KNOWLEDGE ABOUT DIFFERENT ALIGNERS SYSTEMS AMONGST PRACTICING ORTHODONTISTS -ORIGINAL RESEARCH

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ABSTRACT

Aim: The purpose of the present study was to assess the knowledge amongst practising orthodontists about various aligner systems being used in treatment.

Methodology: Two groups of patients (20 participants in total) were selected and were respectively treated with Nuvola® aligner and Fantasmino® system. The two groups were compared by patient's satisfaction, improvement of the irregularity index.

Results: The goal of treatment has been achieved with the two systems. The average index value was 5.08 mm for group A and 4.97 mm for group B. Following alignment, both systems have shown a reduction of the average index value of 0.69 mm for group A and 0.64 mm for group B.

Conclusion: The two types of aligners have shown differences during the treatment. Fantasmino® system has elastic properties of high performance, but its size does not encourage compliance throughout the day. Nuvola® system determines good tooth movement and its size facilitates the patient's collaboration. In both aligner systems, difficulties were found in the correction of torque information and rotations.

Keywords Clear aligners; Invisible appliances, Malocclusion.

INTRODUCTION

Orthodontic treatment has long been synonymous to a mouth full of "unattractive" wires. The stigma extended beyond outer appearance, with people perceiving those with metal braces to have a lower intellect.[1]Introduction of clear aligners thus came as a respite to the orthodontic patient, for their esthetic superiority made them more attractive to metal and ceramic brackets.[2]These are the active clear plastic trays fitting snugly onto the teeth, each worn for 2 weeks on an average, and changed sequentially to accomplish the incorporated tooth movements. From being used for mild malocclusion cases at the outset to treating vast variety of cases contemporarily, from minimal crowding to bicuspid extractions, clear aligners have come a long way and still continue to evolve. Clear aligner materials have evolved from a single layered or monophasic plastic to the 2nd generation polyurethane material, to the currently used 3rd generation multilayered polyurethane-like material that comprises of hard and soft layers. While the soft layer imparts the property of elastic deformation allowing smooth seating of the aligner, the hard layer ensures strength and durability.[3]Polyethylene terephthalate glycol modified (PET-G) remains the commonly used material. Other materials include polypropylene, polycarbonate, thermoplastic polyurethanes, and ethylene vinyl acetate.[4] Tooth movement obtained most accurately with clear aligners is retrusion, followed by rotation, fan-type expansion, and protrusion, respectively.[5]Acceptable results can be achieved for the buccolingual inclination of maxillary and mandibular incisors in mild-to-moderate malocclusions.[6]Clear aligner therapy (CAT) is recommended in non-extraction cases with mild-to-moderate malocclusions in non-growing patients.[7] The treatment with CA is usually performed in combination with other orthodontic auxiliaries and procedures such as attachments, interarch elastics, and interproximal reduction.[8] However, there are some significant limitations in treating complex malocclusions, i.e., the limited root-

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movement control, the intermaxillary discrepancy correction, the anterior extrusion, and rotation movement.[9-11] Moreover, the reliance on patient compliance has been also reported as an important variable for the CA treatment outcome.[12,13] The clinicians who want to use CA to treat their patients have to rely on their own clinical experience, expert opinions, and limited published evidence-based results.[14-18] CA can be provided by both orthodontists and general dentists; however, some significant differences were evinced between the two groups in the use of a CA treatment in their clinical practice.[18] Several differences in treatment plan and management, as well as training and expertise between orthodontists and general dentists performing Invisalign® treatments, were also found in a recent survey.[19] To date, no information on the differences between orthodontists and general dentists' experience with CA, case selection, type of clinical practice, and patients were provided.

AIM OF THE PRESENT STUDY

The purpose of the present study was to assess the knowledge amongst practising orthodontists about various aligner systems being used in treatment.

METHODOLOGY

Twenty patients responding to the inclusion criteria were selected. The sample was composed of 12 females and 8 males, ranging in age from 16 to 45 years (mean 31.7 ± 8.7 years).

The study group was selected according to the following inclusion criteria:

– Class I, II, and III malocclusions

– Mild and moderate dental crowding (assessed through the Little Irregularity Index, with an average value of 5.07 mm)

– Pre-prosthetic orthodontic treatment

– No need for extractions

– No need for orthognatic surgery

The participants were divided into two groups: group A (seven females, three males) was treated with the Fantasmino® system, and group B (five females, five males) was treated with the Nuvola® system. For both systems, the number of aligners utilized ranged from 8 to 14 (mean number 10.8), and the mean treatment time was 5.8 months (about 15 days for each aligner). The two groups were compared by patient's satisfaction, improvement of the irregularity index (Little's Irregularity Index is defined as the summed displacement of adjacent anatomical contact point of the six mandibular anterior teeth), speech impairment, and mean wear time. Patients were asked to wear the appliances for a different time according to the used aligner system: 14 h per day for group A and 22 h per day for group B.

