

Lecture Summary: Temporary Anchorage Devices in Orthodontics: Clinical Experimentation or Evidence-Based?

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8:30-10:00 AM

Dr. Jason Cope

Summary by: Dr. Rodney D. Hyduk

A temporary anchorage device (TAD) is a device that is temporarily fixed to bone for the purpose of enhancing orthodontic anchorage either by supporting the teeth of the reactive unit or by obviating the need for the reactive unit altogether, and which is subsequently removed after use. They can be located transosteally, subperiosteally or endosteally; and they can be fixed to bone either mechanically (cortically stabilized) or biochemically (osseointegrated). It should also be pointed out that dental implants placed for the ultimate purpose of supporting a prosthesis, regardless of the fact that they may be used for orthodontic anchorage, are not considered temporary anchorage devices since they are not removed and discarded after orthodontic treatment. By using dental implants and temporary anchorage devices for orthodontic purposes we are able to obtain zero anchorage loss.

Dr. Jason Cope's initial case presentation displayed a patient with an open bite from the maxillary right first molar to the maxillary left first molar. With the use of palatal implants placed between the first and second molars and a modified transpalatal arch, Dr. Cope employed vertical elastics to the implants. Prior to the implant placement the case was prepared in what appeared to be a routine pre-orthognathic surgical fashion. This preparation involved resolution of some of the crowding and removing dental compensations. It appears that segmentalizing the arch at the major areas of discrepancy allowed the forces to be applied to the appropriate areas. In this case, the intrusive forces were applied to the maxillary posterior segments without compensatory anterior extrusion. Dr. Cope was able to close the anterior open bite by 4.5mm in this example.

This patient together with other cases show changes which many times were only possible with orthognathic surgery or otherwise would have been finished in a compromised fashion, depending on the use of either intra and/or extra-oral appliance anchorage systems. These systems are very patient cooperative dependent.

Dr. Cope stressed that we evaluate his presentation and others presenting their work on temporary anchorage devices with scrutiny and as he referred to it, a "skeptical eye."

Orthodontic anchorage was reviewed historically. It was first understood in the 17th century but not articulated until 1923 when Louis Otfofy defined it as "the base against which orthodontic force or reaction of orthodontic force is applied." Most recently, Daskalogiannakis defined anchorage as "resistance to unwanted tooth movement."

Otfofy also summarized the anchorage categories previously outlined by Angle and others as simple, stationary, reciprocal, intra-oral, inter-maxillary or extra-oral.

Others, including Moyers, Gianelly and Goldman, Marcotte and Burstone and Tweed, followed with developing their own classification systems. All of this showed an apparent lack of consensus on the terminology for describing anchorage. Many of the previous systems dealt with anterior-posterior parameters, and didn't address vertical or transverse relationships. They viewed groups of teeth rather than individual teeth, nor did they account for the entire occlusal plane. The reason we are addressing these factors, is that recent advances in biology, materials and clinical treatment make these new parameters in anchorage a reality.

In classifying all of the factors relating to temporary anchorage devices (TADs), we have relied on a historic prospective from dental implant literature, skeletal fixation methods and other disciplinary sources in dentistry.

The true pioneer of dental implants was Greenfield who envisioned a replacement for teeth, the basis of which was a metal frame that would be inserted into a cavity drilled into the jawbone. Credit is given to Branemark and colleagues in the 1950s and 60s who pioneered the original experimentation work that established the principal of osseointegration, with studying titanium implants and the associated biology.

In 1984, Jeter introduced mini screws, 2mm in diameter, for solitary fixation of mandibular fractures instead of plates and wires.

Focusing on temporary anchorage, Tom Creekmore was the first person from a clinical human standpoint to use mini screw fixation. He used it to intrude anterior teeth, but felt it wasn't a parameter covered by insurance and therefore allowed many of these procedures to be handle by orthognathic surgery.

Dr. Cope feels that some of the characteristics of an ideal anchorage device include the following: simple to use, inexpensive, immediately loadable, small dimensions, can withstand orthodontic forces, immobile, does not require compliance, biocompatible and provides clinically equivalent or superior results when compared with traditional systems. A minimum requirement is that TADs after placement have good stability and the ability to withstand orthodontic forces. When compared to integrated implants which maximum load is proportional to the quantity of osseointegration where as for nonintegrated implants (TADs) the maximum load is proportional to the surface area contact of the bone to the implant.

Presently temporary anchorage devices can be classified as biocompatible or biological. Both of these groups can be sub-classified based on how they are attached to bone, biochemical or mechanical. An example of a biological TAD is an ankylosed tooth temporarily used for orthodontic anchorage. A dilacerated tooth can be used as a biological TAD in a mechanical fashion.

Basic nomenclature and acronyms with a focus on TADs were reviewed by Dr. Cope.

Since the conference was focused on evidence-based orthodontics and practice, Dr. Cope evaluated the literature. He found only one article that was a systematic review, from the Angle Orthodontist, which was recently published.

The problem of evidence based studies at present are: 1) There are so many inconsistent definitions and protocols in the literature that it is impossible to compare one study to another. 2) Loading; immediate, early or delayed, which is the correct approach? 3) Mini-screw; diameter and length. 4) Drill free vs. self-tapping. 5) Screw orientation. 6) Varied force levels.

After all the dust settles, it appears; 1) Definitions are becoming more concise. 2) Loading can be immediate but splinting is appropriate in order to avoid micro motion. 3) Many screws should be 1.5mm or greater in diameter while the appropriate length is still under scrutiny. The other factors mentioned need additional research.

Screw design has been misunderstood and miscommunicated. It appears the newest mini-screw endorsed by Dr. Cope is a drill free not requiring a pilot hole. The lead in angle of the screw is 45 degrees while the trailing angle is at 90 degrees. It creates a joint surface preparation so that it is ultimately designed to resist screw pull out.

Placement of the mini-screws was the last area addressed in Dr. Cope's presentation. He evaluated the pros and cons of high and low screw placement with the ultimate question relating to the particular patient and their circumstances.

The concept of TADs is a relatively new application of more established clinical methodologies. Although the clinician can look to the literature for answers, much is still unknown and will require future prospective basic science and clinical studies. The future development of TADs for orthodontic anchorage will establish a more complete understanding of the biology associated with both oseointegrated and nonintegrated devices.

The mini screw system used for anchorage gives the orthodontist another tool to approach a most difficult problem confronting us on a daily clinical basis.