A NEW USE OF THE MOCK-UP: THE INTRA-ORTHODONTIC MOCK-UP AS A GUIDE FOR A MINIMALLY INVASIVE RESTORATIVE TREATMENT

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ABSTRACT

Esthetic restorative treatment should begin with a final outlined goal. Mock-up can play a key role not only in guiding the clinician in restorative treatment or dental preparation, but also in the patient's acceptance of future restorations, especially in cases where changes in shape and/or size are planned. In the case of esthetic restorative dentistry, the preservation of as much enamel as possible during dental preparation has allowed to obtain better results in the medium and long term, thanks to: the improvement of the adhesion of the restorations when the limits of the restoration are found in enamel, decreased postoperative sensitivity, and lower marginal microfiltration, thus decreasing failure by staining or de-cementing. Currently within the minimally invasive esthetic dentistry, other specialties such as orthodontics can play a key role, providing the ideal position of the teeth to minimize dental preparation or favor the creation of space for the restorative material. In the present clinical case a systematic interdisciplinary approach was adopted, in which the mock-up is used in an innovative way, being placed in an intermediate phase of the orthodontic treatment and in this way, guiding the orthodontist to an ideal esthetic dental position to, at the same time, achieve the best results, both functional and aesthetic, in the least invasive possible way.

KEYWORDS:

Mock-up. Interdisciplinary dentistry. Orthodontics. Restorative dentistry. Conservative, dentistry. Minimally invasive dentistry.

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DOI: https://doi.org/10.14436/2447-911x.15.3.010-027.oar

CASE REPORT

A Caucasian patient aged 45 years attended the clinic requesting both esthetic and functional improvement. He also reported that, because of dental overcrowding, he accumulated food particles between his teeth.

With lips in repose, the patient presented no dental exposure[1] (Fig. 1A).

When smiling, a flat arch[2] was observed and slight gingival exposure, together with disharmony of gingival margins. In addition, inclination of the upper midline to the right was observed, as well as maxillary dentoalveolar compression, which corresponded to wide buccal corridors[3] (Fig. 1B).

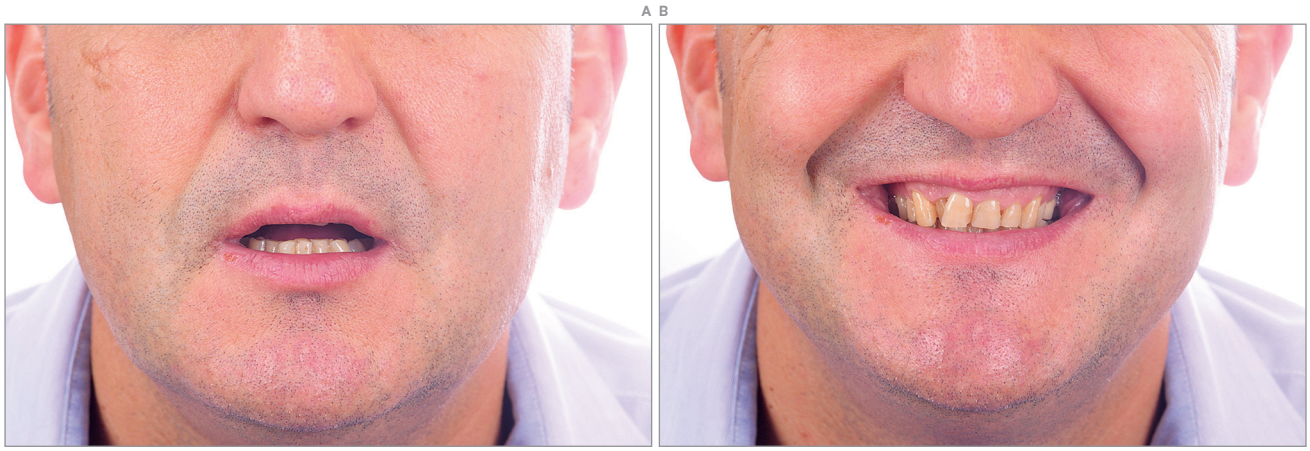

Figure 1:
(**A, B**) Extraoral photograph of patient in repose and smiling.

