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RESEARCH ARTICLE

INVISALIGN – A BRIEF OVERVIEW.

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Abstract

As the frequency of adults seeking orthodontic treatment is increasing in the new era, more is the concern on esthetics. The traditional conventional fixed appliance although provides sufficient tooth movement it lacks esthetics and appeal which has become a major part of concern for patients seeking orthodontic treatment as well as dental health care professionals. Invisalign appliance involves computer-aided-design and computer-aided-manufacturing (CAD-CAM) technology which is made up of thin transparent clear plastic material, combined with laboratory techniques, to fabricate a series of aligners that can move teeth in small increments of about 0.25 to 0.3 mm. This article provides a brief overview about the Invisalign system.

Introduction:-

Esthetics have become a major concern in today's generation. From younger patients to the older patients all have started to reject the conventional fixed appliance treatment and are looking for more esthetic treatment options. Some of these treatment option includes ceramic brackets, Essix retainers, Lingual orthodontics and the most popular among the people and dental health professionals is the Invisalign system .

The concept of moving teeth as a series of planned, individual stages through the use of setup models and elastic appliances was first described by Kesling[2] in the year 1945. Later Henry Nahoum in late 1950's developed the vaccum formed dental contour appliance often termed as the "invisibles".Pontiz R.J[3] introduced the Essix retainer which he claimed to produce minimal tooth movement and McNamara JA[4] et al in 1985 introduced the invisible retainers used as a retention appliance.Sheridan JJ[5] et al in 1993 introduced Essix retainers involving interproximal reduction and progressive alignment. The major limitation of these described methods is that only relatively small magnitudes of change are possible because of the technical difficulty of evenly dividing larger overall movements into small, precise stages manually.

In 1997 Zia Christi and Kelsey Writh started Align Technologies with the help of a handful of forward thinking orthodontists, they applied 3-D computer imaging graphics and created the Invisalign method. This appliance was the first orthodontic treatment method to be based solely on three-dimensional (3D) digital technology. Align Technologies received FDA clearance to market Invisalign in August 1998, and began commercial operations in July 1999.

The Invisalign Appliance:-

The Invisalign appliance is based on the concept of Kesling's proposal. Instead of necessitating a new set-up for each new aligner, creation of an Invisalign appliance involves CAD-CAM technology, combined with laboratory techniques, to fabricate a series of positioners (aligners) made from polyurethane .They are conventionally worn for

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a minimum of 20 hours per day and are changed sequentially every two weeks.These aligners are similar to the splints that cover the clinical crowns and the marginal gingiva. Each aligner is designed to move the teeth a maximum of about 0.25 to 0.3 mm over a 2-week period, and is worn in a specific sequence. The Invisalign appliance are recommended only for patients with high level of compliance[1].

Indications:-

1. Invisalign has been indicated to be used in adults and adolescents who have fully erupted permanent dentitions.
2. Indicated for mild nonskeletal malocclusions .
3. It was successfully used by Boyd in conjunction with segmental fixed appliances, or with full fixed appliances used immediately before and after surgery for certain skeletal Class III malocclusions.
4. Joffe suggested that the Invisalign appliance is most successful for treating 1 to 5 mm of crowding or spacing[6].
5. Deep overbite problems (e.g., Class II division 2 malocclusions) when the overbite can be reduced by intrusion or advancement of incisors.
6. Non-skeletally constricted arches that can be expanded with limited tipping of the teeth

Contraindications:-

Cases contraindicated or which have minimal effect with this system include:

1. severe crowding and spacing over 5 mm
2. skeletal discrepancy
3. severely rotated teeth (more than 20 degrees)
4. anterior and posterior open bite
5. teeth with short clinical crowns
6. periodontally compromised teeth
7. extrusion of teeth
8. multiple missing teeth

Manufacture of the Appliance:-

Once the diagnosis has been made by the clinician, polyvinyl siloxane (PVS) impressions are made of the arches. It is imperative that this impression is accurate and stable, as it is the basis for 3-D dental arch image that is scanned in the computer. Polyvinyl siloxane is the impression material of choice because it yields highly accurate impressions that remain stable for as long as three weeks and allows for multiple pours[9].

The recommended protocol is a two-step technique.

1. Loose-fitting custom tray from a heavy body impression material.
2. Actual impression itself, made from a light body material that produces a highly accurate negative reproduction of the hard and soft tissue anatomy of the dental arch.

The impression, a wax bite, radiographs, photographs and treatment plan are then sent to the manufacturer. Using advanced imaging technology, Invisalign transforms your plaster models into a highly accurate 3-D digital image.

Bite Registration: Bite registration is taken by applying a layer of 3M ESPE IMPRINT bite material with exact thickness of approximately 5 mm occlusal-incisally to the lower arch.The patient is then asked to close the mouth for final occlusion.The bite registration then has to be disinfected before shipping.

