

## What's new in orthodontics? An update on contemporary clinical technologies

### General Trends in Orthodontics

- “Paradigm shift” in diagnosis and treatment planning: more focus on soft tissue response to treatment
  - Trend towards fewer dental extractions in “borderline” cases compared to the past due to concerns about “flattening” profiles and reducing lip support.
- Increasing percentage of orthodontic patients are adults—fastest growing age group is over 40 years of age
  - Increased focus on and demand for esthetic orthodontic treatment options (clear brackets, clear aligners such as Invisalign®, lingual braces, etc.)
  - Increased desire for excellent treatment in the shortest time possible
  - Increased need for complex interdisciplinary treatment planning.

### Recent Advances

- **Appliance advances**
  - **Self-ligating brackets:** these brackets are not a new idea, but have gained popularity in recent years
    - They do not require an external auxiliary such as an elastomeric o-ring or stainless steel ligature tie to ligate the arch wire into the bracket slot. Rather, the bracket has a mechanism built into it that holds the arch wire in the slot.
    - Potential advantages over conventional brackets: (not all advantages claimed by manufacturers and others have been substantiated by research)
      - Decreased friction between bracket and arch wire
      - Decreased plaque accumulation compared to conventional brackets with elastomeric o-rings
      - Decreased chair time for arch wire changes
      - Possibly different tooth movement
      - Possibly faster tooth movement
  - **Customized Appliances:** orthodontic appliances that are custom made to fit each individual patient's teeth, and designed to move teeth from their initial malocclusion to a pre-determined outcome. Goals of customization are increased precision of outcomes and increased treatment efficiency.
    - **Invisalign®** was one of the first customized appliances to use a digital set up of the patient's teeth to plan the final outcome and fabricate

appliances. All clear aligner systems have limitations to what tooth movements can be predictably achieved.

- Customized fixed appliances (brackets) are made to fit each individual tooth for an individual patient, compared to conventional brackets that are designed to fit an “average” tooth shape. The deviation from average is one of the factors that requires orthodontists to compensate by bending wires, and adjusting bracket positions to achieve the best possible alignment
  - **Suresmile® system:** uses an optical intraoral scanner to acquire a three dimensional digital model of teeth and brackets. Digital models are used to create a set up of teeth in the desired final positions. Customized arch wires are robotically formed to incorporate all necessary bends to exert forces and moments to achieve the desired position of teeth. Custom wires are used in non custom brackets to achieve an individualized treatment outcome.
  - **Incognito™ system:** fully customized lingual bracket system. Laboratory or digital set up is used to predetermine the desired positions of teeth. All lingual brackets are individually designed to closely adapt to lingual anatomy of all teeth. Custom arch wires are robotically formed to incorporate all necessary bends to exert forces and moments to achieve the desired position of teeth. This system has been shown to be highly precise, and is an esthetic treatment option that offers greater control over tooth movement than clear aligners in many cases.
- **Lasers in Orthodontics**
    - **Definition:** Light Amplification by Stimulated Emission of Radiation
      - Lasers cut via thermal ablation
      - Degree of thermal absorption is determined by wavelength of laser, electrical power of unit, time of exposure, and composition of tissue
    - **Most common Laser types with orthodontic applications:**
      - Erbium (YAG or YSGG)
        - Hard or soft tissue ablation
        - No tactile sense
      - Diode
        - Soft tissue ablation only
        - May be used in contact mode for tactile sense
    - **Applications**
      - Soft tissue exposures (facial canines)
      - Operculum excision