In intraoral exploration, dental crowding was found in both arches, wear to the upper and lower incisors and canines, and an almost 100% overbite (Figs. 2A and 2B).

Lateral views show a Class I occlusion on the left side, probably produced (the patient presented a skeletal Class I) by the distalization of the lower right hemi-arch, due to the extraction at an early age of the lower right first molar (as reported by the patient) (Figs. 3A and 3B).

The patient wore old complete coverage crowns on teeth 2.5, 2.6 and 3.5, as well as osteointegrated implants supporting crowns at 3.6 and 3.7; molar 4.6 was missing and teeth 4.7 and 4.8 were mesially inclined (the patient complained of trapped food around these teeth) (Figs 4A and 4B).

A B

Figure 2:
(**A, B**) Intraoral exploration observed dental overcrowding in both arches, upper and lower incisal and canine wear, and an almost 100% overbite.

A B

Figure 3:
(**A, B**) Class I occlusion on the left side and complete Class II on the right side (patient presented skeletal Class I) due to the distalization of the lower right hemi-arcade due to extraction at an early age of the lower first molar.

A B

Figure 4:
(**A, B**) Occlusal view of dental arches; the patient had old complete coverage crowns on teeth 2.5, 2.6, and 3.5, as well as osteointegrated implants supporting crowns at 3.6 and 3.7; molar 4.6 was missing and 4.7 and 4.8 were mesially inclined (the patient complained of trapped food around these teeth).

No signs or symptoms of temporomandibular joint (TMJ) pathology were observed.

Based on this clinical and radiological information (Figs. 5a&5b) a series of esthetic objectives were decided as follows:

1. Dental alignment and gingival harmony.
2. Increased dental exposure with lips in repose.
3. Lightening of dental color.
4. Reduction of buccal corridors.
5. Improved smile arc.

When these objectives had been approved by the patient, an interdisciplinary treatment plan was elaborated which, in addition to restorative treatment, included a previous orthodontic phase to improve dental positions guided by the final restorative treatment objectives with help from an intra-orthodontic mock-up.

Treatment commenced by taking the necessary photographic registers to make a Digital Smile Design (Figs 6A and 6B) to help the orthodontist visualize the ideal dental positions in relation to the definitive restorations to be placed.

