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CLEAR ALIGNERS- A REVIEW ARTICLE

Orthodontology

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ABSTRACT

clear aligners are rapidly growing sector of orthodontic treatment. Increased esthetic perception and increased demand for orthodontic care from adults have contributed to demand for a more esthetic technique for orthodontic treatment. For diagnosis, therapeutic preparation, and designing the final occlusal result, clear aligners use digital technology. Clear aligners allow the biomechanics to be optimized by staging tooth movements in a particular sequence in the software program. The rate of tooth movement can also be modified according to the bone physiology of the individual by adjusting the scheduled number of days for aligner adjustments, depending on the individual's bone physiology.

KEYWORDS

Clear aligners, digital technology

INTRODUCTION

Clear aligner technology represents a revolutionary, transformational change in orthodontics that challenges the conventional thinking of how orthodontists move teeth. In 1999 Align technology released Invisalign system and it was the first orthodontic appliance to use computer- aided design (CAD) and computer-aided manufacturing (CAM).[1]

A modern, progressive shift in orthodontics that questions the traditional thinking about how orthodontists change the position of the teeth is defined by clear aligner technology. In 1999, Align technology launched the Invisalign system which was the first computer-aided design (CAD) and computer-aided manufacturing (CAM) orthodontic device to be used.[1]

Dr. H. D. Kesling first proposed a transparent, vacuum-formed tooth-positioning system for slight tooth movement, dating back to 1945. Two options were given to patients in the late 1990s to avoid post-orthodontic treatment relapse, retreat or use a new version of transparent plastic to prevent post- orthodontic treatment relapse, known as Essex retainer. The older version of the active Essex retainer[2] (Fig. 1,2), also known as the Barrer retainer because it was first introduced in 1975 by H.G H.G Barrer, was the spring aligner or spring retainer.

Figure 1: Set up of model stone for fabrication of spring aligners.

Figure 2: Spring retainer/aligner

Aligners of First-Generation

To achieve their performance, the aligner systems were solely dependent on the aligner and no auxiliary elements were integrated.

Aligners of the Second-generation

As aligner systems grew, the use of attachments began to be advocated by producers to enhance tooth movement. This was accomplished when composite buttons were mounted on the teeth.

Aligners for the Third Generation

The software of the manufacturer automatically places attachments where extrusions, derotations and root movements are required. There are three types of attachments that are common: ellipsoid, rectangular and beveled. When derotations and root movements are attempted, ellipsoid attachments (Fig. 3) are used. To extrude a tooth, bevelled attachments (Fig. 4) are used. Where broad mesio-distal motions are needed, rectangular attachments (Fig. 5) are used.[3].

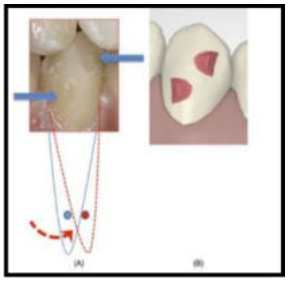

Figure 3: Ellipsoid precision attachments.

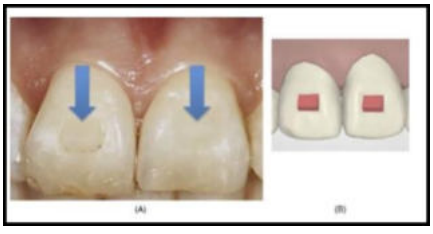

Figure 4: Bevelled precision attachments.

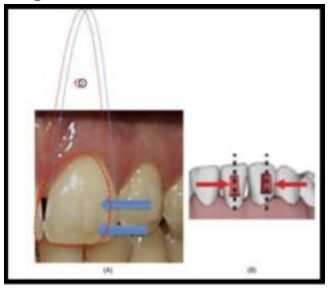

Figure 5: Rectangular precision attachments.