After the clinician's treatment plan has been computerized, A computerized movie - called ClinCheck® - depicting the movement of your teeth from the beginning to the final position is created. The program may be accessed via the internet for either acceptance or alteration by the clinician, to this virtual treatment. Any modifications to the plan are reviewed by an Align staff , orthodontist are available on-line at the manufacturer's website for final approval and a separate specific file is maintained on website for all the patients. The patient's poly-vinyl siloxane impressions and bite registration must first be converted into dimensionally accurate 3-D electronic study models .Scanning technique can be, from a simple laser scan to complex computed tomography (CT) scanning.In a laser scan, a positive model is first created, and laser light is then reflected from the surface of the model.

The Virtual Set Up:-

Once the virtual models are produced they are then sent electronically to Align's facility in Costa Rica where the raw electronic models are "detailed" by using software that simulates standard dental lab procedures, such as bubble

removal, void filling, and gingival-line definition. Then the 3D image is accessed by technician who transforms the raw data into a plan for the manufacture of custom aligners. The process is comprised of 3 phases

1. Cutting Process –To cut the model to separate each tooth to move individually.
2. Creating the final setup- Crown is painted to differentiate between tooth and soft tissues and tooth is moved individually.
3. Staging process – To determine the number of intermediate stages for creating the aligners.

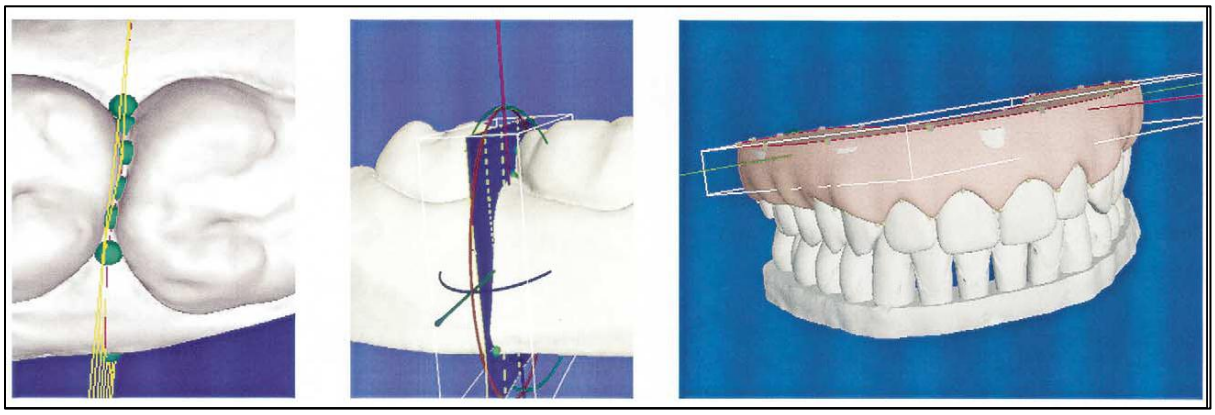

Fig 1

Clincheck® software:-

After the forecast model and treatment sequence have been generated, this information is sent over the Internet to the orthodontist, who reviews the forecast model and sequence by way of the ClinCheck® soft-ware program.This software is used for diagnosis and treatment planning – to evaluate the need for expansion, extraction, distalization, or proclination, for verifying that technician has performed modifications,As a consultation device to show treatment limits to patient, As a communication tool to email the abbreviated ClinCheck to patients and to referring doctors and for evaluating anchorage with the superimposition or surgical simulation tools.

