Aligner Based Orthodontic Treatment – An Overview

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ABSTRACT
The growing number of adult orthodontic patients has increased the demand for aesthetic and comfortable alternatives to traditional braces. An orthodontic approach that gradually moves teeth from their starting position to their finished position using a succession of transparent plastic removable equipment called aligners. The possibility of utilising clear orthodontic appliances was discovered when Kesling pioneered the idea of gradually realigning misaligned teeth to better positions by using a series of thermoplastic tooth positioners in 1946. Aligner-based orthodontic treatment uses multiple sequential aligners or trays to move the teeth step by step, each repositioning the teeth in small increments. Based on the wide range of mechanisms described above, aligners have been used to treat a variety of malocclusions. In current years, the growth of grown up sufferers present process orthodontic remedies has caused the significant clean aligner therapy , taken into consideration a legitimate opportunity to standard constant home equipment for its aesthetic functions and comfort.

KEYWORDS: - Aligners, orthodontic appliances, orthodontic treatment, malocclusion, clear aligner therapy.

INTRODUCTION

The growing number of adult orthodontic patients has increased the demand for aesthetic and comfortable alternatives to traditional braces.[1-4] Clear aligners provide an aesthetically pleasing treatment experience, promote oral hygiene, reduce pain compared to fixed orthodontic appliances, reduce the number and duration of appointments, and reduce emergency visits. [5-6] Clear detachable aligners have visible developing reputation as a classy and snug opportunity to standard constant appliances. Clear aligner remedy additionally seems extra respectful of the patient's periodontal health; in fact, clean aligners permit the sufferers to preserve right day by day oral hygiene way to being detachable.[7] In current years, the growth of grownup sufferers present process orthodontic remedies has caused the significant clean aligner therapy (CAT), taken into consideration a legitimate opportunity to standard constant home equipment for its aesthetic functions and comfort[7]

DEFINITION

An orthodontic technique consisting of a series of clear plastic removable appliances (“aligners”) that gradually move teeth from their original state to their final state after treatment. Align Technology owns the trademark Invisalign®..[8] Clear aligners offer an esthetic and snug remedy experience, facilitate oral hygiene, motive much less ache in comparison to constant orthodontic appliances, lessen the quantity and length of appointments, and require much less emergency visits[9-10]

CLEAR ALIGNERS

Clear aligners were introduced in the United States and were born in the late 1990s by Align Technology© (Santa Clara, California, USA), after which the Invisalign® system was created and later distributed in Italy and other European countries. Countries since 2001 [11]. Manufacturers of orthodontic clear aligners use a variety of materials, including polyurethane and polyvinyl polyethylene terephthalate glycol and chloride (PVC) (PET - G)[12]

HISTORY

In order to make Kesling's idea a workable orthodontic treatment option, Align Technology (Santa Clara, Calif.) developed and presented the clear aligner therapy (CAT) in 1997. This treatment was taken into the lab using Align technology, enabling doctors to outsource it. Align Technology released Invisalign in 1999.[13] The possibility of utilising clear orthodontic appliances was discovered when Kesling pioneered the idea of gradually realigning misaligned teeth to better positions by using a series of thermoplastic tooth positioners in 1946.[14] He made the item out of a substance that was comparable to clear thermoplastic rubber. Based on Kesling's idea of pre-positioning teeth on a master study model, Ponitz (1971) created a "Invisible Retainer." Similar to Kesling's device, the "Invisible Retainer" could only result in minute tooth movements by tipping crowns. Polymethylmethacrylate, or Biocryl, was the chemical used.[15]

TYPES OF CLEAR ALIGNERS

There are four basic types of clear aligners.

- Type 1: Positioners or guides, such as Kesling's tooth positioner, are commonly used.
- Type 2: Thermoformed plastics, like dental spring aligners and Essix retainers.
- Type 3 aligners are constructed from models that have been cut out in the proper location to align teeth over a series of models. They use four or five aligners to slightly shift the teeth.
- Type 4: Digitally created aligners that may correct simple to complex malocclusions, including anterior and posterior segments. Every time the aligner is changed, the teeth move more precisely.

MATERIALS

Clear aligners are available in a variety of thicknesses, ranging from 0.50 mm to 1.5 mm. This may affect their mechanical characteristics and, consequently, their performance, much like the building material did. [16].The colour stability and transparency

of orthodontic clear aligners should be stable during the 2 - week orthodontic treatment period from an aesthetic standpoint. Polyethylene Terephthalate reinforced with glycol is used in three different types of aligner materials (BIOSTAR) Different aligners were made using thermoplastic polyurethanes (TPU) and polyethylene terephthalate (BenQ).

