Guest Editorial

Aligners, Environmental Contamination, and The Role of Orthodontics

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The number of adult patients seeking orthodontic treatment is increasing as well as the demand for more esthetic appliances, requiring alternatives to the conventional fixed orthodontic appliance. Therefore, much effort has been spent in the development of materials that mimic the color of the teeth to provide better esthetics.[1,2] Initially, esthetic brackets made of different materials such as polycarbonate, and polycrystalline or monocrystalline ceramics were used with great clinical acceptability. However, in the last decades, the spotlight has been on the use of clear aligners.

Currently, several commercial brands are available on the world market with different materials in their composition. Thus, it is extremely important to know the structural, mechanical and elastic properties of the material to be used, since, ideally, the aligners require flexibility for insertion and removal, but need rigidity for exerting the force necessary to achieve desired tooth movement. Therefore, the search is on for a thermoplastic material that has a linear force behavior, is resistant and durable, and leads to effective tooth movement.[3]

Based on this and, regardless of the brand, the aligners produced have been based on thermoplastic polymers which can be manufactured under high pressure (composed of polyurethane) or manufactured in a vacuum composed of polyethylene. These synthetic polymers emerged in an attempt to replace natural polymers such as silk and rubber. According to their mechanical behavior, they can be classified as materials that are solid at room temperature but, when heated, become fluid and can be molded, making them a highly versatile material.[4]

In contrast, they have also been considered a great villain for the environment. This is because they are basically formed from petroleum-derived hydrocarbons. These macromolecules form plastics that, besides being non-biodegradable, usually cause damage to the environment when burned.[5] As polymers, aligners cannot be classified as trash without a final destination. Their disposal must consider the importance of these characteristics for environmental contamination, as well as the risk of providing a means of cross-infection dissemination because they were used in the oral cavities of patients and discarded without any care in the common trash.

Based on this, some countries such as the US may consider that aligners are not eligible for "routine" recycling because they are classified as contaminated medical waste. One solution to this problem would be to make professionals and patients aware of the importance of collecting aligners after clinical use. Then, orthodontists would collect used aligners in a waste container so they could be sanitized and sent to a company for recycling. This would avoid the spread of infection as well as provide the correct destination of this material as contaminated and non-biodegradable waste.

Mechanical or secondary recycling represents a viable alternative and consists of converting post-consumer plastic waste into granules (pallets) that can be reused in the production of other materials. This recycling produces products composed of a single type of plastic or products from mixtures of different plastics in certain proportions. It is estimated that only 9% of post-consumer plastic waste in the world is mechanically recycled.[6]

In addition to the environmental risks, there is the risk of releasing toxic products used as additives in the manufacture of polymers. Examples include cyanides released during thermal degradation and BPA (Bisphenol A), which is used to provide transparency and increased strength. A study published by Environmental Health Perspective revealed that, even in small amounts, this chemical can cause diseases such as immune system changes, prostate enlargement, diabetes, hyperactivity, infertility, obesity, precocious puberty, and breast cancer.[7]

There is some controversy about the real presence of BPA in the composition of orthodontic aligners. While manufacturers claim that they do not contain BPA, this has been verified in the systematic review of Iliadi et al., 2020.[8] Recent research showed traces of this compound both in aligners based on thermoplastic materials[9] and in those produced in a vacuum.[10] Thus, considering the relevance to its exposure, it is best to minimize if not eliminate exposure to BPA. For this, it

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would be beneficial to immerse the aligner in water at 37°C for 1 day before wearing.[10,11]

The importance of making orthodontists aware of the subject is clear. The risks mentioned and the correct way to dispose of the aligners should be considered in view of the possibility of their safe reinsertion in the production process aiming at environmental protection. Education regarding health and the environment is the way to establish a more responsible society, committed to ecological and social values, aiming at the full development of human activities. I believe that Orthodontics can play a significant and inspiring role in achieving this.

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