A B

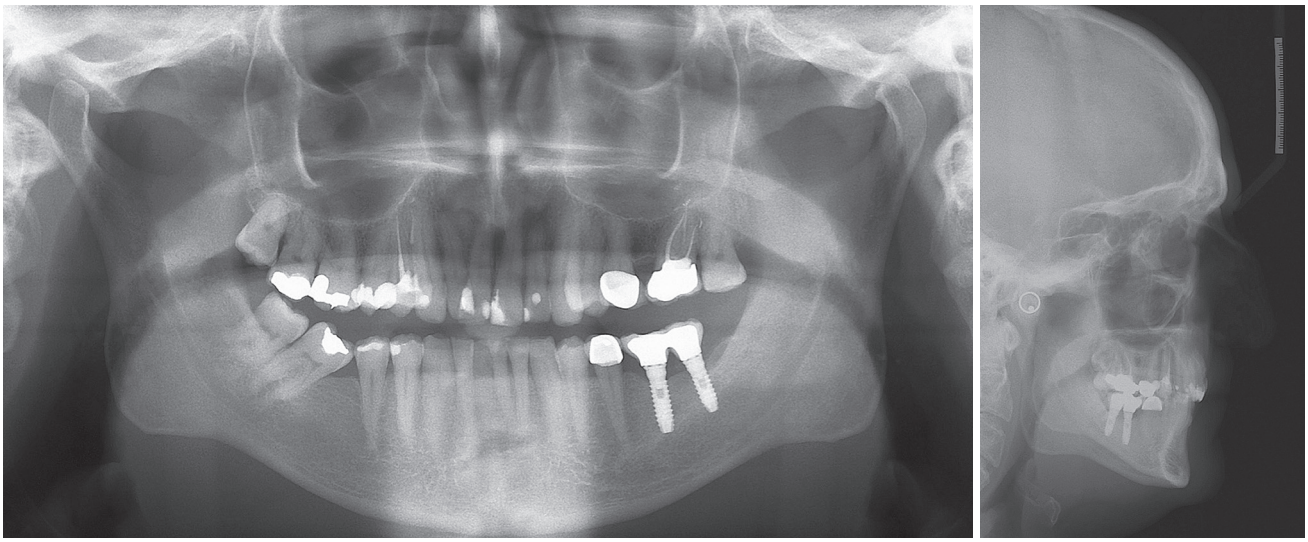

Figure 5:

(**A, B**) Orthopantomograph taken before treatment and initial lateral radiograph.

A B

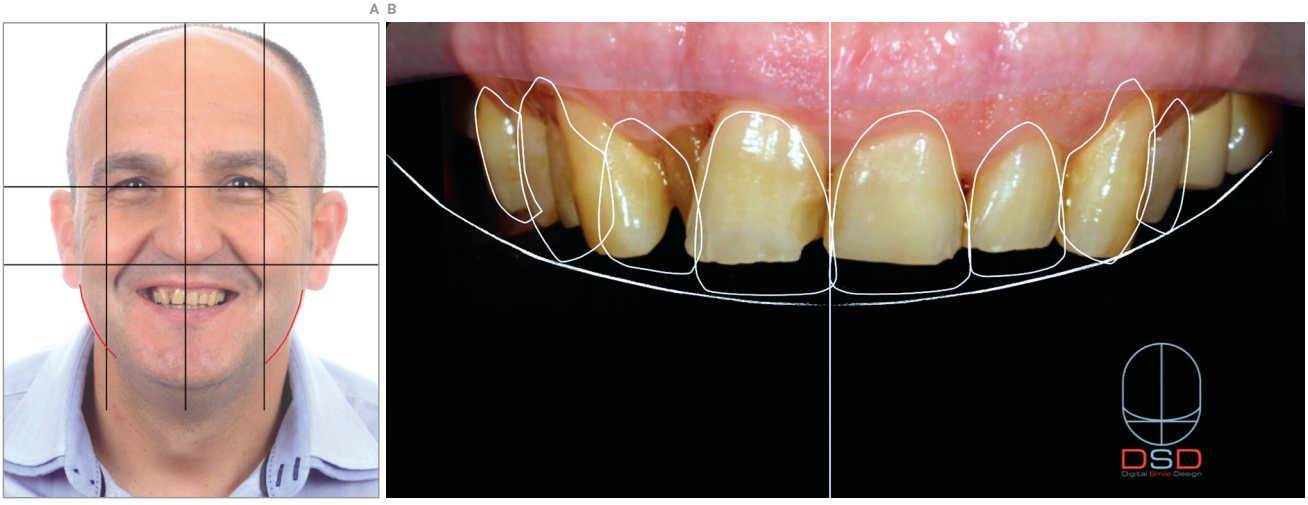

Figure 6:

(**A, B**) Photographic register used for elaborating Digital Smile Design.

At the same time as aligning the teeth, the right side Class II was corrected, mesializing the third quadrant, which had distalized due to the early extraction of 4.6. In this way, treatment avoided deviating the upper midline to the right. Tooth 4.7 was straightened and an implant was placed in the space created to replace 4.6.

When anterior alignment of both arches had been achieved, the upper midline was straightened, gingival margins harmonized, and a new DSD[4] was created (Figs. 7A and 7B). This provided the information required by the laboratory technician to fabricate a diagnostic wax-up of the anterior teeth.