BIOMECHANICS

Aligner-based orthodontic treatment uses multiple sequential aligners or trays to move the teeth step by step, each repositioning the teeth in small increments [17]. This gradual movement is influenced by her two main mechanisms:

SHAPE MOLDING EFFECT

This method has been the primary means of applying force since clear aligner treatment began in the 1940s.[18] This method has been the primary means of applying force since clear aligner treatment began in the 1940s.[19] Between the aligner and the tooth surface there is a contact area and a relief area. A complete treatment consists of a series of sequentially shaped aligners, from the initial anatomical shape to the final tooth position[20]

AUXILLARY ELEMENTS

Auxiliary elements, such as attachments and power ridges, are used to enhance predictability of specific tooth movements[21] Strategic placement of these devices on aligners or teeth can improve power transmission. They are used strategically to transmit forces to specific areas of the tooth surface.[22]

How do aligners treat different malocclusions?

Based on the wide range of mechanisms described above, aligners have been used to treat a variety of malocclusions[23]

1. OPEN BITE -Anterior teeth need to be pushed out, not pressed in. Molars require penetration, not extrusion. The incisors must be tilted back or posteriorly to simulate the open bite of the anterior teeth.[24] Mechanisms and auxiliary elements are similar. Intrusion of the back teeth rotates the mandible forward and counter clockwise, reducing open bite.[25]The pushing force of the aligners is accompanied by pushing force on the back teeth. Harris et al.
2. ALIGNMENT /CROWDING - A single force on the crown creates a tilt. This is probably one of the easiest moves to perform. These movements do not require the force vector to be in a particular relationship with the center of resistance, so less precision is required. Tilt is a by-product of moment of force where the lines of force are away from the center of resistance of the tooth.[26] Aligners use the shape-molding effect for this. In fact, since standard tooth movement is a simple tilt, the general inability of aligners to direct force through the center of resistance is actually an advantage.[27]
3. SPACE CLOSURE - Spatial closure is the interaction between the moment of force produced by the pulling back force and the moment of the couple.[28] The matrimonial moment plays a dominant role in "controlling" tooth movement. Any tooth movement other than uncontrolled tilt takes a little longer. Optimized root control attachments [29]
4. TORQUING OF ROOTS - This type of tooth movement is probably the most forceful in orthodontics. A higher force should be maintained during the exercise. Unfortunately, moving roots with aligners was a tedious task. [30,31,32,33]

Conclusion

With orthodontic treatment using aligner therapy, such as with fixed appliances, root resorption is still a danger. The multiplicity of attachment options even allows us to develop a more exact clinical setup for movement techniques. This is necessary because many of them cannot be superimposed with the systems on which the majority of the scientific experimentation described in the literature is focused due to differences in their fundamental constitutive characteristics, which causes a significant knowledge gap between clinical practise and research.

REFERENCES

1) Weir T. Clear Aligners in Orthodontic Treatment. Aus Dent J. 2017;62:58–62. doi: 10.1111/adj.12480. [PubMed] [CrossRef] [Google Scholar]
2) Karkhanechi M, Chow D, Sipkin J, David S, Boylan R, Norman R, et al. Periodontal Status of adult patients treated with fixed buccal appliances and removable aligners over one year of active Orthodontic Theraphy. Angle Orthod. 2013;83:146–51. doi: 10.2319/031212-217.1. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
3) Melkos AB. Advances in digital technology and orthodontics: a reference to the Invisalign method. Med Sci Monit. 2005;11:39–42. [PubMed] [Google Scholar]
4) Malik OH, McMullin A, Waring DT. Invisible orthodontics part 1: invisalign. Dent Update. 2013;40:203–4. 207–10, 213–5. doi: 10.12968/denu.2013.40.3.203. [PubMed] [CrossRef] [Google Scholar]
5) [Accessed October, 2013]. Available from: hhtp://www.invisalign.com/why-invisalign.
6) Miller KB, McGorray SP, Womack R, Quintero JC, Perelmuter M, Gibson J, et al. A comparison of treatment impacts between Invisalign aligner and fixed appliance therapy during the first week of treatment. Am J Orthod Dentofacial Orthop. 2007;131:302.e1–9. doi: 10.1016/j.ajodo.2006.05.031. [PubMed] [CrossRef] [Google Scholar]
7) Department of Innovative Technologies in Medicine and Dentistry, University “G. D’Annunzio” of Chieti-Pescara, Chieti, Italy
8) IGI global publisher
9) Fujiyama K, Honjo T, Suzuki M, Matsuoka S, Deguchi T. Analysis of pain level in cases treated with Invisalign aligner: comparison with fixed edgewise appliance therapy. Prog Orthod. 2014;15:64. doi: 10.1186/s40510-014-0064-7. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
10) [Accessed October, 2013]. Available from: hhtp://www.invisalign.com/why-invisalign.
11) Kuo E., Miller R.J. Automated custom-manufacturing technology in orthodontics. Am. J. Orthod. Dentofac. Orthop. 2003;123:578–581. doi: 10.1016/S0889-5406(03)00051-9. [PubMed] [CrossRef] [Google Scholar]… Meier B., Wiemer

