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Review Article

Recent Advances in Orthodontics an Overview

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Abstract: In the last decade, recent advancements have been made in the field of orthodontics. With the development of newer advances such as artificial intelligence, the use of robotics, auto-transplantation, newer materials, newer drugs, and genetics in clinical practice, the clinical care of patients has improved significantly. Such remarkable advancements have been achieved in the diagnostic tools, technological, material, imaging, as well as treatment aspects of dentistry and have become the new paradigm of orthodontics. Moreover, three-dimensional (3D) imaging systems such as Cone Beam Computed Tomography (CBCT) have become an invaluable asset for diagnosis and treatment planning. In this article we discuss different advancements in the field of orthodontics.

Keywords: Recent Advancement, Artificial Intelligence, Diagnostic Tools, 3D Imaging.

INTRODUCTION

There has been tremendous progress in orthodontics since E.H. Angle first popularized the fixed orthodontic appliance at the turn of century. Recent years have seen an increased demand for orthodontic treatment in both adolescents and adults, in addition patient and clinician expectations of treatment outcomes continue to rise. There have been advances in the orthodontic brackets, bonding agents, imaging systems, technology, use of mini-implants, and expanding the scope of orthodontics to sleep apnea [1-5].

In the last decade, recent advancements have been made in the field of orthodontics. With the development of newer advances such as artificial intelligence, the use of robotics, auto-transplantation, newer materials, newer drugs, and genetics in clinical practice, the clinical care of patients has improved significantly. Such remarkable advancements have been achieved in the diagnostic tools, technological, material, imaging, as well as treatment aspects of dentistry and have become the new paradigm of orthodontics. Moreover, three-dimensional (3D) imaging systems such as Cone Beam Computed Tomography (CBCT) have become an invaluable asset for diagnosis and treatment planning. In this article we discuss different advancements in the field of orthodontics [6-8].

Advances in Bonding Materials

With the advancements of light-cure composites as orthodontic bonding agents, the bonding of orthodontic brackets has become faster, easier and more comfortable [9]. The light-cure composites afford increased working time than chemically cured composites. Additionally, the extra composite or flash after placing the orthodontic brackets can be removed before the setting of light-cure composites [10]. With the recent advancements of plasma arc curing lights, the rapid curing times of approximately 1 to 2 seconds per bracket, the popularity of light-cured composites has increased even more. The most commonly used light-cure composite Transbond XT has shown bond-strength of more than 6 Mega-pascals on initial bonding and rebonding of brackets after breakage [11]. This bondstrength is more than that required for routine orthodontic purposes. Although Transbond has the advantage of high bondstrength, the disadvantage of light-cure composite is that it requires a clean, dry field for a successful bonding. Thus, more advancement in the bonding agents have been done and cyanoacrylate bonding material has been developed, which can bond to wet tooth surfaces. The bonding strength of cyanoacrylate has been found to be adequate for orthodontic purposes for first bonding [12]. When cyanoacrylate was introduced as an orthodontic bonding agent, it was developed as a self-cure bonding agent [13]. Lately light-cure cyanoacrylate bonding agent has been

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introduced. Thus, orthodontists have an additional bonding agent in their armamentarium which can be used in cases where isolation is difficult such as impacted canine (expose and bond), in patients with high salivation, and second molars.

Advances in Brackets

a) Newer Bracket System

It is the brackets that carry orthodontic force to the teeth during treatment. Despite the fact that metal brackets are better in terms of performance, they are aesthetically less appealing than their plastic counterparts. Brackets are being constructed from tooth-colored materials like porcelain and plastics because of the growing concern about appearance [14].

b) Ceramic Brackets

A reasonable price can be paid for sections of alumina that have structures consisting of either polycrystalline or single-gem structures. Ceramic brackets have a number of benefits, including a high level of aesthetic appeal, a low level of water absorption, increased mechanical properties, and biocompatibility. Because of the stress caused by the archwire, the bracket wing fractured while tying the ligature. Wear on the teeth at the point of debonding, which causes cracks in the enamel, occurs during the course of therapy [15].

c) Plastic Brackets

Patients choose polycarbonate plastic braces because they are beautiful to the eye and are made from durable material. Plastic brackets have a number of drawbacks, including an excessive amount of creep deformation, poor torque capacity, a decrease in toughness and longevity, mucosal bruising, and spotty color [16].

d) Self-Ligating Brackets

Bracket systems with a mechanical mechanism to seal the edgewise slot are known as self-ligating brackets. As a result, the archwire is held in place in the bracket slot by a cover that is integrated into the bracket itself. The fourth wall of the self-ligating bracket may be moved to transform the slot into a tube. A lowfriction, low-force delivery method is the theory underlying this device, ensuring more physiologic tooth movement and a more balanced oral interaction [17].

e) Invisalign (Aligners)

A new technology that allows tooth alignment without brackets has been recently introduced is InvisAlign. This system offers the first true alternative, by using advances in 3D imaging technology to create a series of customized plastic aligners. This uses computer technology to create a sequence of finely calibrated clear plastic aligners as few as 12 or more as 48 trays depending on the severity. Patient will wear each aligner for 2 weeks, removing them only to eat and brush. As patient replaces each aligner with the next the teeth will move little by little until they reach final alignment [18].