RESULTS

The two systems showed no difference in patient's satisfaction, improvement of the irregularity index, speech impairment, and mean wear time. Patients from both groups referred a high level of satisfaction at the end of treatment. Dental alignment and arch coordination at the end of treatment were comparable to the predicted result during the planning phase with both system softwares. At the beginning of treatment, the average index value was 5.08 mm for group A and 4.97 mm for group B. Following alignment, both systems have shown a reduction of the average index value of 0.69 mm for group A and 0.64 mm for group B. (Table 1 & 2)Group A patients showed difficulties pronouncing certain phonemes (t\d\s\z\ts\dz\l\r), which decreased during treatment. Group B did not show this kind of impairment. All patients selected showed good compliance. Patients of group A expressed appreciation for the reduced wear time and the possibility to choose when to wear the aligners.

Table 1- Little's irregularity index values pre- and post-treatment for patients treated with Fantasmino® system (group A)

Patients usingFantasmino®	Pre-treatmentvalues(mm)	Post-treatmentvalues(mm)
1	3.65	0.30
2	5.60	0.90
3	4.00	0.50
4	5.91	0.90
5	3.20	0.30
6	5.73	0.80
7	6.51	1.00
8	3.40	0.40
9	6.00	0.80
10	6.86	1.00
Mean values	5.08 ± 1.37	0.69 ± 0.28

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Table 2- Little's irregularity index values pre- and post-treatment for patients treated with Nuvola® system (group B)

Patients usingNuvola®	Pre-treatmentvalues(mm)	Post-treatmentvalues(mm)
1	3.20	0.30
2	5.64	0.50
3	6.30	0.90
4	3.70	0.40
5	3.50	0.40
6	6.40	0.90
7	6.70	1.00
8	5.20	0.80
9	4.10	0.50
10	3.48	0.60
Mean values	4.97 ± 1.37	0.63 ± 0.26

DISCUSSION

Clear aligner treatment has flourished since its introduction into orthodontics. Continued developments on the technological front are being adapted to improve its efficiency, especially in complex cases. Being a removable appliance, patient compliance is the foremost criteria for success of treatment with aligners and patient motivation is indispensable to avail the planned treatment outcomes. The two systems used in the present study are aligners made of different polymers.[20-22]Fantasmino® aligners are made of poly-vinyl chloride(PVC), a material with elastic characteristics followinga plastic deformation when exposed to moderate loads.This characteristic allows reducing the optimal wear timeto 14 h per day: the deformations subdued by the alignerwhen worn generate a force that is transferred to theteeth. The thickness of the PVC aligners varies with thedesired type of tooth movement but never exceeds 1 mm.Nuvola® aligners are made of polyethylene terephthalateglycol (PETG), a light, resistant, and very clear material.It is resistant to time and wear, and its elasticityallows for a gradual tooth movement. PETG aligners have a thickness that changes throughout the differenttreatment phases: 0.75 mm at the beginning of treatment,0.85 mm during the intermediate phase, and 1 mm at theend of treatment. This system requires an optimal weartime of 22 h.Both systems can take advantage of auxiliaries to facilitatedental movement, such as composite attachments[23] bonded to the buccal or lingual tooth surfaces. Attachmentscan have different shapes and sizes, dependingof the kind of tooth movement required. It is possible touse an etching jig, with holes corresponding to the desiredposition of the attachments, in order to avoid undesireddemineralization of an excessive portion of tooth enamel.The Fantasmino® system allows the use springs inBeta Titanium or Australian wire, to enhance rotation and tipping oruprighting of teeth, hooks or vestibular archwires. Laser scanners (structured light scanners) are used by both systems to acquire images of the plaster casts. Nuvola® system uses a dedicated software, NUVOLA CAD 3D (a CAD plug-in from Rhinoceros, Robert McNeel& Associates, Rome, Italy), while Fantasmino® system uses a software CAD created by OrtolabPompei (Pompei Napoli, Italy). The images acquired need to be converted into STL format, a file format used in CAD stereolithography. The STL format represents a solid (in this case the patient's plaster casts) through a mesh of triangles in a 3D environment. This conversion is necessary to rapid prototyping [24], which is an additional technique where a resinous material is apposed layer by layer. Starting from the images of the patient's dental casts, processed as explained above, the desired orthodontic movements are planned and divided into subsequent phases. For each phase, a model of the virtual set-up is printed through rapid prototyping. These models are used to create a series of dental aligners, thanks to a thermoforming process. To obtain a good dental alignment and arch coordination, it is mandatory to make a correct diagnosis and to choose treatment objective achievable with the limited biomechanics offered by clear aligners. Another key factor is to investigate the patient's expectations and social and professional needs in order to choose the most appropriate appliance.

CONCLUSION

Although all clear aligner systems have shown to have evident biomechanical limits, barely producing bodily movement and expressing torque, both clear aligner systems in this study showed good treatment efficiency.

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