Comparison of edgewise and clear aligners

For the clear aligner technique, the orthodontic concepts of force

application, engagement, anchorage, and biomechanics were to be applied. Clear aligners, however, move teeth differently than fixed devices do. When determining whether to handle a case with fixed appliances or clear aligners, sound awareness of the similarities and discrepancies between fixed appliances and clear aligners (Table.1) is important for the clinician.[4,5]

	Fixed appliances	*Clear aligners*
Force	Exerts pulling type of force on teeth	Exerts pushing type of force on teeth
Engagement	Archwire in bracket: The thicker the wire, the greater the engagement	Plastic around the mouth: The more plastic wrapped around the teeth, the greater the engagement
Anchorage	Reciprocal anchorage: the third law of Newton	It is possible to predetermine anchorage segments
Extrusion	Single tooth only	Anterior segment
Intrusion	Relative intrusion Only	Complete segment or selective intrusion
Torque	Torque of labial and lingual Root	Torque of lingual root via power ridges
Root inclinations	Regulation of root inclinations by positioning of brackets and bending of archwires	Regulation of root inclinations by means of optimized attachments and digital gable bends
Incisor inclination	On alignment, incisors tend to procline	Exceptional control of incisor inclination
Vertical control	With incisor proclination and alignment, overbite and overjet reduces	Exceptional vertical control in cases of minimal overbite and overjet
Midline correction	Dependent on use of elastic wear	Predictable

Unique features of clear aligners

1. Using a type of plastic with a piezoelectric property, clear aligners were fabricated, which, if proven for new plastic materials, it can be used for quicker tooth movement and less orthodontically induced root resorption.
2. In patients who are not compliant, particularly with after completion oforthodontic care, retainers wear, if relapse occurs, new aligners are less often needed by the patient.[18] The occlusal coverage disengages the occlusion in deep bite cases that allows free movement of teeth. When central occlusion and centric relationships do not coincide, it may also serve as a jaw positioning splint.
3. Clear aligners act as a posterior bite plate/block in open bite cases, which can help to regulate the vertical dimension, especially when combined with the anterior vertical pull chin cup.
4. Clear aligners are more hygienic and, compared to either buccal or lingual fixed orthodontic appliances, less gingival or periodontal complications are encountered with clear aligners.

Selection of case for simple aligner therapy

1. Class I with mild to moderate spacing/crowding.
2. Half- class II cusp with mild crowding
3. Class III with minor cases of overbite/overjet
4. Deep bite, open bite in anterior region.
5. Extraction of lower incisor and premolars

Examination of Clincheck Strategy

When the clinician assesses the orthodontic records, makes a malocclusion diagnosis, and formulates a treatment plan, the ClinCheck software plan is developed. The clinician checks the software plan for ClinCheck, makes adjustments to the plan, and then approves the final plan.[6] The aligners are produced upon approval. The clinician then needs to implement the plan clinically to handle the case to the expected final occlusion.

Ten steps in the analysis of ClinCheck's plan:

1) Investigate the original occlusion.
2) Review the tab for Comments.
3) Review the number of treatment steps.
4) The animation and staging tabs are reviewed.
5) Determine the final occlusion.
6) Evaluate the tool for superimposition.
7) Evaluate the Assessment of Tooth Movement.
8) Evaluate the prototype of the attachment.
9) Interproximal reduction evaluation.
10) Evaluate the design of precision cuts.

Digital workflow and treatment follow-up

1) New patient consultation
2) Records, diagnosis, and treatment planning
3) Evaluation and approval of ClinCheck plan
4) Insertion of aligners
5) Clear aligner appointments for adjustment
6) Additional records of alignments and digital scans
7) Insertion of supplementary aligners
8) Clear aligner appointments for adjustment
9) Records for Posttreatment
10) Retention

Aligner adjustment appointment checklist includes:

1) Compliance of patients
2) Oral health
3) Tracking tooth[9]
4) Interdental Contacts
5) Necessary acts for this appointment
6) Next Aligner Fit
7) Appointment
8) Completion

Anterior open bite correction

Anterior openbite correction is one of the most challenging situations facing orthodontists today, as the vertical incompetence of the arches does not allow proper correction between the antagonistic teeth due to poor dental and skeletal position.[7,8]

There are various treatment options that include maxillofacial surgery to correct skeletal open bite (maxillary and mandibular planes are divergent with increased vertical facial height and inclined bispinal plane), open bite malocclusion due to overextrusion of posterior may be fixed by intrusion of posterior segments or extrusion of anterior dental sectors alone Align Technology's proposed G4 advancement included multi-tooth anterior extrusive attachments (Fig. 6) for anterior open bite correction.[9] This innovation, along with the possibility of intrusive mechanics for posterior molars, specifically aligns the orthodontic system of choice for the correction of anterior open bite malocclusions.