When the anterior tooth positions and gingival margins were verified as acceptable, canine-to-canine brackets were removed from both upper and lower arches and silicon impressions were taken.

Using a transparent plastic impression tray and transparent silicon, a key was fabricated to place the intra-orthodontic mock-up in the patient's mouth. The mock-up was fabricated from microhybrid composite to increase durability, as it would remain in the mouth for six months, re-bonding the brackets removed earlier onto the mock-up.[5] (Fig. 8A)

This first mock-up, as well as guiding orthodontic treatment as described below, helped assess the esthetics of the proposed restorations,[6] and gave the patient time before orthodontic treatment ended to get used to the new dental morphology.

A B

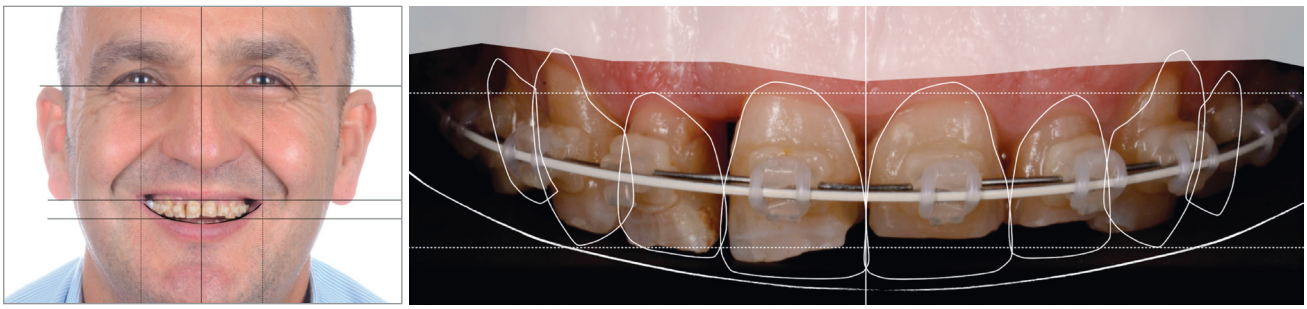

Figure 7:
(**A, B**) Digital planning after anterior alignment of both arches, straightening of upper midline, and harmonization of gingival margins.

