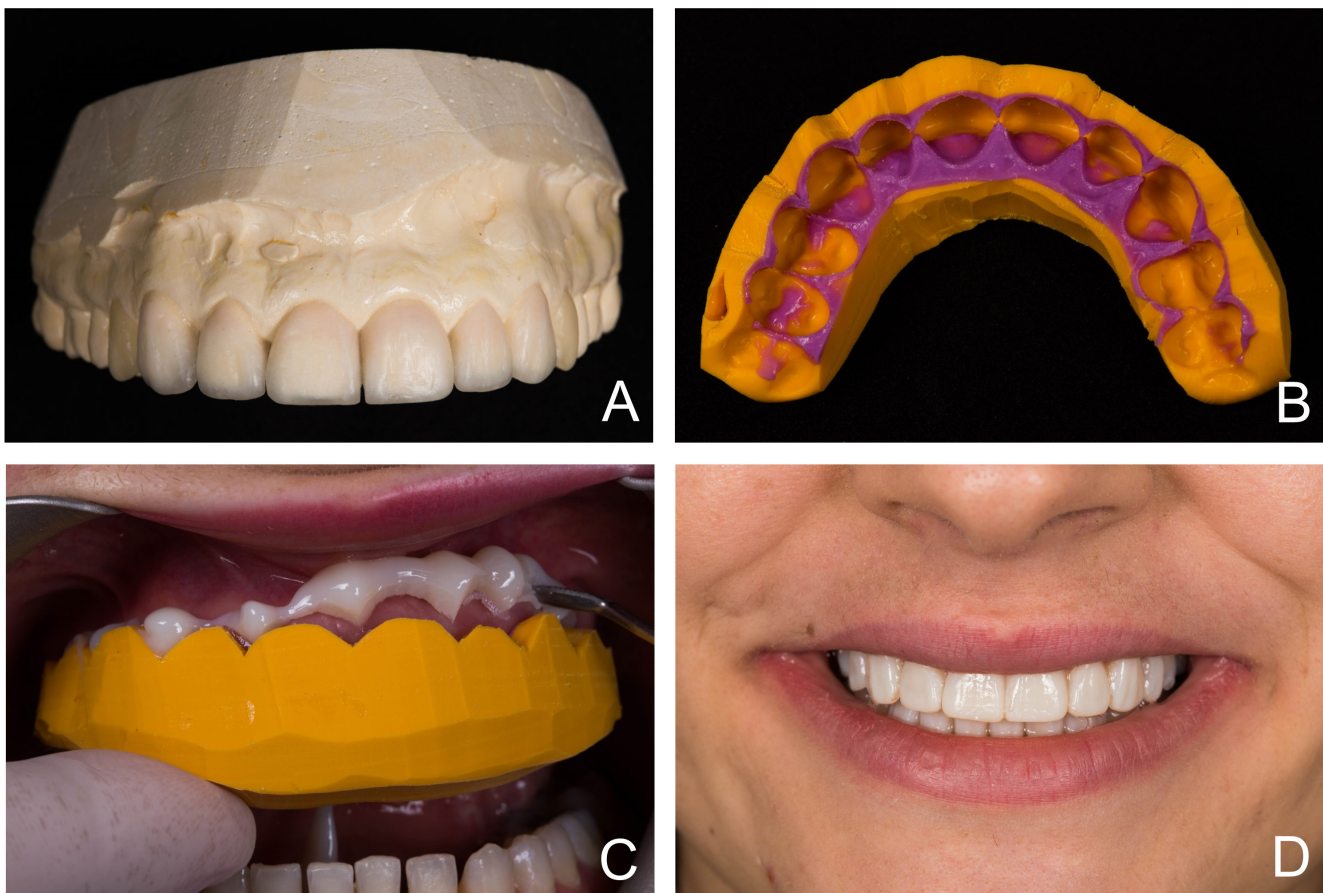For esthetic and functional evaluation of the digital plan the casts were mounted on a semi-adjustable