K.B., Miethke R.R. Invisalign®-patient profiling. Analysis of aprospective survey. J. Orofac. Orthop. 2003;64:352–358. doi: 10.1007/s00056-003-0301-z. [PubMed] [CrossRef] [Google Scholar]
12) Barone S, Paoli A, Paolo NE, et al. Mechanical and Geometrical properties assessment of thermoplastic materials for biomedical application. In: Eynard B, Nigrelli V, Oliveri S, et al. eds. Advances on mechanics, design engineering and manufacturing. Lecture notes inmechanical engineering. Springer Cham 2017: p. 437-46.
13) Bouchez R. Clinical success in Invisalign orthodontic treatment. 1st edn. Quintessence Publishing (IL) 2019.
14) Kesling HD. The philosophy of the tooth positioning appliance. American Journal of Orthodontics and Oral Surgery 1945;31(6):297-304.
15) Ponitz RJ. Invisible retainers. American Journal of Orthodontics 1971;59(3):266-72.
16) Nahoum H. The vacuum formed dental contour appliance. NY State Dent J 1964;9:385-9
17) T. Weir Clear aligners in orthodontic treatment Aust Dent J, 62 (suppl 1) (2017), pp. 58-62
18) J Hennessy, Al-Awadhi EA Clear aligners generations and orthodontic tooth movement J Orthod, 43 (2016), pp. 68-76
19) T. Weir Clear aligners in orthodontic treatment Aust Dent J, 62 (suppl 1) (2017), pp. 58-62 İ Tamer, E Öztaş, G. Marşan Orthodontic treatment with clear aligners and the scientific reality behind their marketing: a literature review Turk J Orthod, 32 (2019)
20) İ Tamer, E Öztaş, G. Marşan Orthodontic treatment with clear aligners and the scientific reality behind their marketing: a literature review Turk J Orthod, 32 (2019), pp. 241-246
21) TT. Wheeler Orthodontic clear aligner treatment Seminars in Orthodontics, Philadelphia Elsevier (2017)
22) M Simon, L Keilig, J Scwarze, BA Jung, C. Bourauel Forces and moments generated by removable thermoplastic aligners: incisor torque, premolar derotation, and molar distalization American Journal of Orthodontics, 145 (2014), pp. 728-736
23) TT. Wheeler Orthodontic clear aligner treatment Seminars in Orthodontics, Philadelphia Elsevier (2017)
24) K Harris, K Ojima, C Dan, M Upadhyay, A Alshehri, CL Kuo, *et al.***Evaluation of open bite closure using clear aligners: a retrospective study** Prog Orthod, 21 (1) (2020), p. 23, 10.1186/s40510-020-00325-5
25) A Giancotti, F Garino, G. Mampieri **Use of clear aligners in open bite cases: an unexpected treatment option** J Orthod, 44 (2017), pp. 114-125
26) BW. Lee The force requirements for tooth movement part I: tipping and bodily movement Aust Orthod J, 13 (1995), pp. 238-248
27) G Rossini, S Parrini, T Castroflorio, A Deregibus, CL. Debernardi Efficacy of clear aligners in controlling orthodontic tooth movement: a systematic review Angle Orthod, 85 (2015), pp. 881-889
28) M Simon, L Keilig, J Scwarze, BA Jung, C. Bourauel Forces and moments generated by removable thermoplastic aligners: incisor torque, premolar derotation, and molar distalization American Journal of Orthodontics, 145 (2014), pp. 728-736
29) T Karras, M Singh, E Karkazis, D Liu, G Nimeri, B. Ahuja Efficacy of Invisalign attachments: a retrospective study Am J Orthod Dentofacial Orthop, 160 (2021), pp. 250-258
30) DK Baldwin, G King, DS Ramsay, G Huang, A-M. Bollen Activation time and material stiffness of sequential removable orthodontic appliances. Part 3: premolar extraction patients Am J Orthod Dentofacial Orthop, 133 (2008), pp. 837-845
31) W Hahn, A Zapf, H Dathe, *et al.* Torquing an upper central incisor with aligners—acting forces and biomechanical principles Eur J Orthod, 32 (2010), pp. 607-613
32) X-J Zhang, L He, H-M Guo, J Tian, Y-X Bai, S. Li Integrated three-dimensional digital assessment of accuracy of anterior tooth movement using clear aligners Korean J Orthod, 45 (2015), pp. 275-281
33) F-F Dai, T-M Xu, G. Shu Comparison of achieved and predicted tooth movement of maxillary first molars and central incisors: first premolar extraction treatment with Invisalign Angle Orthod, 89 (2019), pp. 679-687