Introduction

The orthocaps Hybrid Aligner Therapy (HAT) is a treatment option that broadens the indications of aligner treatments. This technique makes aesthetic treatment possible for almost all malocclusions, without the need for complex labial or lingual systems. It also helps to reduce the number of treatment steps and treatment duration as a whole. Complicated tooth movements can therefore be carried out more effectively and quickly.

In 1950, Elsasser published an article on the use of the Kesling positioner: “H. D. Kesling developed the concept of an appliance capable of moving teeth without brackets, bands or wires... This was the beginning of a new treatment concept using tooth positioners.”

More and more patients today, want invisible orthodontic treatments instead of conventional fixed braces, yet still expect equivalent results. This increased demand for modern aligners or lingual appliances that we see today, was predicted by Kesling over 70 years ago and was also one of the motivations in developing his appliance.

Limitations of lingual appliances

The advent of modern lingual appliances, first introduced in 1967 by Kinja Fujita and developed further in the 1970s in the US, is the result of an ever-increasing demand for aesthetic alternatives in clinical orthodontics. The disadvantages of lingual appliances compared with conventional labial multi-band/multi-bracket appliances are high labour costs, reduced inter-bracket distance, difficult access during wire changes, speech problems, tongue irritation, complicated handling of the appliance and irregularities of lingual tooth surfaces.

Limitations of aligner-based systems

The main limitation of aligner-based systems, is the fact that they involve a removable appliance which cannot work unless worn by the patient as prescribed. A prerequisite therefore, is maximum patient cooperation. Another limitation is the difficulty of achieving targeted and constant orthodontic forces throughout the treatment. Attachments are therefore essential to transmit the right forces to correct malpositions.

Studies on treatment efficacy with aligners

Clinical studies to date, have mainly focused on one aligner system, which has dominated the market since 1999 namely, Invisalign. There are, however, no independent studies on the efficacy of other comparable aligner systems, such as orthocaps, ClearCorrect and eCligner. Differences in the treatment results between the systems mentioned should be expected, since there are differences in the respective concepts, workflows and materials used. Apart from that, the known general limitations of all removable thermoplastic appliances apply. A few studies that point to these limitations are discussed in this article.

Djeu et al. demonstrated that Invisalign did not perform as well as fixed appliances in a comparison group with malocclusions. The Invisalign group lost 13 objective grading system points compared with the fixed appliance group. The success rate with Invisalign was 27% lower than the success rate with fixed appliances. The aligner system was shown to have advantages in the closure of small gaps and anterior tooth rotations.

According to Phan and Ling, the Invisalign appliance can be used with limitations in patients with simple malocclusions. Furthermore, it was demonstrated that results are more difficult to achieve in comparison with fixed appliances. It was also mentioned that a combination of this aligner with fixed appliances could shorten treatment duration and improve results.

Kravitz et al. showed that the mean accuracy of tooth movements was 47.1% with Invisalign. The least accurate movement was extrusion of the maxillary central incisors (18.3%) and the mandibular central incisors (24.5%). Accuracy decreased significantly with rotations of more than 15°.

According to Simon et al., the mean success of tooth movement with Invisalign was 59%. The mean accuracy of incisor torque was 42%. Premolar de-rotation showed the lowest accuracy, of approximately 40%. Distalisation of the maxillary molars was achieved in 87% of cases. The extent of the planned movements and the staging had a significant influence on the treatment result.

In a review of 271 publications between April 2005 and December 2012, ten studies were selected for inclusion...
Orthodontists have been combining multi-band appliances with aligners for quite some time, in order to compensate for certain limitations that are to be expected with aligner treatment alone. The new concept of HAT is based on the idea that part of the movements planned in aligner treatment, can be carried out with fixed partial appliances to achieve aesthetic, effective treatment. This method therefore allows for concomitant use of two conceptually and mechanically different appliances, through which an effective treatment can lead to better clinical results. The exact times, modalities and use of the common lingual fixed auxiliaries can be determined in the treatment plan. Aligners can only be used successfully for severe, protracted or complicated movements in combination with auxiliaries. A large part of the movement is achieved with the aligners, while auxiliaries are used as needed, primarily as support. Auxiliaries can be used during three different treatment phases.

1. Pre-aligner treatment auxiliaries

Certain distalisation, expansion and constriction appliances can be used as part of a comprehensive treatment plan before the initial use of aligners. Examples include such appliances as the Beneslider, Wilson lingual arch, quadhelix, hyrax expander and trans-palatal arch.

