

LINGUAL ORTHODONTICS CAD-CAM IN PRIVATE CLINIC

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ABSTRACT

Lingual Orthodontics (LO) is a technique that stands out in the context of increasingly demand for aesthetic appliances, represented today mainly by the boom of clear aligners. Suitable for any type of malocclusion, the latest lingual devices aggregate customization through CAD-CAM technology. This paper reviews five of the main points that analyze the feasibility of Lingual Orthodontics CAD-CAM work currently in private clinic. The conclusions indicate that the use of CAD-CAM in Orthodontic appliances customization is a current reality. Lingual Orthodontics assimilation by most clinicians is also a trend and depends on a change of professional attitude in face of growing demand for aesthetic appliances.

Keywords: Technology, dental aesthetics, Lingual Orthodontics.

INTRODUCTION

One of the major challenges in the practice of current orthodontics is to find a treatment path that associates effectiveness, clinical practicality and, at the same time directly meets patients' needs. In this sense, there is a clear perception that one of the factors that most influences the choice of orthodontic devices for adult patients is the aesthetic condition offered during treatment. Some studies have confirmed that adult patients really care about metallic devices appearance and are less likely to accept the proposals of treatments that may impair their aesthetics^{1,2}. In developed countries, one study concluded that rejection of treatment with "visible" devices reaches 33% of the subjects interviewed³. Following this trend, intense marketing campaigns have been carried out by manufacturers of many clear removable aligner systems⁴. However, the literature still raises questions about aligners applicability for the treatment of all types of malocclusion. A research⁵ revealed that the average accuracy of tooth movement performed with Invisalign (Align Technology, United States) is only 41%.

In the future, research and clinical experiences will be able to equate the indications and limitations of removable orthodontic aligners more properly. The fact is that this type of treatment has determined a new wave, which is going through exponential growth in the popularity of the so-called "Invisible Orthodontics". In the acceptance opened by the clear aligners, at least in our times, the device that most meets aesthetic requirements and, at the same time, provides complete three-dimensional control to correct any type of malocclusion is the fixed lingual device⁶.

On the other hand, professionals able to offer the Lingual Technique are still few, especially on the Western side of the planet. The reasons for this detachment are many, starting with the trauma left by the troubled beginning of this technique in the United States more than 40 years ago, when many difficulties were described, and the technique went into total discredit. Then, the laboratory methods of personalized prescriptions based on manual setups did not prove to be technically quite simple and represented one of the greatest demotivating factors for professionals to enter Lingual Orthodontics⁷.

Times have changed and CAD-CAM (Computer-Aided Design/Computer-Aided Manufacturing) technology has entered Orthodontics in the production of devices with full force in recent times. However, even today, the Internet offers sources considered "poor"⁸ and much disbelief still persists about the practice of Lingual Technique⁹, even in face of the new panorama that has been opened.

This article aims to discuss five aspects that describe Lingual Orthodontics today confronting them with the expectations of clinicians and patients.

Distribution of Professionals Practicing LO

Studies have shown that the distribution of Lingual Orthodontists is uneven around the world. In the Republic of Ireland 10% of professionals revealed that they use routinely lingual devices in their patients¹⁰. Something similar happens in the United States, where interest in the technique affects 10.87% of residents in Orthodontics. This number rises to 28% in Saudi Arabia¹¹. In the United Kingdom 16.1% of Orthodontists practice LO¹², in Australia¹³ 25% and in India of 248 subjects surveyed, an impressive 70% of professionals said they use the Lingual Technique in their patients¹⁴. No references were found that could indicate the portion of orthodontists using LO in Latin American countries. In countries that stand out for the number of specialists in Orthodontics, as in Brazil (which has around 27,000 specialists), based on the congresses and specific events held in the country over the last few years, it is not risky to say that less than 4% of professionals offer the Lingual Technique to their patients.

The market calls for aesthetics and is driven by the intensive marketing of companies for clear aligners. The treatments limitations with clear aligners may carry a probable frustration for both professionals and patients. This is where a gap arises in which the Lingual Technique comes in as a solution. In this sense, it is interesting to hear the words of a market expert¹⁵ "it is necessary to cultivate the perception of opportunities, the prediction of competitors' movements and the decision-making based on facts, whether they are real behaviors of customers and competitors or information that points to the opportunities."

The work with LO represents an opportunity for professional differentiation. This is one of the

few Dentistry subspecialties that still lacks trained professionals. The low availability of professionals sets precedents for the prominence of those who practice the LO in face of competition.

Laboratory Service: Manual X CAD-CAM

As mentioned before, a laboratory phase that precedes lingual brackets bonding has always been one of the reasons that drove professionals away from the practice of Lingual Technique. It was determined that the laboratory phase among others was essential to fill the mechanical deficiencies of the prefabricated devices¹⁶, which seems an unusual situation. This externalized an unusual problem in

the dental environment in which materials commercialized were deficient and orthodontists should be responsible for the eventual “correction” of these problems in the laboratory.