Figure. 6: Optimized anterior extrusive attachments.

Anterior deep bite correction

Deep bite correction with clear aligners for orthodontists is biomechanically difficult. There are many contributing factors, including, but not limited to: non-compliance with patients, inefficient or inappropriate virtual case configuration, and loss of anchorage due to poor retention of aligners.[10] While aligners have several benefits compared to fixed appliances, aligners also have few disadvantages

Their biomechanical drawbacks and difficulties also need to be considered for deep-bite malocclusions, such as occlusal safety and avoidance of broken brackets.[11] Some developments include deep bite correction with direct aligner treatment: pressure zones, optimized deep bite attachments, and precision bite ramps (Fig. 7).

Figure. 7: Precision bite ramps

The extruding mandibular teeth should be positioned on the reverse curve of the spee mechanics in lower arch attachments.[12] For teeth undergoing intrusion, attachments are often unnecessary, with the exception of the mandibular canines if intrusion of more than 1 mm mandibular incisor is needed. For the mandibular canines, horizontal beveled attachments are preferred.

Class II elastics and bite ramps provide supporting auxillaries for deep bite correction. Elastics aid in mandibular molar extrusion and proclination of mandibular incisors; they can also be used by Class I patients as well. Intruding the mandibular anterior teeth and disarticulating the posterior teeth to allow their extrusion can be used with bite ramps.[13] On the lingual surfaces of the four maxillary incisors, bite ramps should be positioned. In the case of maxillary anterior intrusion, as in the case of malocclusion in Class II

Division 2, the bite ramps should instead be positioned on the canines. This is because the pressure directed along the long-axes of the maxillary incisors requiring intrusion is minimized by bite ramps. Bite ramps allow less plastic to be in contact with the cingula of the incisors, which decreases the available surface area for the desired vectors of intrusion force.

Class II malocclusion therapy using clear aligners

Precision cuts, power ridges and optimized root control attachments are innovations for Class II anteroposterior (AP) correction (Fig. 8).

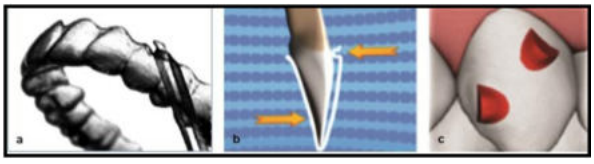

Figure 8: (a) Precision cuts (b) Power ridges (c) Optimized root control attachments.

Precision-cut hooks in the maxillary arch :

The intraoral elastic exerts a distal force when precision-cut hooks are placed on either the canines or first premolars in the maxillary arch, as the elastic is hooked directly to the aligner, on the entire arch. In cases where sequential distalization has been configured for Class II correction, same concept is also effective in reinforcing anchorage, using the mandibular arch to reinforce anchorage for maxillary molar distalization.

Precision-cut hooks in the mandibular arch:

Precision-cut hooks are required for Class II elastic wear on the mandibular first molars.

Button cutouts in the maxillary arch:

In Class II, Division 2 Malocclusions the retroclined maxillary incisors would need to be proclined for correction of incisor inclination, deep bite, and incisor alignment. In this situation, a distal force on the entire aligner may not be ideal because as they procline, the maxillary incisors need the freedom to travel labially. Via a precision cut hook, it may be inappropriate to hook an elastic directly to the aligner, so button cutouts can be required on the maxillary canines to separate the elastic force from the aligner.

For buccally erupted canines that may need extrusion for alignment button cutouts often work well. Alternatively, in Class II, division 2 situations, to distance the elastic force from the maxillary incisor tooth movement, the precision-cut hook can be positioned more distally, for example on the first premolars.

Class III Malocclusion Treatment using Clear Aligners:

For Class III anteroposterior (AP) correction the precision cuts, power ridges, and optimized root control attachments are same as those for Class II treatment.

Power ridges:

power ridges can be positioned on the mandibular incisors in Class III malocclusions to correct the inclination of the mandibular incisor. Alternatively, in an attempt at dental compensation, the mandibular incisors can retroclined.

