Anatomical Limitations Regarding treatments of patients and the Introduction of Biocreative Orthodontics (BO) Strategies

(Targeting Applications of TSADs and Accelerated Tooth Movement in Clinical Practice)

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Introduction

When treating patients, we encounter unexpected obstacles to carry out the initial treatment plan. We realize most of troubles occur when patients’ initial conditions were not analyzed accurately and exact diagnoses were not performed accordingly. As we start treating patients more and more, we build greater depth of knowledge on differentiating these troubles during diagnoses. These troubles mostly come from anatomical limitations, and these limitations are related to either soft tissues or hard tissues. Soft tissue limitations are related to tongue, scar tissue, frenum while hard tissues concern alveolar bone, sinus wall, periodontal disease, bone density or quality, and periodontal changes caused by aging. Diagnosing these limitations and correct treatment planning accordingly is the key to success of patient treatments.

Biocreative Orthodontics Strategy (Biocreative Therapy)

The use of temporary skeletal anchorage devices (TSADs), such as the miniscrew implants (MIs) or the miniplates, circumvents the compliance factor of patients and provides a consistent intraoral anchor unit. Furthermore, skeletal anchorage enables orthodontists to perform the desired tooth movements without any untoward tooth movement of adjacent teeth. Use of bone anchor units advances the quality of orthodontic treatment by simplifying the biomechanics, eliminating iatrogenic orthodontic movements, and effectively reducing the total treatment duration. Biocreative Orthodontics Strategy or Biocreative therapy (C-Therapy) is a novel treatment philosophy advocated and clinically applied by K.R. Chung in Korea since 1999. It uses C-type TSADs, which includes C-implants, C-tube miniplates, and/or C-palatal miniplates. The use of TSADs in biocreative therapy is quite different than other systems that use MIs. Unlike many conventional orthodontic treatment mechanics that integrate MIs as auxiliaries, biocreative therapy focuses on the C-type TSADs as the core construct of the dental movement
protocol and uses orthodontic brackets and wires in addition to TSADs. C-type TSADs can endure multidirectional heavy orthodontic and orthopedic forces with better stability, thereby enabling tooth movement more effective and efficient within a shorter time frame. Moreover, Biocreative Strategy actively utilizes corticotomy or osteotomy under local anesthesia to overcome severe skeletal discrepancies.

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Biocreative Strategy Check list

Orthodontic Diagnosis Is Based Upon The Face – Cephalometric Correction, Tooth Arch Discrepancy, Crowding, Curve of Spee, and The Anteroposterior Correction Requirement. Actively utilize the Biocreative Strategy Check list to diagnose and to make a treatment plan. Careful diagnosis and appropriate treatment mechanic is essential.

1. **Diagnosis:** Consider patient’s eagerness and 3 dimensional anatomic boundaries.

This 21-year-old adult male presents with a chief complaint of “I don’t like these crooked and protruded teeth.” Possible etiologies for his malocclusion include horizontally impacted lower third molars, a mouth breathing habit, and low tongue posture. Before coming to our clinic, other orthodontists recommended combined surgical-orthodontic treatment, but the patient refused surgical orthodontic treatment with extraction of four bicuspids, LeFort I Maxillary surgery and mandibular advancement surgery.

2. **Target decision:** Extract upper first bicuspids and lower third molars, and use TSADs in the upper posterior dentition as independent appliances for upper anterior retraction, upper posterior intrusion, and lower full dentition distalization.

3. **Treatment Tool (TSADs) selection:** Two 1.8mm in diameter, 8.5mm in length sand blasted large grit with acid etched (SLA) C-implants selected between upper second bicuspids and first molars.
4. **Target Teeth/Bone movement:** .016X.022” stainless steel archwires were placed on the upper anterior dentition and through the hole of C-implant. Retraction of the anteriors was accomplished using 3/16” 3oz intramaxillary elastics. An .018” nickel titanium wire with gable bends was placed in the lower arch as an initial archwire, and the patient used 5/16”3.5oz Class III elastics to the C-implant for tip back mechanics.

5. **Finishing and Detailing:** By this time, the open bite closed by intrusion of the upper posteriors using a .017X.025” stainless steel T-loop segmented archwire and elastic thread to the neck of C-implant. Cross type C-plate was placed at the midpalatal suture area for intrusion of upper posterior dentition. Detailing in .018X.025” SS wires was undertaken for six months. The total active treatment time was 14 months.

**Clinical Application of Biocreative Strategy**

**Story 1. Periodontally involved Patients.**

The most common orthodontic problems in periodontally compromised patients include: Proclination of the maxillary anterior teeth, irregular interdental spacing, rotation, over-eruption, pathological migration, loss of teeth and traumatic occlusion. Even with reduced periodontium, if oral health is maintained, orthodontic treatment can be carried out. If a thorough oral hygiene regime is implemented initially and throughout orthodontic treatment, satisfactory results can be accomplished without irreversible damage to the periodontal tissue. However, for the periodontally challenged patient, treatment with the simplest possible orthodontics systems is essential. For this reason, **Biocreative Strategy is suitable for periodontally involved patient treatment in orthodontics, because Biocreative Strategy engages only the Targeting teeth and periodontium.** According to the periodontal disease, TSADs selection can be varied. Chronic periodontitis patients could achieve successful outcome with mini implant, but if the periodontitis is acute and progressing, first focus on the
periodontal treatment and select TSADs that does not affect bone remodeling by active periodontal disease.