Advances in Wires

After introduction of thermo elastic and nobium nickel titanium archwires a breakthrough in archwires no major development has emerged in the past decade. Technology such as NiTi wires have replaced the traditional S.S wires of past, providing patients with a temperature-sensitive wire that allow for continuous movement of teeth over longer periods of time. Decreases time and increased comfort [19].

a) Thermal-Activated Archwire

It was introduced by Evans & Danning in 1996. In these wires desired shape of arch was incorporated using heat. These wires are ligated in the patient's mouth and get activated to return to its original shape due to heat present in the oral cavity.

b) Nickel Free Titanium Beta III Arch Wires

It was given by Dr. Burstone and Goldberg. Beta 3 is a comparable nickel free titanium arch wire, that provides strength and versatility of s.s along with resiliency of niti. Beta 3 offers a smooth surface for excellent sliding mechanics and superior bend performance. It probides twice the bend and deflection of S.S. without permanent deformation.

c) CNA

Due to problems associated with niti of notwithstanding cold bending, not fabricating loops, not being weldable or solderable. CNA came to origin. 3-Nitro aniline -2-chloro-4-nitro aniline alloy (CNA).

d) Super Elastic Composite Wires

Since mid-1990, the research teams working in U.S & japan presented extensive evidences on feasibility of esthetic polymeric wires. • Super elastic composites have the potential to be used in orthodontics. Super elastic polymer composites have the potential to substantially reduce those forces. The design of these composites is based on a soft polymeric core and a super elastic shape memory metal.

e) Opti-Flex Wires

These are new orthodontic archwire that is designed to combine unique mechanical properties with highly esthetic appearance. Made of clear optical fibre and comprises of three layers. Silicon dioxide core that provides the force for moving teeth. Silico resin middle layer that protects the core from moisture and adds strength. Stain resistant nylon outer later that prevents damage to the wire and further increases its strength. The wire can be either round or rectangular and is manufactured in various sizes. Its mechanical properties include a wide range of action and the ability to apply light continuous force. Sharp bends must be avoided since they could fracture the core. It is highly resilient arch wire, especially effective in alignment of crowded teeth.

f) Shape Memory Plastic Wires

Polynorbonen, a shape memory plastic developed in japan in 1991. Has a glass transitional point of 35°C. Once the environmental temperature exceeds the critical point, this plastic will begin to display an elastic property, and then return to its original shape if deformed. This shape memory plastic wire of 1mm in diameter can be stretched to two or three times of its original length at a temperature of 50°C and exert a relatively stable continuous light force of 119-156gms to move the teeth.

Advances in Anchorage

Orthodontic TADs have become very popular in the modern orthodontic practice for the treatment of complex malocclusion. TADs can be used in orthodontic for the correction of transverse, anteroposterior, and vertical discrepancies. TADs have high success rates for orthodontic purposes, specifically the palatal TADs. Consequently, palatal TADs are more commonly used than buccal TADs [20].

- **Advances in Software**

a) Cone Beam Computed Tomography

Orthodontists now have access to a number of radiographic images that were previously impossible to obtain using conventional radiography techniques. CBCT has the following applications in orthodontics: impacted teeth, oral anomalies, airway examination, alveolar bone height and volume evaluation, temporomandibular joint (TMJ) morphology, skeletal views, face analysis, and 3D study of dentition [21].

b) Digital Cephalometry

Digitized cephalometric imaging has recently become a realistic alternative due to the introduction of low-cost radiography (extraoral) and an increase in the use of computers in orthodontics. Computerized digitizing methods such as Digiceph, developed at Indian Institutes of Technology Delhi's Center for Bio-Medical Engineering and the Department of Dental Surgery at All India Institute of Medical Sciences, as well as 13 cephalometric analyses, have all been created in India [22].

c) Radiovisiography

In digital radiography, the first system was launched. A system for imaging dental work with minimum exposure to radiation and many more benefits than traditional radiography. Without the need for a dark chamber, it was able to create immediate photographs [23].

d) Sure Smile

Computer administration, 3D imaging of dentition, complicated 3D data processing, and robots have led to a novel treatment strategy. Patient-centered practices give high-quality care with minimal pain, compliance demands, and chair time, and finish treatment on schedule. There are several benefits to using SureSmile (Dentsply Sirona, Charlotte, NC), including the reduction of treatment mistakes due to poor appliance management, picture capture, 3D visualization of diagnostic instruments, and improved communication between orthodontists and their patients via the use of precision appliances [24].

Advances in Antibacterial Coatings onto Orthodontic Appliances

In the process of orthodontic treatment, the presence of orthodontic appliances make it difficult to clean tooth surfaces. This can lead to an increased level of bacterial colonization, resulting in enamel demineralization and periodontal diseases. Considering the large surface area that orthodontic appliances usually have and that they can be in direct contact with bacteria throughout the treatment, modifications in the form of coatings on the surface of orthodontic appliances can be an effective and practical approach to reducing bacterial proliferation and preventing relevant adverse effects [25].

CONCLUSION

Recent advance in Orthodontics have changed the way clinicians practice. It has afforded more efficiency to the clinicians so that they can provide better orthodontic treatment to their patients effectively. Such advances have also contributed to the increase the number of patients seen every day by orthodontists. Most advances in the orthodontic field arise from the demand for higher efficiency. Orthodontic clinics usually work on a fast-paced setting. And thus, increased efficiency in terms of better technology can help the clinicians treat the patients in a better, faster, and easier manner.

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