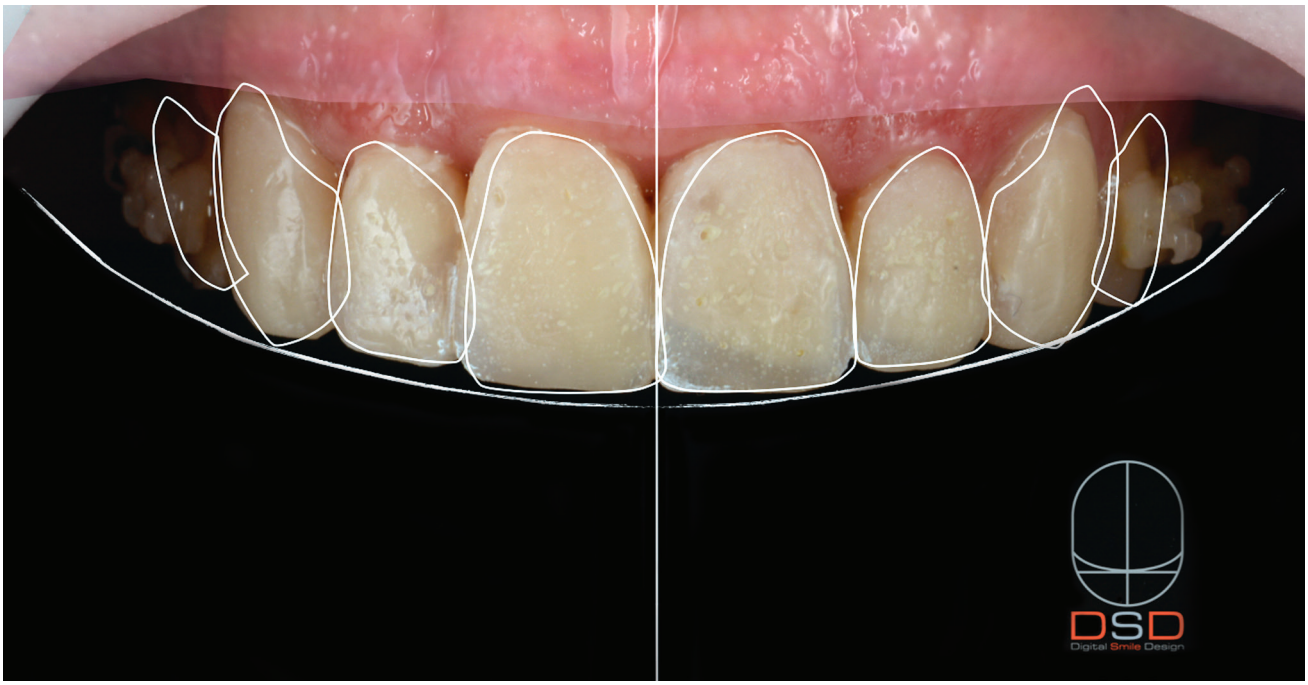

Figure 8:
(**A**) *MIntra-orthodontic mock-up placed in mouth.*

It should be noted how the anterior brackets were removed to place the mock-up and assess its esthetics (Fig. 8B), before replacing the brackets again to finish adjusting the occlusion (Fig. 9).

With the mock-up placed in the mouth, it can be seen how some occlusal interference was created. This acted as an anterior bite plane, producing posterior open bite. (Fig. 10) This open bite was corrected later on, extruding the posterior teeth and so increasing the vertical dimension.[7,8] The vertical increase was determined by the esthetic requirements of the final anterior restorations and guided the orthodontist in the correction of the patient's initial overbite without intruding the anterior teeth. In this way, the patient's incisal exposure was reduced during orthodontic treatment but created a large amount of inter-incisal free space for placing porcelain restorations, which could be bonded without dental preparation.

Figure 8:
(**B**) Only anterior brackets were removed to place the mock-up for esthetic assessment.

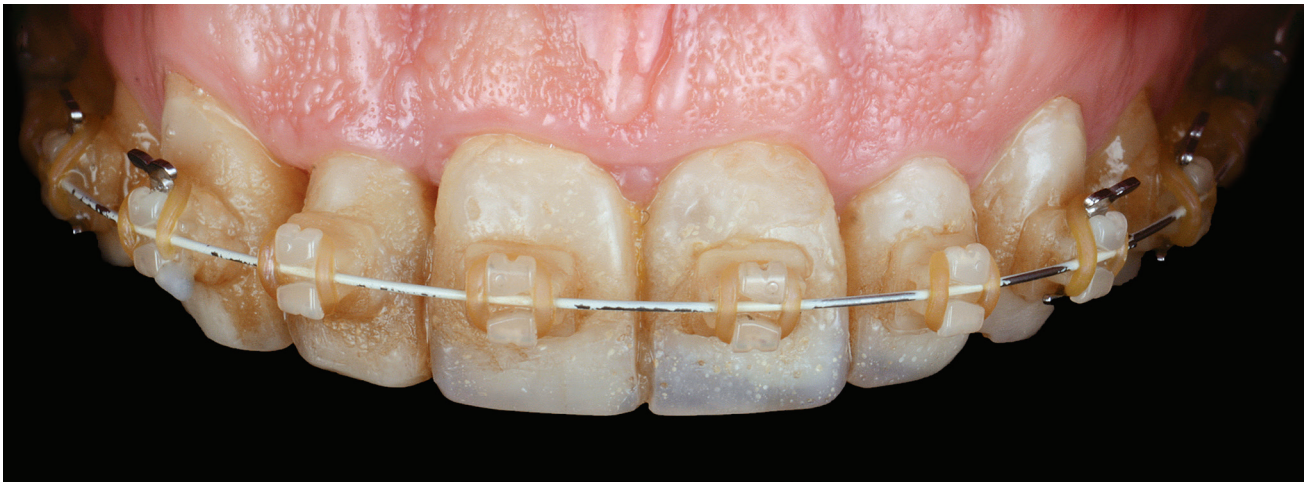

Figure 9:
Bonding brackets onto intra-orthodontic mock-up.