Also, as already mentioned, machines and laboratory systems that required preparation services of manual setups prevailed for several decades as main methods of brackets base customization, forming compensatory pads in composite resin. Simplified laboratory methods were also feasible, but a certain additional skill of the professional in the management of arches would be necessary (Figures 1-12). In one way or another, few orthodontists did not feel safe to offer the Lingual Technique in their offices.



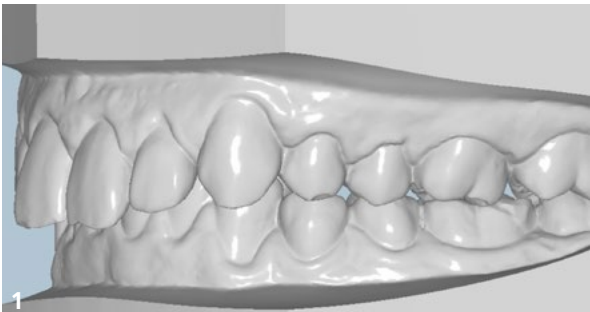


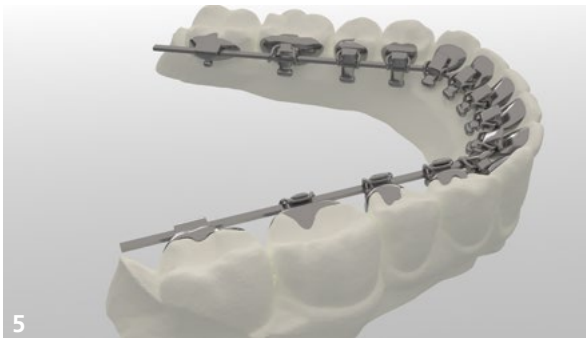
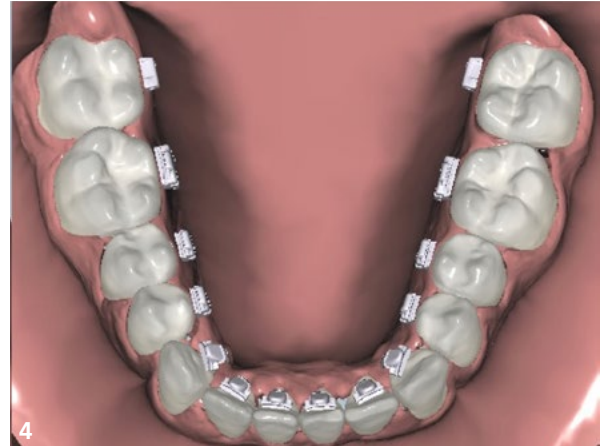
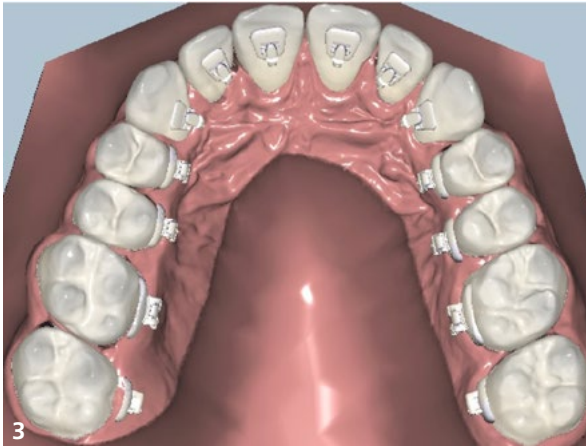
Figures 1-12 - Clinical case of a Class III malocclusion correction treated with Lingual Orthodontics, in which a simplified laboratory phase was used without compensatory pads in resin. Figures 1 through 5 show the initial state. The lingual device was mounted directly on the malocclusion models and transferred to the patient by means of an indirect bonding process¹⁷. The individualizations were performed by means of folds in the arches (Figures 6 and 7). Photographs 8 to 12 show the treatment result.

All laboratory methods would prove to be efficient in skilled hands, but currently it is practically unanimous among the authors that the quality of lingual devices customization is superior, when CAD-CAM technology is employed¹⁸. The greatest advantage of the use of CAD-CAM in Orthodontics is in the device individualization¹⁹, enabling a personalized and unlimited prescription for each patient.

The Lingual Technique with CAD-CAM technology was introduced in Lingual Orthodontics in 1998 by Wiechmann, who used a destination

configuration to facilitate the individualized placement of lingual brackets^{19,20}. In his system, compensations of lingual face differences were made in an individualized lingual arch and manufactured by a robot. This lingual system became known as Incognito (3MUnitek, United States). Harmony Lingual System (American Orthodontics, France), and E-braces (Guangzhou Riton Biomaterial, China) are among other examples that have also added something to CAD-CAM technology in the production of their lingual systems (Figures 13-18).





Figuras 13-18 - Digital flow of a lingual device customized by CAD-CAM technology. (Octopus L, Aditek, Brazil). Figure 13 shows the initial state of the malocclusion from a patient intraoral scan, in Figure 14, the simulation of treatment in a setup, in 15 and 16, the brackets placed in the virtual models, in the printed model (Figure 17) and, later, with the lingual device transferred and placed in the patient in initial leveling and alignment phase (Figure 18).