Precision cuts:

Precision cuts may be requested as precision- cut hooks or button cutouts. Generally, precision-cut hooks can be positioned on both the maxillary molars and the mandibular canines for correction of Class III malocclusion with differential movement of the maxillary and mandibular dental arches.

Optimized root control attachments:

When distalizing mandibular premolars and canines to correct a Class III malocclusion, optimized root control attachments allow for translation of teeth.

Class III elastic simulation jump:

Class III elastics would be expected to be worn full time if a simulation jump is requested on the prescription form. As treatment advances, the patient can start with a 1⁄4-inch, 2-oz (light) elastic, working up to a 1⁄4-inch, 4.5-oz (medium) elastic.

Surgical orthodontic treatment using clear aligners

The treatment period for surgical orthodontic cases with clear aligners is possible and much quicker than for those with standard fixed orthodontic braces.[14,15]

The system of clear aligners is more appropriate for patients, especially adults. With clear aligners, recovery after surgery is much quicker compared to those with standard fixed orthodontic braces.

CONCLUSION

As a custom-designed orthodontic appliance, made to adapt to individual tooth morphology and anatomy, the ideal orthodontic appliance could be conceived. On the basis of tooth morphology and root surface area, it will be customized to move each individual tooth with exactly the amount of force needed to move it. The final occlusal outcome will be customized according to the dental arch shape of the individual, smile esthetics, and support for the soft tissue lip. For each individual, the tip, torque, in-and- outs, and occlusal contacts could be designed specifically. This ideal appliance would be cosmetic, hygienic, and comfortable and would correct the malocclusion in the shortest possible time period.

REFERENCES:

1) Ghafari JG. Centennial inventory: The changing face of orthodontics. Am J Orthod Dentofacial Orthop 2015; 148(5):732–739.
2) Sheridan JJ, LeDoux W, McMinn R. Essix retainers: fabrication and supervision for permanent retention. J Clin Orthod 1993:27(1):37-45.
3) Boyd R, Miller RJ, Vlaskalic V. The Invisalign system in adult orthodontics: mild crowding ans space closure cases. J Clin Orthod 2000;34(4): 13-5.
4) M, Keilig L, Schwarze J, Jung BA, Bourauel C. Forces and moments generated by removable thermoplastic aligners: Incisor torque, premolar derotation, and molar distalization. Am J Orthod Dentofacial Orthop 2014;145(3):728–736.
5) Boyd RL, Vlaskalic V. Three- dimensional diagnosis and orthodontic treatment of complex malocclusion with the Invisalign appliance. Semin Orthod 2001; 7(4): 274-93.
6) Boyd RL. Complex Orthodontic Treatment Using a New Protocol for theInvisalign Appliance. JCO 2007; 25(2): 525-47.
7) Kau CH, Feinberg KB, Christou T. Effectiveness of clear aligners in treating patients with anterior open bite: A retrospective analysis. J Clin Orthod 2017;51(3):454–460.
8) Schupp W, Haubrich J, Neumann I. Treatment of anterior open bite with the Invisalign system. J Clin Orthod 2010;44(4):501–507.
9) Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. Am J Orthod Dentofacial Orthop 2016;149(6):269– 276.
10) Giancotti A, Mampieri G, Greco M. Correction of deep bite in adults using the Invisalign system. J Clin Orthod 2008;42(5):719–726.
11) Khosravi R, Cohanim B, Hujoel P, et al. Management of overbite with the Invisalign appliance. Am J Orthod Dentofacial Orthop 2017;151(6):691–699.
12) Rozzi M, Mucedero M, Pezzuto C, Cozza P. Leveling the curve of Spee with continuous archwire appliances in different vertical skeletal patterns: A retrospective study. Am J Orthod Dentofacial Orthop 2017;151(4):758– 766.
13) Sifakakis I, Pandis N, Makou M, Eliades T, Bourauel C. A comparative assessment of the forces and moments generated with various maxillary incisor intrusion biomechanics. Eur J Orthod 2010;32(2):159–164.
14) Boyd RL. Surgical-orthodontic treatment of two skeletal Class III patients with Invisalign and fixed appliances. J Clin Orthod 2005;39(3):245– 258.
15) Womack WR, Day RH. Surgical- orthodontic treatment using the Invisalign system. J Clin Orthod 2008;42(3):237– 245.