The device remains essentially stable and serves as the active unit. The titanium anchorage of tooth movement primarily involves the force system and predictability of orthodontic movement. The only variation is that emphasis has to properly understand the basic biomechanical principles ...

With the advent of titanium as a biomaterial in orthodontics, skeletal anchorage has emerged as an alternative treatment tool in solving many complex orthodontic problems. In the past, complex cases would be limited to a solution by means of a surgical procedure. Today, titanium usage benefits patients with numerous missing teeth ultimately as an esthetic finish prosthetic as well as serving as an anchor unit necessary for predictable orthodontic movement.

Titanium anchorage devices can be divided into temporary or permanent. Although the temporary anchorage devices, TADs, are currently a very popular treatment modality, adult patients who are missing numerous teeth would benefit more by utilizing a conventional endosseous dental implant. The benefits are twofold: achieving the complex orthodontic movements and serving as prosthetic dental restoration at the end of the orthodontic treatment.

In order to maximize the cost-effectiveness of these skeletal anchorage devices, the orthodontist has to properly understand the basic biomechanical principles, which are the same fundamentals that apply to conventional orthodontic treatment. The only variation is that emphasis shifts to analyzing and understanding of the force system and prediction of tooth movement primarily in the active unit. The titanium anchorage device remains essentially stable or anchored. As such, the biomechanical analysis should focus on the active unit and assume stability from the skeletal anchorage device.

Endosseous dental implants can be placed before the initiation of orthodontic treatment. This treatment approach has very little room for error in the three dimensions of space. It is important to note that there is an approximate 1 mm margin of error in the mesiodistal, occlusogingival, and buccolingual final position of the implant. Any error above this margin will more than likely compromise the outcome. Compensation of this error will then fall to the shoulders of the restorative dentist to redress. Thus, in order to achieve this ideal placement, the interdisciplinary team has to have a 3-D model of the final result depicting the objectives of treatment. All the members of the team should be in agreement and understand how the objectives are going to be met.

At the University of Connecticut, this 3-D model starts on paper by means of an occlusogram.1 The occlusogram is a diagnostic tool that enables the orthodontist to visualize the changes that will be obtained with treatment (Fig. 1). The benefit achieved by using this tool is that the original relationship can be used as a reference for the desired movements. To complete this the 3-D analysis, the vertical and anteroposterior movements are sketched in the conventional visualized treatment objectives (VTO) popularized by Ricketts.2 Based on the occlusogram and the VTO, which are produced uncomplicated because of the leverage of implants.

A significant amount of movement can be accomplished without side effects by using a skeletal anchorage unit. The only caveat is that molar protraction is limited to the opposing arch, incisor intrusion, and serving as an osseointegrated stable unit, no side effects such as extrusion and tip back are seen on the reactive unit (Fig. 2).

Retraction and protraction of the teeth is usually difficult, but adjacent to an implant, this movement is rendered uncomplicated because of the anchorage available from the nearby implant. It is clear that a significant amount of movement can be accomplished without side effects by using a skeletal anchorage unit. The only drawback is that molar protraction is still slow, especially when the desired tooth movement is intrusion.3

Finally, intrusion of molar teeth can be accomplished from a molar in the same arch. To effectively accomplish this an arm should be extended in order to allow an intrusive force to be delivered (Fig. 5). Intrusion of an overerupted segment can also be accomplished by placing an implant on the opposing arch and delivering an intrusive force from it through repelling magnets (Fig. 4).4,5

In summary, complex orthodontic problems in adult patients can be treated in multiple ways by exploiting the leverage of implants. Endosseous implants in patients with multiple missing teeth are a very cost-effective option. A proper understanding of biomechanics enhances the possibility of using skeletal anchorage to achieve orthodontic movements in different sites around the arch. Complex orthodontic movements such as intrusion of the posterior teeth and significant intrusion of the incisors can be accomplished using endosseous implants. Furthermore, the implants can be later restored prosthodontically serving as a permanent solution to the missing teeth in the partially edentulous adult patient.