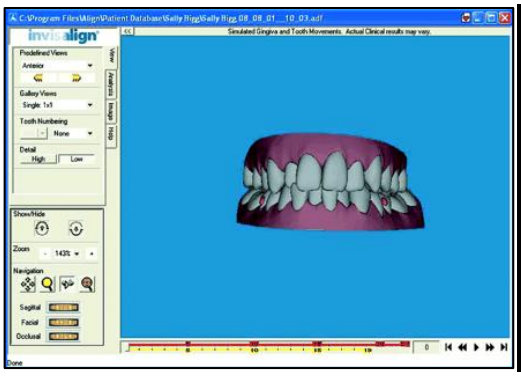

Fig 2

Fig 3

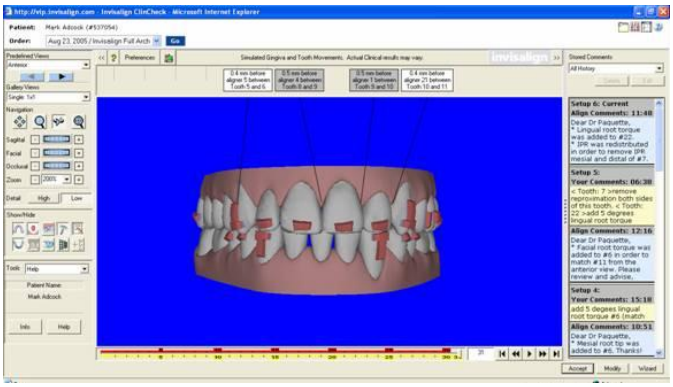

Fig 4

Stereolithography:-

Upon the prescribing clinician's approval of the diagnostic setup and treatment animation each stage of the treatment is converted into a physical model with a machine called a stereolithography (SLA). These SLA models are loaded into automatic aligner- forming system that heats, forms, and laser marks sheet plastic over each plastic model. These parts are transported on a conveyer belt to a robotic arm. The robotic arm that loads each part into an automated cutting machine for trimming to be completed in less than 30 seconds. Once trimmed the part is ejected, and the aligner is separated, polished, disinfected, and packed for shipment for the customer. The clear, 0.030 inch thickness, overlay appliances or aligners are subsequently made for each resin model.

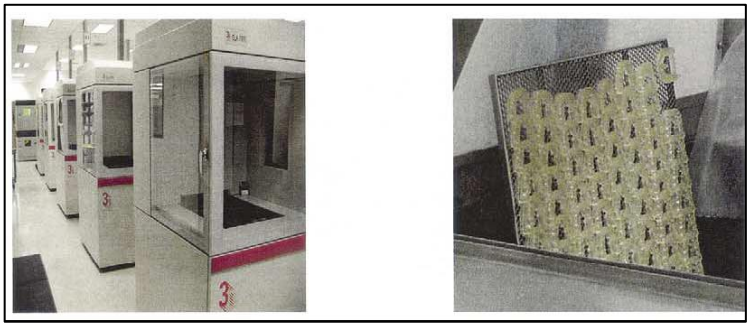

Fig 5

Fig 6

Aligner Material:-

Invisalign appliances are composed of polyurethane with added methylene diphenyl diisocyanate and 1,6 hexanediol. The diphenyl structure provides stability and sufficient reactivity to form a polymer free of byproducts. Polyurethane, the basic constituent polymeric component of Invisalign aligners, is not an inert material and is affected by heat, moisture, and prolonged contact with enzymes. At present Align Technology is using Exceed-30 (EX30) as aligner material as it is more flexible (easier to use with attachments), moreover it rarely breaks and remains clear.Exceed-40 (EX40) is used as retainers.

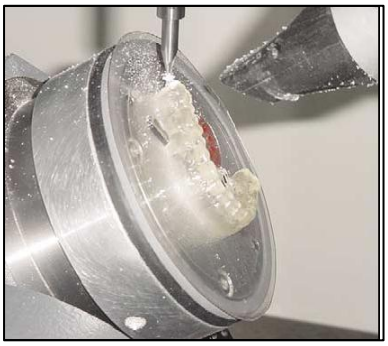

Fig. 7

Fig.8

Attachment:-

Align Technology defines attachments as three dimensional shapes (ellipsoidal, rectangular and beveled)added to tooth geometry to enhance the interaction between an Aligner and the teeth.These are represented by the red shapes seen on some teeth in ClinCheck® that translate into an equivalent geometry built into the aligner.

Attachment protocol: Align Technology will automatically place attachments wherever required. One may request attachments for any of tooth movements by specifying in the special instructions box of the treatment form or in the comments box in ClinCheck.

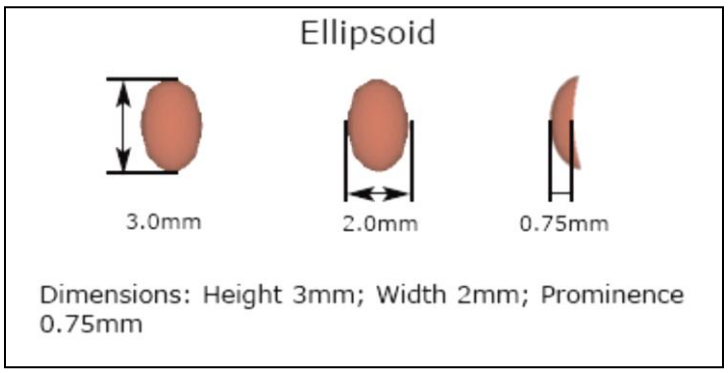

Fig 9

Progress of Treatment:-

The initial treatment visit involves inserting the first appliance of the series and carefully checking to be sure the appliances are fully seated. Some patients require attachments to their teeth to facilitate certain movements such as extrusion, extraction space closure or rotation of molars a clear, 0.015" to 0.020" thick template and posterior composite restorative material. Appliances are worn for 2 weeks for each Aligner (24 hours daily).More than two weeks per aligner in extraction cases with bodily movement, for patients who wear Aligners less than 22 hrs/day, or if problems occur with Aligner seating completely. After the final appliances are worn, the clinician may determine whether additional stages of treatment are required, a new PVS impression will be necessary for rescanning.

