Non-extraction treatment of a Class II case with a missing mandibular central incisor using a CAD/CAM lingual orthodontic system

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Adult orthodontic patients insist on aesthetic treatment options that have the least possible impact on their work and life. Clear aligners are an excellent treatment option that is well suited to many comprehensive orthodontic treatment plans. You may have already figured out that case selection is essential, and some movements are more difficult to perform well with removable aligners.

Incognito lingual braces (3M ESPE) are an ideal treatment option for adult patients who are best treated with a fixed system and who are looking for invisible orthodontics. They are also perfect for patients who are not committed to dealing with removable aligners. Lingual braces are an exciting advancement in orthodontic care, and many patients are thrilled. I would like to present a brief background on the Incognito lingual braces system, followed by a discussion of a case I treated with lingual braces and why I chose this system.

The Incognito appliance is manufactured using state-of-the-art CAD/CAM technology. The first step in the fabrication process is taking accurate polyvinyl siloxane impressions and bite registration using polyvinyl siloxane, and then creating a model in plaster and a diagnostic wax-up thereafter (according to my direct instructions). The final model is then sent to me digitally for feedback, and I can make a series of changes until I am satisfied with the final result. The final model is then scanned with a 3-D scanner and the brackets are designed on the computer.

The bracket and archwire system consists entirely of individualised components. The bracket bases and bodies, the position of the bracket body on the bases, the bracket-slot orientation (ribbonwise), the direction of the archwire insertion (vertical or horizontal) and the archwire geometry are all individually adjusted to each tooth, according to malocclusion and the orthodontist's instructions. Rapid prototyping tech-
nology is used for the manufacturing of the lingual brackets. The braces are then cast from gold alloy, mounted in a flexible indirect bonding tray, and shipped out ready to be bonded. Direct bonding is feasible too, owing to the extended individual bases.

Bending archwires is one of the most difficult tasks in orthodontics. In this system, computer-operated bending of archwires using robots is used to manufacture precisely shaped archwires. Even super-elastic archwires can be precisely shaped. This helps solve three major problems in lingual orthodontics:

1. Patient discomfort during the adaptation phase: The appliance is designed to be as flat as possible, not much higher than a bonded retainer; this significantly improves patient comfort.
2. Difficulties in re-bonding: The customised bracket base covers the major part of the lingual tooth surface and therefore allows direct re-bonding without the need for any other positioning aids.
3. Inaccuracies in finishing: Inaccuracies of the slots due to production and resulting variation in torque play are now part of the past, owing to Incognito. Measuring rates show divergences of not more than 0.008 mm between the slots. The precisely shaped archwires also make high-standard finishing easily achievable.2, 3

Figure 1 shows the different steps in manufacturing braces with the Incognito system.

This case report describes the treatment of a patient with a skeletal Class II malocclusion due to a retrognathic mandible and protrusive maxilla. He also had a congenitally missing mandibular left central incisor. The extraction of a single mandibular incisor can be employed as a compromise treatment of certain malocclusions if the end result fulfils the requirements for a healthier dentition that is functionally and aesthetically harmonised in relation to the surrounding structures.4 In this case, one of these incisors was missing so extraction was not necessary.

The Class II malocclusion was corrected by non-extraction orthodontic treatment with a CAD/CAM fixed lingual appliance (Incognito). The Class III molar relationship had not changed at the end of treatment, but a Class I canine relationship was achieved and the facial profile improved owing to improvement in the position of the mandibular incisor in relation to the mandibular plane, which affects the position of the lower lip.

**Diagnosis and aetiology**

The patient was male, aged 23 years and 9 months, and had the chief complaint of crowding of the maxillary and mandibular anterior teeth. He had Class III canine and molar relationships on both sides, a 2 mm overjet, a 4 mm overbite, a missing mandibular left central incisor, the maxillary midline was coincident with the midsagittal plane, the mandibular midline was shifted to the left, the maxillary dental arch had about 7 mm of crowding and lower dental arch had 8 mm of crowding, excluding the width of the missing mandibular
incisor, and the maxillary lateral incisors were in crossbite (Fig. 2). According to cephalometric analysis, there was a Class II jaw relationship and normal vertical facial height. The patient was in good health and his medical history showed no contra-indications to orthodontic therapy (Fig. 3).

