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A Recent Advances in Orthodontic Technology.

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ABSTRACT :

The field of orthodontics has evolved significantly with the integration of cutting-edge technology and materials, enhancing the diagnosis, prevention, and correction of misaligned teeth and jaws. This overview highlights key developments that have streamlined orthodontic practice, offering orthodontists tools to provide more efficient and effective patient care. Clear aligner therapy (CAT) has emerged as a popular alternative to traditional orthodontics, thanks to technological advancements in materials and design. Digital impressions have revolutionized the diagnostic and treatment planning process, offering precision and comfort to patients. Advanced orthodontic brackets, including smart and aesthetic brackets, have improved both functionality and aesthetics. 3D imaging, particularly with cone beam computed tomography (CBCT), offers less radiation exposure and more accurate analysis for treatment planning. Temporary Anchorage Devices (TADs) have expanded the scope of orthodontic treatments by providing stable anchor points. These advancements collectively result in more precise, convenient, and efficient orthodontic care, benefiting both patients and practitioners.

KEYWORDS: Temporary anchorage, Recent advanced technique, 3D Imaging, orthodontic material, aligners, digital impression.

INTRODUCTION:

Orthodontics is a branch of dentistry that focuses on diagnosing, preventing, and correcting misaligned teeth and jaws. This field of orthodontics has witnessed remarkable progress over the years, driven by continuous advancements in technology and materials. The primary catalyst for these advances has been the demand for greater efficiency in orthodontic clinics, where fast-paced settings call for the adoption of better technology to enhance patient care. In this overview, we will delve into these significant developments that have streamlined orthodontic practice, providing orthodontists with tools to treat patients more effectively and efficiently. Furthermore, it underscores the evolution of orthodontic devices, 3D imaging, digital impression, clear aligners , smart brackets, TAD's, Niti wires leading to enhanced efficiency in treatment [1-5].

CLEAR ALIGNER THERAPY:

Thanks to rapid technological advances in biomaterials, computer aided design (CAD) and computer aided manufacturing (CAM), clear alignment therapy (CAT) has become a viable alternative to traditional orthodontic treatment. In addition, a recent North American study found that many of the younger generation of orthodontists believe that clear aligners are primarily used to treat malocclusion [6,7]. To achieve unidirectional orthodontic movement, CAT typically involves a series of tight, clear plastic braces that fit snugly over the teeth and are worn by the patient at all times except while eating and brushing. These trays are changed regularly every 1-2 weeks. Thus, clear aligners have undergone many advances over the years to improve their clinical effectiveness in treating various malocclusion. There are eight generations of clear trends, summarized and evaluated by Hennessy and Al-Awadhi [8], Ganta [9], Moshiri [10] and Wajekar [11] as follows. The history of clear alignments can be summarized in eight innovative generations:

- First generation: These are basic thermoformed plastic aligners with limitations.[12-15]
- Second generation: introduction of plugins, buttons and additional functions.[16-17]
- Third Generation: Advanced SmartForce™ features and precision accessories.[18]
- Fourth generation: G4 brackets are designed for open bites and advanced surgeries.[19-21]
- Fifth generation: advanced deep bite correction function.[22-23]
- Sixth generation: SmartStage™ technology for extraction of premolars.[24]
- Seventh generation: Invisalign G7, focuses on young patients.[25]
- Eighth generation: deep bite correction and software improvements [10,26].

Each generation brings advances in materials and techniques to achieve better orthodontic results. These advances aim to provide a more aesthetic, comfortable and effective treatment.

DIGITAL IMPRESSION:

Digital impression in orthodontics means the use of advanced technology to make accurate three-dimensional images of the patient's teeth and mouth. This technique has largely replaced the traditional methods of taking the physical form of the tooth with impression material [27]. They provide truly accurate 3D models that ensure the perfect fit of the device. This provides convenience for both the orthodontist and the patient, because unlike traditional impressions, they do not have to participate in a messy environment. It is faster, reduces the time the patient spends in the chair, and with the help of these digital models, a personalized treatment plan is developed for each patient. As a result, digital records create a convenient and easily accessible record of a patient's oral health that makes it easy to track treatment progress. Overall, digital impressions have revolutionized the field of orthodontics, making the diagnosis and treatment planning process efficient, accurate and more convenient for the patient.

