The Indications of Polyethylene in the Orthodontic Field

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PETG (polyethylene terephthalate) is a very popular plastic material when it comes to manufacturing invisible orthodontic appliances. These devices are very common nowadays because they provide an esthetic treatment alternative to braces. This type of plastic material has several indications in orthodontics: manufacturing night guards, positioners, orthodontic aligners, invisible single-layer/multi-layer thermoplastic retainers, bite splints, space maintainers, mini trays, fluoride trays, growth guiding splints, etc. The polyethylene foils provide resistant wear and rigid devices, with no substantial elastic deformation, capable of assuring a reliable orthodontic treatment.

Keywords: polyethylene foils, thermoplastic retainers, orthodontic aligners

Thermoplastic materials such as PETG were initially used in general dentistry. The use of polyethylene foils was recently introduced in orthodontics due to the continuous development of the invisible orthodontic techniques such as Clear Correct, My Clear Brace, Invisalign, etc.[1]. When different amounts of PETG are mixed with EVA (ethylene vinyl acetate) a series of thin thermoplastic foils can be obtained [2]. These foils are used for manufacturing different orthodontic appliances that behave well even in a high humidity environment [3]. The quantity of EVA can vary, depending on the purpose, but it is mostly used as a softener, making the material sensitive to heat. [4]

Polyethylene was first used in orthodontics in the fabrication of removable retainers. The PETG foils can be made of a single layer thermoplastic foil or a multi- layer foil. Single layer retainers lack dimensional stability and wear resistance. In order to improve these properties, multi-layer retainers, made out of thermoplastic foils, became more popular. They consist of a hard polymer, such as PETG, a softener (like EVA) / soft polymer (like polyurethane) and a fiber resin reinforced material in order to assure a proper rigidity [2].

Foil thickness is another factor that varies when the orthodontic purposes are taken into consideration. Positioners are made out of foils that can be as thick as 4 mm, while orthodontic aligners (manufactured according to an in-office dental set-up) are made out of much thinner foils (0.6 mm; 0.8 mm). The orthodontic retainers consist of thermoplastic PETG foils with a thickness of 1 mm. Orthodontic appliances that guide the skeletal growth in children patients are usually made out of thin foils (0.8 mm) but they also have an acrylic bite plane/inclined plane. Scheu Dental (Germany) and Forestadent are the biggest companies that provide vacuum formed thermoplastic foil for dental purposes [5]. The main constituents of the foils are: PETG (mostly multi- layer foils), EVA and PC (polycarbonate foils).

Experimental part

Our study objective, after reviewing a few clinical cases, was to find multiple applications of these PETG foils in the orthodontic field. The aim of this study was to provide reliable translucent thermoplastic appliances to the patients within a few hours, in the same day. Therefore, the dental office must acquire a compact pressure vacuum forming device (Ministar from Scheu Dental) in order to manufacture orthodontic appliances from PETG foils. An orthodontist or a dental technician has to make an accurate in-office dental set-up. Using this set-up, a passive or an active orthodontic appliance can be made in a few minutes with the use of the vacuum forming device and the thermoplastic foils. We selected two clinical cases in order to emphasize the extended applications of the polyethylene materials in orthodontics.

The first case refers to an adult patient with a minor malposition after an active orthodontic treatment. A small repositioning of a tooth was made with the use of a set-up in order to correct the imperfection (fig. 1).

A medium polyethylene foil was used in order to obtain an orthodontic retainer with a small correction of the lateral incisor (fig. 2).

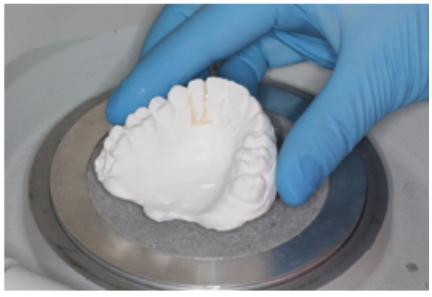

Fig. 1. The set-up with the repositioned tooth

Fig. 2. The orthodontic appliance on the stone model (before the sectioning and the finishing phase)

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The multi-layer type foil is usually used for orthodontic retention splints. These foils are resistant to water absorption and molecular changes due tointraoral environmental factors [6,7].

Hard type polymers like polyethylene or polycarbonate are capable of maintaining the archform for a long period of time.

Another type of orthodontic appliance that can be made from PETG foils and an additional acrylic component is a growth guiding device/splint for children with skeletal or dental anomalies. Acrylic bite planes can be easily adapted to a vacuum formed splint/aligner, in order to guide the maxilla or the mandible in a retruded /protruded position (depending on the clinical case).

The most popular appliances made out of PETG or other polymers are the invisible orthodontic aligners such as Clear Aligner, Invisalign, etc. These systems provide a digital set-up of the clinical cases. In order to reduce the costs, in-office set-ups can be made for some of the patients with mild malocclusions [8,9]. Based on those set-ups, a series of aligners can be manufactured in the dental office, with the use of a Ministar device, and delivered to the patient in a very short period of time. This is an effective way to increase patient collaboration and reduce the costs of the orthodontic treatment (especially when it comes to mild malpositions).

The last case is an example of in-office manufactured aligners from PETG foils. The female patient had a small crowding in her upper anterior segment. An active appliance was made from polyethylene (Scheu Dental foils) that included a Clear Aligner expansion screw (fig. 3, 4) in order to achieve space for the dental alignment. (fig. 5) Several aligners to correct the incisors' position where then manufactured. This clinical case is still in progress.

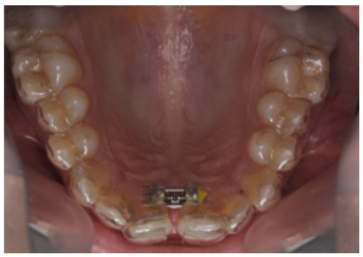

Fig. 3. The expansion splint (polyethylene aligner and Clear Aligner expansion screw)

Fig. 4. A midline diastema was obtained

Fig.5. The first aligner used for the correction of the incisors (after enough space was achieved)

Results and discussions

Polyethylene is a hard type polymer with very good mechanical properties and provides strength and rigidity to the orthodontic appliances [10]. It behaves well intra-orally because the water absorption is quite low compared to other polymers used in dentistry. The PETG foils are translucent, therefore they provide an esthetic treatment alternative to braces. Dimensional stability is the most important feature of the polyethylene because the orthodontic forces must remain stable in order to assure an active and reliable appliance. The elasticity of the material is responsible for the gradual dental movements [6,11]. Furthermore, polyethylene is a non-mutagenic and non- allergenic material.

Conclusions

The orthodontic appliances made out of polyethylene require patient cooperation because they must be worn 20-22 h/day in order to be effective. If worn properly, good treatment outcomes are expected. These devices are confortable, esthetic, provide a good oral hygiene and they are harmless to the periodontal tissues. Some studies show that orthodontic appliances made from a combination of polyethylene and PVC (poly vinyl chloride) could offer a faster treatment result or reduce the recommended wear time from 20 h/day to 14 h/day.[8] More studies are required in this field to assure an optimal appliance for the orthodontic patients.

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