_Treatment objectives_

The treatment objectives included correction of the maxillary and mandibular crowding, improvement of the dentoalveolar and maxillomandibular relationships, improvement of facial aesthetics, and establishment of a stable occlusion and better smile.

_Treatment alternatives_

Three treatment options were suggested to the patient. The first alternative entailed labial orthodontics using either metal or clear brackets. The second option entailed lingual orthodontics, as the aesthetic demand was very high for the patient and clear aligners would not have been able to achieve the needed results. Both options 1 and 2 were non-extraction. The third option was to extract all four first premolars but this would have affected the facial profile negatively. After detailed discussion with the patient, we chose option 2, non-extraction using a lingual appliance.

_Treatment progress_

Treatment began with customised, pre-adjusted, CAD/CAM fixed lingual appliances (0.5588 mm slots) placed on both the maxillary and mandibular arches using an indirect bonding technique. Levelling, alignment and expansion of the arch were achieved using heat-activated, super-elastic, customised wire (14, 16, 16 x 22; and 18 x 25). Detailing and finishing were performed using 16 x 22 stainless-steel wire and 18.2 x 18.2 Beta III Titanium Archwire. The total active treatment time was 17 months. Patient compliance was good. For retention, fixed maxillary and mandibular retainers were provided, as well as an Essix retainer at night.

_Treatment results_

The post-treatment extra-oral photographs showed general improvement in the facial profile. The post-treatment intra-oral photographs showed satisfactory dental alignment, Class I canine and Class III molar relationships, and a normal overbite and overjet. In addition, the maxillary and mandibular incisors had a normal inter-incisal angle due to the interproximal reduction in the maxillary arch. In Figure 4, we can see how accurate the model was compared with the final treatment outcome for both arches. At the end of treatment, a normal morphological and functional occlusion was obtained, with anterior guidance in lateral and protrusive excursions. Class I canine relationships were obtained on both sides. The good interdental relationship also provided a well-balanced facial profile with lip competence.

_Discussion_

The treatment objectives were attained with the non-extraction treatment protocol using a
CAD/CAM lingual system. Obviously, the results reflect the effects of not only the proclination of the mandibular anterior teeth, but also the relief of crowding in both arches and the accuracy of the model in reflecting the final result (Fig. 5). We still had to perform interproximal reduction in the maxillary arch to achieve a normal overbite and overjet, with the canines in a Class I relationship. Another treatment option would have been to extract the maxillary and mandibular first premolars. However, this was not a favourable treatment alternative owing to its negative effect on the facial profile.

Performing lingual orthodontic treatment for each patient in the average orthodontic office is now a reality. The treatment results are of a high level, and all our patients may benefit from an invisible appliance. Former problems, such as discomfort, speech alteration, finishing inaccuracies, and particular tooth anatomy, can be overcome in this manner.³

The extraction of the mandibular incisors constitutes a therapeutic alternative in treating certain anomalies. It is not a standard approach to symmetrically treating most malocclusions, but the therapeutic aims must be adjusted in certain clinical situations to individual patient needs, even when this means that the final occlusion achieved is not ideal. The deliberate extraction of a mandibular incisor in certain cases allows the orthodontist to improve occlusion and dental aesthetics with minimal orthodontic treatment. In all cases, however, a diagnostic cast is required to predetermine the occlusal possibilities precisely.⁴

Conclusion

The key to success in lingual orthodontics in terms of both professional and patient satisfaction is practice and training. The Incognito system can be used for all types of malocclusions with the same precision as labial braces.

The possibility of incisor extraction should be a part of every clinician’s portfolio of treatment techniques. If it is planned carefully and executed properly, incisor extraction can be an effective way of satisfying a particular set of treatment objectives.

Editorial note: A complete list of references is available from the publisher.

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