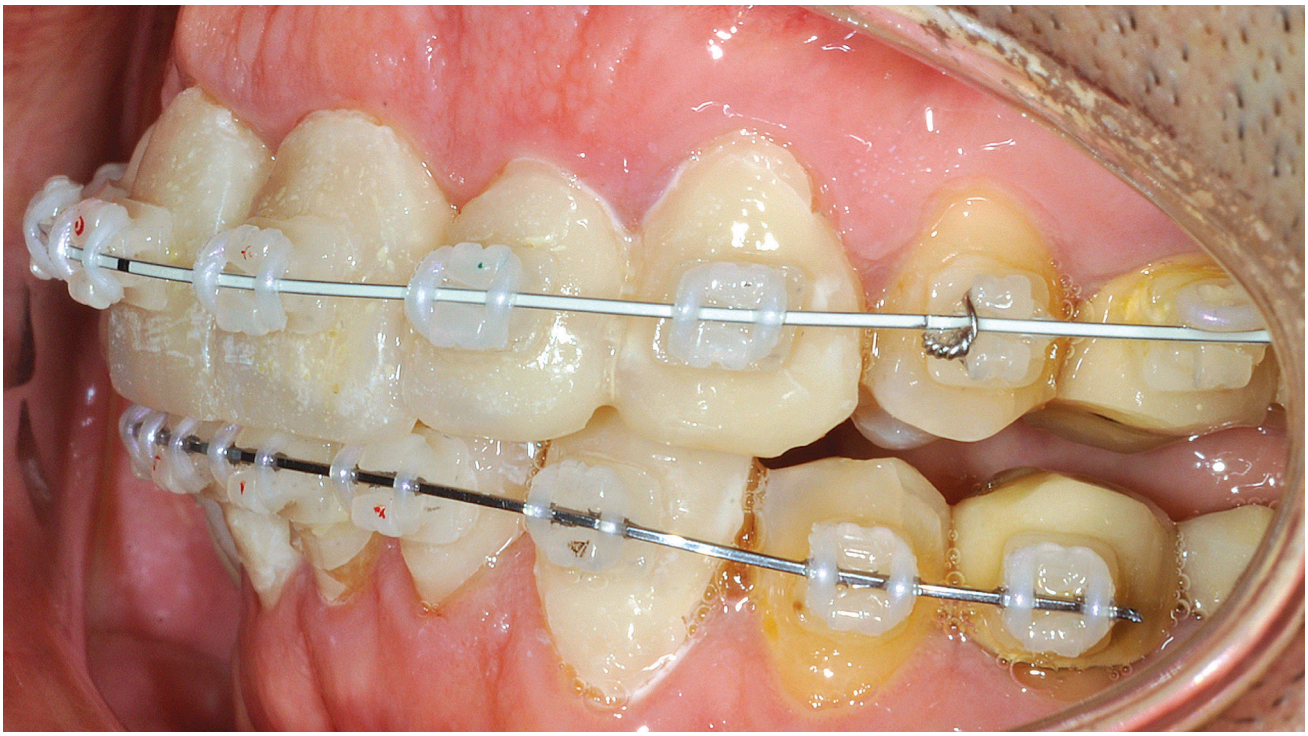

Figure 10:
Mock-up in the mouth; occlusal interference is created that acts as anterior bite plane, producing posterior open bite.