- Access to bonding partially erupted teeth
  - Esthetic gingivectomy
  - Appropriate diagnosis including localization of CEJ, osseous crest, mucogingival junction, and quantification of keratinized tissue is essential for appropriate treatment planning
- **Temporary Anchorage Devices (TADs)**
  - Rationale: Newton's third law states that for every action there is an equal and opposite reaction. Many desired orthodontic movements have undesired side effects. TADs do not move in response to force levels used in orthodontics and can allow desired movements while eliminating the unwanted side effects. TADs have expanded the range of tooth movement and allow some movements that were previously impossible.
  - Types of TADs
    - **Miniscrews:** titanium screws that are either self-drilling (do not require the use of a pre-drilled pilot hole) or self tapping (do require the use of a pilot hole). These screws range from 6-12 mm in length and 1.2-2 mm in width, and can be safely placed in many regions in the maxilla and mandible. Placement is usually completed with profound topical anesthesia, or local infiltration
    - **Miniplates:** modified titanium fixation plates similar to those used in osteotomy or trauma fixation. Placed by surgeon and secured with miniscrews. More invasive placement procedure than miniscrews, but can withstand greater forces
    - **Palatal implants:** osseointegrated implant placed in the hard palate of adults. More invasive surgical procedure than miniscrews, and requires waiting period to allow for osseointegration. Requires surgical trephine to remove. Less commonly used than other types
  - Applications:
    - Posterior intrusion for closure of anterior open bites
    - Molar protraction
    - Maximum anterior retraction
    - Class II correction (maxillary distalization)
    - Occlusal plane cant correction
    - Class III orthopedics ( maxillary protraction in preadolescent patients)
    - Others
- **Diagnostic Advances**
  - **Cone Beam Computed Tomography (CBCT) in orthodontics**

- Allows for improved diagnosis and treatment planning in specific applications:
  - Management of impacted teeth and dental anomalies
  - Diagnosis and assessment of dentofacial deformities—especially skeletal asymmetry
  - Pre-surgical planning for orthognathic procedures and miniscrew placement
- There are many different CBCT scanners available for orthodontic use, and the range of ionizing radiation exposure to patients is extremely variable among machines.
- Benefits of full field of view CBCT scans to routine orthodontic patients (those who do not have impacted teeth, skeletal asymmetries, orthognathic surgery treatments, etc.) may be outweighed by the increased risk associated with elevated ionizing radiation exposure compared to the orthodontic standard images of panorex and lateral ceph.
- **3D photography:** creates three dimensional extraoral image of patient that can aid with diagnosis and treatment planning—particularly in patients with dentofacial deformities. Can be integrated with CBCT data to create a combined 3D view of both hard and soft tissues.
- **Digital Models:** can be acquired by intraoral scan, CBCT, or by scanning an impression or plaster model. May offer the following advantages over plaster models:
  - Elimination of need for physical storage space
  - Ability to create multiple diagnostic set-ups without laboratory work
  - May be used to create indirect bracket bonding set-ups
  - Easily shared with other dentists / specialists via email to facilitate interdisciplinary treatment planning
- **Approaches for Accelerated Orthodontics**
  - **Accelerated Osteogenic Orthodontics (AOO)**
    - Full thickness flaps reflected with multiple corticotomies and bone grafting material placed over decorticated areas
    - Leverages regional acceleratory phenomenon (RAP)
      - An increase in metabolic activity (including modeling and remodeling) initiated by injury to bone
    - May accelerate rate of tooth movement and potentially expand envelope of movement??
  - **Modified Corticotomies**

- Less invasive surgical procedure--multiple vertical incisions without flap reflection.
- May use piezotome for corticotomies
- **Propel**
  - Conservative trans-mucosal cortical “micro perforations” without any incisions
  - Performed in interproximal regions
- **Vibration / Piezoelectric potential**
  - **Acceledent**
    - 30 Hz micro pulse vibration used 20 minutes per day
    - Potential to stimulate cell differentiation and maturation more quickly??
- Evidence of efficacy of any of these approaches in vivo is lacking in the peer-reviewed literature

#### Take Home Messages

- There have been many technological advances in orthodontics that have improved diagnosis, treatment planning, treatment precision, and treatment efficiency.
- Patients of all ages can benefit from orthodontic treatment that is faster, more efficient, more esthetic, and more comfortable than ever
- However, none of these advances are a substitute for sound diagnosis, and clinical judgment. A high-tech customized orthodontic appliance that is capable of achieving excellent results with high precision will still result in a bad outcome if the diagnosis and treatment plan are not well thought out.

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