Figure 2. Mock-up based on digital smile design (DSD) measurements. (A) Diagnostic wax-up using the DSD as a guide. (B) Silicone index for the construction of the mock-up. (C) Removal of excess bis-acrylic resin from the silicone index. (D) Mock-up enabling clinical visualization of the maxillary (from premolar to premolar) and mandibular (from canine to canine) teeth in the frontal view of the patient's smile.

articulator and we created a mock-up. For this, diagnostic waxing was carried out, followed by molding with addition silicone (Express™XT; 3M ESPE, Saint Paul, MN, USA), cutting of the final impressions at the cervical line, insertion of acrylic resin veneer (Protemp™4; 3M ESPE, Saint Paul, MN, USA) and removal of excess material (figure 2). For esthetic evaluation was considered the satisfaction of the professional and the patient, and for functional evaluation, the presence of anterior guides (incisive and canine).

The incisor guide was considered satisfactory when the anterior lower teeth slid through the palatal concavity of the upper anterior teeth, disocclusion of the posterior teeth, and the canine guide when the lower canine slid into the upper canine palatal concavity, disocclusion of the posterior teeth.

Following esthetic and functional approval of the mock-up, we performed minimally invasive tooth preparation (about 0.3 mm) (figure 3A), with diamond tips (2135 and 2135F). After that, polishing of the preparation was performed with abrasive-impregnated silicon rubber (American Burrs, Palhoça, SC, Brazil).

Gingival retraction cords (Ultrapack®; Ultradent, South Jordan, UT, USA) were inserted for the double-mix impression with addition silicone (Express™XT; 3M ESPE, Saint Paul, MN, USA), followed by selection of the A1 color (Vita Easyshade®; VITA, Bad Säckingen, BW, Germany). The obtained final impressions were sent to the laboratory to produce the laminate veneers, which were made with feldspathic porcelain on refractory cast. The interproximal contacts and marginal adaptation were tested using an A1 shade try-in gel (RelyXTM Veneer Try-In; 3M ESPE, Saint Paul, MN, USA).