Behaviour Profile and Patient Adaptation to the Lingual Device

It is expected that the patient who chooses a method of “Invisible Orthodontics” behaves differently than the one who does not care about the device appearance. It is known that lingual orthodontic patients have more perfectionist characteristics than patients who choose conventional orthodontic treatment²¹. Associated with this behaviour

is the fact that lingual orthodontic appliances do not show the visual interferences of common fixed devices (Figure 19). This is a great advantage for the patient (aesthetics), which can also be considered a disadvantage for the orthodontist: without the usual coverage of fixed lip devices, every movement must follow a calculated step, which will be clearly visualized and that directly affects the orthodontic patient¹⁷ degree of demand.



Figure 19 (A-C) - Photograph of lingual orthodontic treatment with active movement of distalization in execution: patients who elect "clear devices" have more demanding behavior and all movements must follow in order to avoid any damage to the smile aesthetics.

Here, it is worth using high precision systems and regarding this, as previously mentioned, CA-D-CAM technology once again stands out compared to the old methods of brackets placement and planning in Lingual Orthodontics.

There has been many questions regarding patient's adaptation to lingual devices. One study showed that there would be a significant reduction in the need for adaptation time in cases of digitally customized lingual devices compared to the old brackets prepared in conventional laboratories²².

Comparing fixed vestibular and lingual devices, no significant differences were observed in the overall pain classifications during treatment among patients. For both groups, pain decreased over the follow-up period. As expected, individuals with lingual devices experienced more pain in the tongue, while those treated with lip braces presented more pain in the lips and cheeks²³.

In any case, it is important to be attentive to patients who have retrusive jaw and mandible relationships. One study showed that this would be a

group with greater difficulty to adapt to the lingual device, what could be explained by the restriction of intraoral space for the tongue²⁴.

Biomechanical Domain

Literature is full of studies that demonstrate the feasibility of LO use in any type of malocclusion²⁵⁻²⁷. This has been evidenced since the introduction of the technique almost 50 years ago and the main problems related to the biomechanical

domain, especially those related to reduced inter-brackets distances are well studied. For the latter, the solutions would be the use of superelastic wires, progressive brackets bonding¹⁷ and, more recently, self-ligating brackets, which integrate greater flexibility to clips, and are under study. The association between the new clips and flexible wires will incorporate light force levels with minimal friction²⁸, particularly interesting property for reduced inter-brackets distances (Figures 20 and 21).



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Figures 20 e 21 - Clip on Niti in development²⁸ (Octopus Lingual Braces - Aditek do Brasil). The idea of this connection system is to create additional deflection in the lingual system, indispensable property, where the interbrackets distance is considered a mechanical difficulty.

One question remains unanswered: to what extent will the new generations of CAD-CAM lingual devices actually influence the acceptance of LO by orthodontists? Prerogatives are the best possible, since virtual tools significantly facilitate the comparison of possible solutions, greatly improve brackets placement (therefore, their degree of accuracy) and the digital customization of the prescription opens the doors to endless possibilities of treatments. Still, the growth of the technique depends on the change of the professional attitude.

Obviously, the contribution of the association of the latest discoveries in the specialty insofar as they will facilitate the biomechanical domain, will also influence the context of the Lingual Technique growth. Just as an example extra-alveolar mini-implants are especially indicated in association with lingual devices, as their aesthetic aspect is favorable and can contribute to anchorage control in the same way as conventional fixed devices. The use of botulinum toxin application to control excessive muscle contractions during LO facilitates biomechanics and has also been studied²⁹.

Treatment Costs

Many professionals consider that the operational costs of applying more sophisticated techniques would be outside of the reality of acquisition by their patients. In part, this perception is true: patients seem to have difficulty recognizing the degree of investment that requires orthodontic treatment with more sophisticated devices. Just to have an idea, a study confirmed the tendency that adult people would prefer lingual and aligning treatments to traditional vestibular devices²⁶. However, these same subjects revealed that they would be willing to pay for these aesthetic therapies, on average, only US\$ 610.00 (six hundred and ten dollars) more than traditional vestibular devices¹.

In the past, laboratory methods based on manual setups required very specialized labor, great precision at each step and, although they were more economical, because they did not require specialized equipment, they were more expensive from the hours/work point of view¹⁷. CAD-CAM is still considered a relatively recent technology and brings with it some disadvantages such as difficulty

of acquiring arches scanned images and a higher cost compared to traditional brackets manufacturing systems. In time, this technology will find more followers as the main problems can be solved. For example, models of physical plaster or moldings can be used to obtain arches images on flatbed scanners, in those places where intraoral scanners have not arrived yet. The technologies that address the manufacturing of personalized brackets with characteristics of mass production, with consequent reduction of costs and time of manufacturing will soon be available.

CONCLUSIONS

An efficient use of lingual bracket production systems by CAD-CAM will require a coalescence between technology, work feasibility and, mainly, a change in the professional behavior. Due to the relative precocity of innovation, this technology is still being assimilated by industry and orthodontists. It is already safe to say that the CAD-CAM technology due to the results demonstrated so far, driving the development of personalized appliances, will dictate the parameters of Orthodontics for the new times.

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