Thickness of the maxillary sinus wall was 2 mm at the apical area of upper posterior teeth and no pathologic change was found inside sinus space in the CT scan (39yrs Female). Because 2 mm penetration of sinus membrane by prosthetic implant could be remodeled spontaneously without any complications, C-tube positioning was planned on the cortical bone of the lateral sinus walls. After placement of the modified T-type C-tube with 2 or 3 fixation screws, CBCT evaluation of the left and right sinus walls revealed minimum penetration into the sinus floor without complications.

Strory 2. Anterior Protrusion Patients

Biocreative Strategy considers patient’s anatomic limitations and biomechanics are selected correspondingly during non-extraction treatment of anterior protrusion patients.

There are many different force application options of TSADs in the oral cavity. For example, molar distalization can be achieved either by placing C-implants (www.cimplant.com) in the anterior region and pushing the posterior dentition distally (pushing mechanics), or conversely the C-implants can be placed in the posterior region in such a way that a sliding jig can pull against it to move molars distally (pulling mechanics). They can be also placed in the maxillary posterior region in conjunction with CIII elastics to the mandibular anterior dentition to distalize both upper and lower posterior dentitions. The most commonly recommended site for placement when distalizing the posterior dentition is between the upper first molars and upper second premolars. Thus, it becomes necessary that the C-implant should be relocated since it can obstruct distal movement of premolars once sufficient space has been created. Consequently, the C-implant can be relocated distally in the molar region, and the force vector can be changed from a push to a pull system.
Recommended protocol for immediate relocation of C-implant

- After applying local anesthesia, insert an explorer in the hole of the head component of C-implant and pull it with concurrent counterclockwise rotational force to separate the head attachment from the screw base.

- Remove the screw base with counterclockwise rotational force using a manual screwdriver included with a system.

- Using a sterile screw holder, rinse the screw with normal saline and keep it with the screw holder.

- Determine the relocation site using appropriate radiographs, apply topical and local anesthesia to the area, and mark insertion site with an explorer.

- Pilot-drill a 1.5 mm in diameter guide hole (Stryker Leibinger Co., Freiburg, Germany) at 1000 rpm to a depth sufficient just to perforate compact bone. Alternatively, the pilot-drilling can be performed by manual placement and removal of a pilot self-drilling-miniscrew of 1.5 mm in diameter immediately before inserting the C-implant body at the new location.

- At this point, the clinician should ensure that the concavity of the removed C-implant body is well-fitted into the screw driver.

- Insert the self-tapping implant by rotating the screwdriver clockwise with mild pressure. Direct the angle of the C-implant body parallel to the occlusal plane. Irrigation should be avoided in order to maximize the contact of C-implant with the patient's own blood for better adaptation.

- Attach the head component and softly tap to fix it in place. Orthodontic force is immediately applied afterwards.
Story 3. Anterior Deep Bite Patients

For anterior deep bite patients, intrusion arch or uprightingsprings are generally used, but Biocreative Strategy uses C-tube in treating patients. In this patient, periapical radiographs showed extremely narrow interradicular spaces between central and lateral lower incisors due to distal tipping of lateral incisor crowns. I-type C-tube was chosen as a choice of TSADs primarily because of noticeably narrow interradicular space where mini-implants could not be placed without risking damages to adjacent root structures. Brackets were bonded on the lower dentition. Four first premolars were extracted and an I-type c-tube was placed in the apical region of lower anteriors. Intrusion of lower anteriors accomplished out by connecting elastic thread between c-tube head and lower incisors. After adequate amount of intrusion was obtained, four incisors were ligated to the c-tube head to retain vertical position of the incisors. With a successful intrusion of lower anterior teeth, the C-tube was no longer needed in the mandibular anterior legion. But, it could be reused in the upper left posterior for the midline correction. The C-tube can be replaced in a same patient, but the fixation screw loses the sharp self-drill cutting edges once used. So, using new fixation screws, the C-tube was repositioned and the elastics were activated for the midline correction.

https://www.youtube.com/watch?v=XdlWGL4ieHE&list=UUJeq93XfaeHPMUh4ns1si0A

Story 4. Gummy smile patients

There are ongoing debates on whether surgery has better outcome over the orthodontic treatment regarding gummy smile patients. Clearly in case of vertical maxillary excess, surgery is the better option. However, if intrusive retraction is possible with minimal root resorption, orthodontic approach could be a good treatment option. One of the advantages of TSADs is that it allows target teeth movement. Nonetheless, there exist placement limitations for vertical tooth movement. For the correction of gummy smile, multiple applications of miniscrews (6-8 or more) are placed for total intrusion. In case of gummy smile and anterior protrusion, BS
method 2- Biocreative Intrusive Retraction system (C-IRS)- can be applied to patients. By inserting miniscrews (diameter 1.5mm and length 4mm) at the zygomatic buttress and connected extension wires can give desirable retraction intrusion. But, this method involves minor surgery to incise superior of vestibule for TSADs placement, and possible complications are movable mucosa irritation, pain and infection.