For luting, etching of the internal surfaces of the laminate veneers was performed with 10% hydrofluoric acid (FGM, Joinville, SC, Brazil) for 90 s, which was then washed with water and air-dried. Once dry, an adhesive
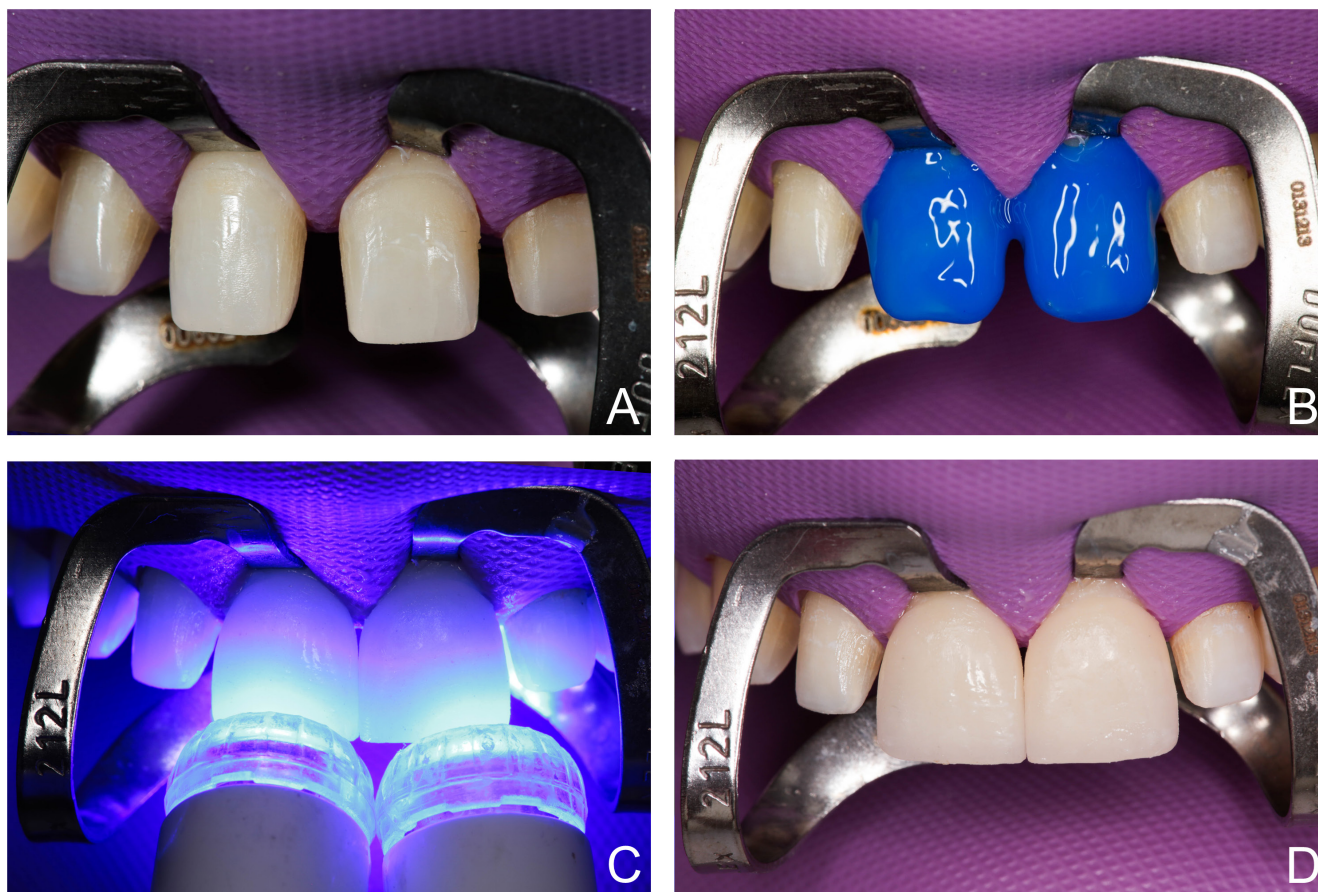

Figure 3. (A) Teeth preparation for luting. (B) Acid etching of the enamel with 37% phosphoric acid. (C) Luting of the laminate veneers with light-curing resin cement. (D) Intraoral frontal view after luting in teeth no. 11 and 21.

with silane (Single Bond Universal; 3M ESPE, Saint Paul, MN, USA) was applied. We then performed absolute operative field isolation and etching of the teeth with 37% phosphoric acid (Ultra Etch®; Ultradent, South Jordan, UT, USA) for 30 s (figure 3B), rinse with water for 60 s, enamel drying using air pressure until it was opaque white. When dry, an adhesive agent was applied (Peak®; Ultradent, South Jordan, UT, USA). The bonding agent was applied in two layers with microbrush and gently agitated for 10 s, followed by thinning/drying for 10 s using ¼ to ½ air pressure and then by light curing for 20 s [17].

Finally, luting of the laminate veneers was performed with light-curing resin cement in the shade A1 (RelyX™ Veneer; 3M ESPE, Saint Paul, MN, USA). The excess cement was removed and each surface was photoactivated for 40 s (figure 3C and D). Occlusal adjustment was made by selective wear using spherical diamond tips (1014) to restore the functional relationship of the dentition to a perfect balance with the other structures of the stomatognathic system. After that, polishing was performed with porcelain rubbers. The Figure 4 shows the final result.

Figure 4. (A) Intraoral frontal view of the definitive restorations after luting. (B) Final smile photograph of the clinical case.

