

Lec 14 Digital Orthodontics

Orthodontics, like the other dentistry disciplines, has recently benefited from the influx of technological innovations. These innovations have principally involved the means and procedures of diagnosis, with new developments being introduced in the field of photography, tomography, optical and laser scanning. Several orthodontic systems implement these new technologies, providing the orthodontist with a comprehensive orthodontic treatment package consisting of digital diagnostics, 3-dimensional (3D) digital planning, and computer-designed customized brackets and arch wires. The possibility of maintaining the pre-treatment arch form.

There are numerous advantages to converting to a fully digital workflow. Elimination of traditional impressions and dental-cast production stages enhance practice efficiency, patient comfort, avoidance of impression redundancy and the need for band fitting, elimination of shipping expenses, delays, and model breakage; shorter laboratory turnaround time; improved office cleanliness; and better communication with the laboratory technician.

Patient digital impressions are stored in a more convenient way and can be easily transferred to any lab or an in-office milling machine for a simpler, faster, and more predictable appliance fabrication. Simply stated, the digital workflow promotes both patient comfort and practice efficiency. Moreover, it meets the demand of multiple-doctor practices and multiple practice locations. On the other hand, a limitation of digital dentistry is the high cost, not only in devices, but also in software subscription, updates, and trainings for the medical staff who work with them.

1- Cone Beam Computed Tomography (CBCT)

Used particularly in cases with impacted teeth, eruption problems, root proximities, root resorption, TMJ issues, complex orthognathic surgery cases, and to locate and diagnose maxillofacial pathologic structures. CBCT cab be used for:

- ☑ *Design 3D guides for miniscrews placement which will help orthodontists avoid any damage to anatomical structures and reduce patient discomfort.*
- ☑ *Analyze and monitor airway volume.*
- ☑ *Monitor and study very accurately the skeletal and dental effects of rapid maxillary expansion.*
- ☑ *detection of any supernumerary teeth*
- ☑ *evaluation of the clefts*

2- Intraoral Scanner

The intraoral scanner is an electronic device that emits a light source (which can be laser or structured) that captures the anatomical structures of the teeth and surrounding gum and creates a digital document of it in the form of 3D images.

Some Advantages:

- Accurate and simple to produce.
- Easy to detect and correct defects immediately
- Cause minimal patient discomfort.
- Eliminate the need to maintain the materials required for conventional impressions.
- Minimize disinfection and cross-contamination issues.
- Avoid the storage problems of plaster casts, the possibility of breakage or misplacement.
- Easily shared worldwide without the need for packing and shipping.
- Immediately available chairside for analysis and viewing.

- Faster to start treatment planning and model analysis like arch length, arch width, and tooth size Bolton analysis in speedy and more accurate method.
- Can be used in various orthodontic software to perform virtual treatment plans

Disadvantages

- High initial and maintenance cost.
- Taking the bite registration can be an issue with certain types of malocclusion like posterior cross bite or open bite.

3- 3D Printing

3D printing or additive manufacturing is a process of making three-dimensional solid objects from a digital file. It is the opposite of subtractive manufacturing. The most common technologies used for 3D printing today are stereolithography (SLA) and digital light processing (DLP).

4- Study Models

A rapidly advancing digital technology in orthodontics is 3D modelling and printing, prompting a transition from a more traditional clinical workflow toward an almost exclusively digital format. Digital models of the patient dentition and oral structures can be created either indirectly from a patient's models or impressions using an extraoral scanner, or directly from the patient's oral cavity using an intraoral scanner.

Some clinical application:

Clear Aligner Therapy (Invisalign)

With the recent increase in adults seeking orthodontic treatment, there has been a corresponding increase in demand for appliances that are both more aesthetic and more comfortable than conventional fixed appliances.

Invisalign aligners consist of a series of clear, removable, plastic appliances that the patient wears sequentially to achieve the final result. The Invisalign system uses a computer-based online software to plan the treatment ahead of time and the

orthodontist can share the expected final results with the patients. Invisalign aligners were introduced to offer not only the advantage of better esthetics but also the convenience of removal during consumption of food and beverage, less pain, as well as better oral care. Success with clear aligners depends on patient compliance (wearing aligners as instructed).

Align Technology also requires accurate maxillary and mandibular impressions made in a polyvinyl siloxane material along with a bite registration, both of them are scanned to permit the fabrication of a virtual model.

A physical 3D model is needed for each individual aligner of the treatment set, and it is made using 3D printing, stereolithography. Next, aligners are fabricated by molding the clear material over the 3D model of the patient's teeth (thermoforming or vacuum forming)

Indications for Clear Aligner Treatment:

- Mild-to-moderate crowding
 - *With arch expansion*
 - *With interproximal reduction (IPR)*
- Posterior dental expansion
- Close mild-to-moderate spacing
- Intrusion of incisors (one or two tooth segments)
- Lower incisor extraction for severe crowding
- Tip molar distally

Requires Bonded Attachments

- ⊙ Extrusion of incisors
- ⊙ Incisor or canine rotation correction

Requires Attachments and Modified Aligners

- ✿ Premolar extraction space closure
- ✿ Molar relationship correction
- ✿ Deep bite correction

Does Not Perform Well

- Prolonged treatment in children
- High canines
- Severe rotations (especially rounded teeth)
- Severe crowding
- Skeletal problems
- Open bite

Other application of digital orthodontics;

- ✿ *Custom Brackets (lingual and labial)*
- ✿ *Custom Wires*
- ✿ *Indirect Bonding*
- ✿ *Removable and Functional Appliances*
- ✿ *Metallic Appliances*
- ✿ *Bone-Borne Devices*
- ✿ *Fixed Retainers*