2. Intra-aligner treatment auxiliaries

The most important part of the HAT is the integration of auxiliaries with concomitant use of aligners. A significant portion of these auxiliaries is composed of lingual partial appliances, which are indirectly bonded to the lingual tooth surfaces. These modules are composed of lingual brackets and wires, on which the aligner can be placed in a custom-fit way. The movement of teeth is controlled by the interaction between the aligner and the fixed modules. Teeth that serve as anchorage units, are fixed by the aligner placed on top of them, while teeth that must be shifted are moved by the special cavities or movement channels with in the aligner in a targeted manner. Figure 1a shows the starting position of the teeth prior to aligner treatment, and Figure 1b shows the situation prior to placement of the auxiliaries in order to accelerate the treatment process and de-rotate the canines. Figures 1c to h present the further treatment process up to the end result.

Virtual brackets and wires were part of the treatment plan according to our concept. The sequential movement that should be achieved by the aligner and the planned movement induced by the fixed partial appliances are synchronised using computer technology. The extent and the distance of the movement of the auxiliaries can be mapped and simulated using 3-D tracking. This technique can be reviewed in detail in the relevant patent specification (process for the production of an orthodontic set-up, WO 2014135599). Tooth movements can also be made possible by creating suitable movement channels within the aligner using special computer processes.

Creating fixed auxiliaries

Virtual modules (brackets and wires) are placed on a virtual set-up model (Fig. 2a). The teeth with the fixed attachments are then returned to the original position (Fig. 2b). The data gained in this way forms the basis of the real models, which are necessary for the fabrication of the transfer tray. The auxiliaries are fixed to the teeth using the transfer tray. Special brackets (i-TTR, Rocky Mountain Orthodontics) with rounded contours and without undercuts allow for easy handling in combination with aligners (Figs. 3a–d).

With the i-TTR bracket, up to three archwires can be used. The central slot can receive a $0.016 \times 0.022$ in. archwire (ribbon-wise), while two rounded archwires (maximum of 0.016 in.), one gingival and one incisal, can be pulled under the wings. The possibility of using archwires on three different vertical levels significantly broadens the spectrum of use. Heat-activated nickel-titanium archwires are ideal for this purpose. Once the teeth have been partially straightened, another archwire can be used in another slot in order to sustain the movement. This makes a change to a stronger archwire unnecessary.

Pre-activated and pre-loaded auxiliaries for faster and easier use are already being developed by the Ortho Caps company. With this variant, it would no longer be necessary to ligate the archwires after attaching the brackets, as these pre-loaded archwires together with the brackets would be provided via the transfer tray as a single unit for indirect bonding.

3. Post-aligner treatment auxiliaries

Using aligners for the orthodontic closure of gaps in extraction cases is a great challenge, since the adjacent teeth may tip into the extraction space. Once the space closure has been completed with aligners, special auxiliaries help to upright the roots. Another special auxiliary for anterior tooth torque after aligner treatment is currently in the trial stage at Ortho Caps.
orthocaps BiteMaintainer for finishing and retention

The treatment concept discussed, which entails the combination of different techniques and appliances, can also be used for the finishing and retention phase. Use of a bite maintainer may also be advantageous in special cases, for example for functional occlusal balancing, occlusal interferences and undesirable lateral malocclusion caused by aligner treatment.

The orthocaps BiteMaintainer is a type of positioning device made from dental silicone. For cases treated with the orthocaps system, only a lateral cephalometric radiograph, along with centric bite registration, is needed. The design for the BiteMaintainer is modelled in a CAD software after the localisation of the mandibular hinge axis (Fig. 4). This method not only saves time for the orthodontist, but also allows for an exact reconstruction compared with former methods. The BiteMaintainer can be used as a retention device and a finishing device.

Discussion

As the history of orthodontics shows, most of the techniques and appliances used today, including the aligner, are not new concepts or even inventions. We also know as orthodontists, that every technique and every appliance has its advantages and disadvantages. In order to offer our patients the best possible treatment that delivers a guaranteed good long-term result that is both aesthetically and clinically acceptable, we must make the most of all techniques and appliances. The orthocaps HAT uses modern technologies that integrate various treatment processes and methods in order to
provide improved, simpler solutions for the planning and execution of treatment.

The methods discussed here broaden the indication for the orthocaps aligner system and avoid some of the inherent limitations that all aligner systems share. With the use of the orthocaps HAT, the number of treatment steps and the treatment duration are reduced. HAT also allows for invisible aligner treatment and demonstrates efficacy and shorter treatment time in complex cases. The results achieved with this method are comparable to those of conventional lingual or labial appliances.

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