When Class I occlusion had been achieved and the vertical dimension increased, fixed multi-bracket apparatus was removed, (Fig. 11) in the certainty of sufficient space in the anterior region for the future porcelain restorations, which could be bonded without the need to eliminate healthy dental tissue.[9] Moreover, interdental spaces were not closed during orthodontic treatment, helping the dentist to achieve harmonious dental sizes (Fig. 12).

When the orthodontic phase had been completed, another mock-up was fabricated with the same dental sizes and all the occlusal adjustments obtained during the orthodontic phases, which was used to carry out dental preparation[10] (Fig. 13).

Figure 11:
When occlusion had been adjusted to Class I and the vertical dimension increased, fixed multibracket apparatus was removed.

Figure 12:
Image shows interdental spaces not closed during orthodontic treatment that helped the restorative dentist to obtain harmonious dental sizes.

Figure 13:
Mock-up with the same dental sizes.

Lastly, six upper and six lower feldspathic veneers were fabricated designed to match the initial esthetic objectives and to restore the original dental anatomy and anterior guidance (Figs. 14A and 14B).

Note how the brackets bonded to the mock-up have generated an "in-out" movement on the anterior teeth, allowing the vestibular faces

Figure 14:
(**A**) Conventional feldspathic veneers. (**B**) Feldspathic veneers placed on teeth.

of the definitive restorations to remain aligned to the faces of the posterior teeth, so that the vestibular position of the real teeth remained 0.5 mm more lingual than those teeth not requiring restoration, leaving enough vestibular space to house the porcelain veneers bonded without any need for vestibular reduction (Figs. 15A, B and C).

B

Figure 15:

(**A**) From left to right and top to bottom: **A**): Initial photograph; **B**): When dental and gingival alignment had been obtained, it was time to place the intra-orthodontic mock-up in the mouth; **C**) Orthodontic treatment finalized with the mock-up in the mouth; **D–E**) Dental positions after orthodontic treatment, when mock-up has been removed; **F**) Veneers placed on teeth.

Figure 16:
Extraoral photographs from start to end of treatment.

DISCUSSION

A restorative treatment such as the one reported here presents a number of challenges, all of which must be met if treatment is to meet esthetic objectives while conserving as much of the existing dental structure as possible and obtaining a predictable outcome in the long term.

The creation of inter-occlusal space, increasing the vertical dimension by extruding the posterior teeth using an interference device such as the intra-orthodontic mock-up is a controversial topic. This approach to creating prosthetic space was first described by Dahl,[7,8] who reported that 6 months after the placement of definitive anterior restorations, patients did not present any changes to the vertical dimension and no case presented a relapse to initial values 5 years after treatment.

Other authors such as Gianelly[11] have found that these increases are more stable from the skeletal point of view in patients in growth than among adults no longer in growth.

As affirmed by Magne,[10] dental preparation by means of the mock-up preserves a larger amount of enamel, making the both the restoration and bonding procedures more predictable.

In the present case of multidisciplinary treatment, the use of the mock-up implemented during orthodontic treatment permitted minimally invasive dental preparation. Careful planning at the start of treatment made it possible to place the dental substrate in the optimal position to receive the proposed restorations.

CONCLUSIONS

The intra-orthodontic mock-up can be a useful tool in interdisciplinary treatments involving orthodontics and restorative dentistry that offers several advantages:

» Placement of the dental substrate during orthodontic treatment aims to minimize and facilitate dental preparation.

» Modification of anterior guidance, guided by esthetic planning (the mock-up guides the orthodontist in modifying anterior guidance).

» Obtaining the space required for ceramic restorations without the need for dental reduction.

» Use of the intra-orthodontic mock-up as long-lasting provisional, allowing time for the patient to get used to and accept new dental size and morphology.

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How to cite: Faus-Matoses I, Faus-Matoses V, Faus-Llácer VJ. A new use of the mock-up: The intra-orthodontic mock-up as a guide for a minimally invasive restorative treatment. J Clin Dent Res. 2018 Sept-Dec;15(3):10-27.

Submitted: June 22, 2018 - Revised and accepted: August 30, 2018.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.