Risks and Inconveniences:-

1. Failure to wear the appliances for the required number of hours per day, not using the products as directed by your doctor, missing appointments, can lengthen the treatment time .
2. Dental tenderness may be experienced after switching to the next aligner in the series.
3. Gums, cheeks and lips may be scratched or irritated
4. Teeth may shift position after treatment- retainers at the end of treatment should reduce this tendency
5. Tooth decay, periodontal disease, inflammation of the gums or permanent markings (e.g. decalcification) may occur .
6. The aligners may temporarily affect speech and may result in a lisp, although any speech impediment caused by the Invisalign products should disappear within one or two weeks

7. Aligners may cause a temporary increase in salivation or mouth dryness.
8. Attachments may be bonded to one or more teeth during the course of treatment
9. Teeth may require interproximal recontouring or slenderizing in order to create space .
10. Existing dental restorations (e.g. crowns) may become dislodged and require re-cementation or in some instances, replacement
11. Short clinical crowns can pose appliance retention issues and inhibit tooth movement
12. The length of the roots of the teeth may be shortened during orthodontic treatment.
13. Teeth that are not at least partially covered by the aligner may undergo supraeruption.

Conclusion:-

The Invisalign appliance may be a treatment option for simple malocclusions - but it has some limitations. Achieving similar results like conventional fixed appliances may be difficult.The use of the Invisalign appliance in combination with fixed appliances has been explored to reduce the time needed to wear fixed appliances, but may result in considerably higher professional fees overall. Conversely, the Invisalign appliance can provide an excellent esthetics during treatment, ease of use, comfort of wear, and superior oral hygiene in mild dental malocclusions. Additional research and refinement of the design should allow further development of this worthwhile treatment.

References:-

1. Manuel Lagravère, Carlos Flores-Mir. The treatment effects of Invisalign orthodontic aligners-A systematic review. JADA December 2005Volume 136, Issue 12, Pages 1724–1729
2. Kesling, H.D.: The philosophy of the Tooth Positioning Appliance, Am. J. Orthod. 31:297-304, 1945.
3. Ponitz, R.J.: Invisible retainers, Am. J. Orthod. 59:266-272,1971.
4. McNamara, J.A.; Kramer,K.L.; and Juenker, J.P.: Invisible retainers, J. Clin. Orthod. 19:570-578, 1985.
5. Sheridan, J.J.; Ledoux, W.; and McMinn, R.: Essix retainers:Fabrication and supervision for permanent retention, J. Clin. Orthod. 27:37-45, 1993.
6. Joffe L. Invisalign: early experiences. J Orthod 2003; 30(4):348–52
7. Kuo E, Miller RJ.:- Automated custom-manufacturing technology in orthodontics.Am J Orthod Dentofacial Orthop 2003;123:578-81
8. Sheridan JJ. :-The readers' corner.What percentage of your patients are being treated with Invisalign appliances? J Clin Orthod 2004;38:544-5
9. Wong BH.:- Invisalign A t o Z. Am J Orthod Dentofacial Orthop 2002;121:540-1
10. Xiem Phan,Paul H. Ling. Clinical Limitations of Invisalign.jcda April 2007, Vol. 73, No. 3.
11. Lagravère MO, Flores-Mir C.:- The treatment effects of Invisalign orthodontic aligners: a systematic review.J Am Dent Assoc 2005;136:1724-9.
12. Jiafeng Gu, Jack Shengyu Tang, Brennan Skulski, Henry W. Fields Jr., F. Michael Beck, Allen R. Firestone, Do-Gyoon Kim, Toru Deguch. Evaluation of Invisalign treatment effectiveness and efficiency compared with conventional fixed appliances using the Peer Assessment Rating index. Am J Orthod Dentofacial Orthop 2017;151:259-66
13. Casko JS, Vaden JL, Kokich VG, et al.:- Objective grading system for dental casts and panoramic radiographs.Am J Orthod Dentofacial Orthop 1998;114:589-99.
14. Thomas J. Cangialosi,Michael L. Riolo, et al:-The ABO discrepancy index: A measure of case complexity.Am J Orthod Dentofacial Orthop 2004;125:270-8
15. Short-term chemical and physical changes in invisalign appliances. Gracco A,Mazzoli A Aust Orthod J. 2009
16. How well does Invisalign work? A prospective clinical study evaluating the efficacy of tooth movement with Invisalign.Neal D. Kravitz, Budi Kusnoto, et al (AJODO – 2009)