DISCUSSION

Virtual esthetic rehabilitation planning should be performed after evaluation involving both dental and facial analyses [2-4,6,8,9,12,14,16]. Treatment planning using the DSD protocol has gained popularity over the past few years. It now represents an important tool for dentists, patients and dental technicians to improve communication as well as the predictability of treatment success [2,4-11,13-15]. In addition, new technologies brought a number of benefits to a better DSD planning, like dynamic dentofacial analysis, digital ruler, buccal wax-up, digital wax-up software and 3D analysis of the case [1]. In the current clinical report, we described how to obtain a predictable result for esthetic restoration involving DSD planning and porcelain laminate veneers restoration.

An ideal smile has the teeth with correct form, position, color and shade, and the smile curve (incisal edges of the maxillary anterior teeth) parallel lower lip [3]. To ensure correct digital planning, it is essential to follow a photographic protocol for better visualization and analysis of clinical problems [2,4,9,12-14]. A series of extra- and intraoral photographs are taken for the DSD. Vertical and horizontal reference lines, including the interpupillary, intercommissural and midline, are drawn on the front extraoral image. Next, a digital facebow record is created based on the reference lines. A digital calibrated ruler is used to measure the width-to-length ratio of the teeth [2,4,8,9,12-15], after which the width of the upper central incisor is calculated. For calculation, we applied the golden proportion described by Coachman et al. [2], who suggested that the width of the central incisor should range between 70% to 90% of its height. In the present clinical report, a proportion of 80% was used. Additionally, an approximate smile simulation was generated using Adobe Photoshop. All of this information was then transferred

to a diagnostic wax-up and intraoral mock-up to ensure esthetic and functional harmony [3,4,9,11-15].

Although DSD is considered a simple technique which does not involve any sophisticated equipment, operator training is always desirable as DSD is only a tool [6-8,13-15].

Teeth restorations can be performed by direct or indirect technique. The indirect technique requires often more clinical session and wear of the healthy dental structure [18]. However, this technique exhibit in compare with direct technique, better color stability, polymerization contraction occurring outside the mouth, less amount of residual polymer, better physical properties, less marginal infiltration and more durability [19], therefore, chosen for this clinical case. Another option would be orthodontic treatment. However, the patient was dissatisfied with the teeth shape, wishing to change them.

After planning with DSD and choose by indirect technique, a mock-up test was realized [3,4,9,11-15]. Following esthetic and functional approval of the mock-up, the porcelain laminate veneers restorations were performed. Enamel preservation is an essential clinical parameter for ensuring the success of laminate veneers, as dentin exposure may reduce the longevity of the restoration [9,11,13,14]. Thus, the present case describes laminates minimally invasive preparations (about 0.3 mm) involving only the dental enamel. Moreover, we chose to use feldspathic porcelain as these provide excellent esthetic value. However, the final esthetics of the ceramic depends on the luting composite, the color of which can be assessed with the try-in gel, which simulates the shade of the ceramic restorations without compromising the final esthetic result [3,9,14,15]. The present clinical report demonstrates the potential of this technique and the need for advancements in this area. Studies in the literature have shown success of porcelain laminate veneers for many years [20-22].

CONCLUSION

Precise treatment planning is essential to achieve successful anterior and posterior restorations, considering the esthetic and functional parameters. The omission of one or more esthetic parameters may lead to clinical failure. Prediction of the approximate final result is important in communication with the patient, generating more security and motivation. Communication with the dental laboratory technicians is also considerably more effective as it is possible to clearly express the desired outcome.

Diagnostic waxing, along with a mock-up, is essential for successful planning because it enables better patient contact with the end result. In addition, the mock-up allows confirming the functionality of the planned treatment.

Finally, the present clinical report demonstrates the potential of DSD technique and the need for advancements in this area.

Collaborators

SML GONTIJO, analysis and interpretation of data; drafting, writing and critical revision the article; final approval of the article. PM MORGADO, acquisition, analysis and interpretation of data; writing and critical revision of the article; final approval of the article. LS NEVES and EMB LAGES, analysis and interpretation of data; writing and critical revision of the article; final approval of the article. EC FRANÇA and HH ALVIM, conception and design of the work; acquisition, analysis and interpretation of data; critical revision of the article; final approval of the article.

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