In order to maximize the cost-effectiveness of skeletal anchorage devices, the orthodontist has to properly understand the basic biomechanical principles …

Fig. 1b


Dr. Uribe is a full-time assistant professor and program director in the Division of Orthodontics at the University of Connecticut Health Center. His clinical interests are in multidisciplinary treatment involving the use of endosseous dental implants and temporary anchorage devices. He maintains an intramural practice in the university, and has research interests in the areas of biomechanics and clinical research. He is also interested in basic science research in the area of orthodontic tooth movement.

References


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Skeletal anchorage units: manifold benefit and savings

An interview with Prof. Dr. Flavio A. Uribe regarding ‘Biomechanics in the orthodontic treatment of complex multidisciplinary problems’

Please describe the major aspects of your treatment concept for mutilated dentition.

In recent years, the purview of orthodontics has grown to include an increasing number of adult patients, many of whom present with complex malocclusions which demand complicated treatment plans. Often, these more mature patients are referred by the prosthodontist. In such cases, a prosthetic solution is not possible due to lack of intermaxillary space, proper distribution of the edentulous spaces, canted occlusal planes, etc.

To achieve an optimal occlusion, a multidisciplinary team effort is necessary, but orchestrating and integrating the different disciplines is of paramount importance and must start with the outcome in mind. In order to visualize this outcome, the team has to go through a process of highlighting the problems. Once clear, precise objectives are determined then a mechanical means to obtain that objective can be formulated.

At the University of Connecticut, we first construct our 3-D objective model from a combination of treatment planning tools such as the visualized treatment objective (VTO) and the occlusogram. These are produced on paper and are used to sketch the initial malocclusion and ultimate final outcome (see article).

Based on these “blueprints,” a 3-D model diagnostic wax up is constructed. Since these patients are missing numerous teeth, edentulous open spaces can be difficult, but is managed by relying on the already fabricated 3-D model. The interdisciplinary team uses this model in conjunction with the clearly outlined objectives of treatment to transfer the final position of the implant to the patient. By implementing this course of treatment the implants can be placed prior to any orthodontic appliance and their dual benefit exploited.

What are critical success factors in your concept?

The key to success is a clear and complete understanding of the objectives of treatment by the team of specialists intervening, namely the orthodontist, periodontist and restorative dentist. All the members of the team should have a full understanding of the objectives of treatment to achieve the objectives with the minimum amount of side effects. Remembering Newton’s third law, “for every action there is an equal and opposite reaction,” the orthodontist must be mindful both of the desired action but also of the repercussions that would ensue of that action; it is here that a thorough understanding of biomechanics is critical. The more complete an understanding of biomechanics the clinician has, the more ample are the treatment options afforded the patient.

Where do borderlines have to be set in respect to contraindications?

There are no real contraindications for the treatment of complex problems. The only contra indication that would apply to any orthodontic patient is a serious systemic disease that would not only contraindicate orthodontic treatment, but also eliminate the possibility of skeletal anchorage units employed. As described, there is a manifold benefit and savings in using skeletal anchorage units. The benefit is in patient comfort, treatment time, patient time spent in the dental chair, patient’s expense and exposure to surgical procedures; overall a clear advantage to the clinician, as well as the patient.

“An understanding of biomechanics allows for a reduction in the number skeletal anchorage units employed.”

“The key to success is a clear and complete understanding of the objectives of treatment by the team of specialists intervening…”

Please describe the economic advantage of this concept?

Since many of the adult patients present with edentulous sites, it is possible to use conventional dental implants for skeletal anchorage, which would later be restored with a prosthesis. Therefore, the patient would have a twofold benefit from a single skeletal anchorage unit. By understanding biomechanical concepts, placement of mini implants would not be necessary and thus the patient would be spared another procedure and expense. For example, it has been shown that intrusion of the incisors can be readily done without the use of direct anchorage of a mini-screw. Dental implants in the posterior can be used to obtain different movements within the posterior buccal segments and simultaneously used as anchorage from which cantilevers are placed to achieve this same intrusion anteriorly.

An understanding of biomechanics allows for a reduction in the number skeletal anchorage units employed. As described, there is a manifold benefit and savings in using skeletal anchorage units. The benefit is in patient comfort, treatment time, patient time spent in the dental chair, patient’s expense and exposure to surgical procedures; overall a clear advantage to the clinician, as well as the patient.

Reference


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