ADVANCED ORTHODONTICS BRACKET:

Brackets can be defined as a simple rigid l-shaped structure, with one arm attached to the vertical surface of the tooth, while the other protruding horizontal arm supports a weight (orthodontic wire) and acts as a shelf [28], so that the brackets act as a means of integrating a biomechanical therapy program into the tooth being treated [29] The term bracket was introduced in the EH Angle in 1916 and enormous progress has been made since then until this year.

a) Smart brackets:

The idea behind the Smart Bracket concept is an orthodontic bracket with an integrated microelectrical chip and multiple piezoresistive strain sensors. The measurement data is transmitted wirelessly to a computer screen [30,31] It includes a CMOS chip, a microcoil, a carrier and an arch wire. These brackets reduce the radiological monitoring of teeth for root resorption, thus exposing the patient to less radiation [31]. As a result, it develops friendlier and less painful application techniques, providing unbiased feedback to the doctor.

b) Aesthetic bracket:

Aesthetic bracket are more elegant than metal bracket because they consist of ceramic or plastic as the color blends into the surrounding tooth structure. Adult orthodontic patients usually ask for them because they don't like visible braces as it is making it more noticeable . There are also disadvantages, because the plastic used to build the brackets makes them weak to force, which often leads to wear on the teeth[5], while the ceramic bracket has more friction, that ceramic bracket has a stainless steelslot to prevent tooth wear [32].

c) Low nickel bracket:

These brackets were created for patients who are hypersensitive to nickel [33]. They are made to limit exposure to nickel, as stainless steel brackets contain nickel, which can cause nickel hypersensitivity.

3D IMAGING:

3D imaging plays an important role in the new era of orthodontics. 3D imaging is an adapted form of cone beam computed tomography (CBCT) that exposes patients to significantly less radiation than a CT scan. The advantages of a 3D image are as follows:

• Less exposure to radiation

• Inexpensive

• More accurate.

• Useful information for analyzing morphology

• Comparative evaluation before and after treatment.

• Fewer distortions and magnification errors than CT [34,35]

In addition, CBCT analyzes in more detail the Cervical Vertebrae Maturity Index (CVMI), root resorption, soft tissues, teeth and even airways [35,36,37] 3D imaging also led to the development of a new voxel method. one above the other. regardless of how the carrier defines the landmarks[38]. Thus, 3D imaging overcame all the disadvantages of 2D imaging and created a more accurate analysis and a better treatment plan for each individual.

TEMPORARY ANCHORAGE DEVICE:

In recent years, the use of temporary anchorage devices has expanded. The word TAD refers to a group of devices that provide a bony attachment point for various orthodontic movements. It is also called mini-screws or mini-implants. The TAD is temporarily attached to the bone to improve orthodontic anchorage. This supports the teeth of the reactive unit or eliminates the need for a reactive unit. Once the device has served its purpose, it is removed from the bone .

They can be used transosseous, subperiosteally, endosteally, or attached to bone biochemically (osseointegration) or mechanically (cortically stabilized). Infinite anchorage was made possible by the use of dental implants and TADs in orthodontics where no movement was observed as a result of reactive force [36,37,39-41]. Mini-implants have replaced other types of retainers to provide various forces for posterior tooth movement or canine extrusion [42].

Orthodontic mini-implants are smaller in size than prosthetic dental implants [43] Orthodontic implants are 1.5–2 mm in diameter and 6–10 mm in length. The surface of the implant is polished and smoother. This is because the mechanical fixation of the implant is different from that of bone implants. The mini-implant is a safe, versatile, 3-dimensional and minimally invasive orthodontic reinforced anchor that can be used as an adjunct to orthodontic fixation. Most current orthodontic mini-implants are self-drilling, so there is no need for a pilot drill to place the implant in the bone [44]. Mini-implants work better than a traditional intraoral anchor design because they are embedded in the bone. They are used in different positions in the upper or lower jaw to correct orthodontic alignment in an anterior, vertical or transverse direction.

CONCLUSION :

Thus the recent advances in orthodontic equipment and techniques have dramatically changed the field of orthodontics. 3D imaging and mini implants are playing a central role in revolutionizing orthodontic procedures. These innovations have redouned in improved treatment effectiveness, better aesthetics, and greater patient comfort. In addition, clear aligners and digital impressions have made orthodontics more precise, convenient and less time-consuming.

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