Biocreative Strategy came up with new treatment modality to overcome these problems. Kinematics of lingual bar on nonparalleling (KILBON) system created by Dr. Kwon S-Y predetermines intrusive direction and amount and design unique lingual retractor accordingly to retract the anterior segment with force application on palatal miniscrew or miniplate to achieve vertical movement of anterior segment and posterior segment at the same time. When additional molar vertical movement is necessary, TPA spanning posterior segment can generate intrusion by force application to TSADs.

3D KILBON is created by these considerations on retraction utilizing patient’s x-ray data and model. http://www.hindawi.com/journals/ijd/2014/164164/ www.orapix.com

But in case of extremely thin anterior alveolus patients, the bone remodeling caused by compression will have limitations. Augmented corticotomy should be considered in these cases.

Strry 5. Anterior Open bite

The guideline of TSADs for posterior intrusion: patient and clinician convenience is the top priority. If 3mm or less posterior intrusion is required and sufficient interradicular space exist, orthodontic miniscrew (1.8mm diameter or less) only can yield expected intrusion. But for the TSADs stability, maxillary sinus wall should be taken into consideration. Extended sinus wall challenges clinician on initial stability of TSADs. Through CBCT evaluation, micro plate can be applied in thin sinus cortical bone of 2mm. Even with this sinus wall, multiple miniplate fixation screw can redistribute stress. Extremely thin alveolus that TSADs placement is hindered suggests miniplate bending to secure stable anchor site for an option.

One more thing to consider in case of 3mm or more posterior intrusion cases is the existence of maxillary sinus septum. The prevalence of sinus septa was 21.3% (87/408), and 31.4% (64/204) of patients had more than 1 sinus septum. The anatomic location of the septa were distributed in the 2nd molar region (43.7%), 1st molar region (31.0%), 2nd premolar region (21.8%) and 1st premolar region
To overcome these complications of possible root resorption and prolonged treatment time during intrusion, advanced Biocreative strategy—Speedy surgical orthodontics—can be applied. Speedy surgical orthodontics is defined as corticotomy-facilitated orthodontic treatment that combines corticotomy and orthopedic force application.

The mini-plate is more suitable than the mini-implant for corticotomy because of the heavier force requirements of 300-500g per each side. For the palatal area, implantation of the mini-plate in the midpalatal area is recommended because the thinner soft tissue layer and thicker cortical bone depth provides better initial stability than the palatal slope would; and, no nerves or vessels pass through this area. On the buccal side, the skeletal anchorage is positioned at least 2-3 mm above the horizontal cutting line to avoid the area of active bone remodeling and obstacles such as dilacerated roots, an expanded maxillary sinus, or a severe alveolar ridge resorption.

**Story 6. Impacted teeth.**

This topic is popular and many treatment methods are introduced. With Biocreative strategy in mind, it is possible to use minimum number of TSADs for maximum effect.

When a tooth is impacted under thick alveolar bone with available space, conventional treatment plan of surgical exposure followed by orthodontic traction with complete fixed appliance would be considered first. Yet, this protocol has disadvantages such as the complexity of the biomechanics, patient discomfort, and unwanted movement of anchored teeth. In contrast, if traction is carried out against TSADs, traction is applied without any reciprocal reaction. TSADs have been used as indirect anchorage to support anchor teeth, perhaps placed in the interradicular space of the maxillary posterior teeth. A palatal TSAD can be used to reinforce a Nance button. These tactics may not be appropriate in the mixed dentition due to low bone density or the risk of root damage to unerupted permanent molars.

In this clinical case, we describe three orthodontic traction cases of impacted teeth in the mixed and early permanent dentition with a titanium C-tube miniplate placed in the opposing arch and intermaxillary elastics to provide the traction force. They were successfully brought into their intended position without fixed appliances during orthodontic traction.
Orthodontic traction of impacted teeth using C-tube plates can be an optimal treatment option when patients are in mixed dentition for the following reasons. First, the roots of erupting permanent teeth or residual deciduous teeth are insufficient to function as an anchorage. The anchor value would be even more decreased in the transitional stage of dentition due to areas of unerupted teeth. Second, with the Biocreative Orthodontic strategy, the treatment time with fixed appliance therapy is greatly reduced or even eliminated. The time normally spent prior to exposure of the impaction to level and align the teeth to prepare for heavy steel wires is not required. Use of the C-tubes makes the fixed appliances unnecessary. This eliminates the risk of enamel decalcification and gingival inflammation. Third, adjacent teeth are not used as anchorage, so adverse intrusive forces are not applied. Conventional intra-arch mechanics using reciprocal forces such as elastic threads between a gold chain and the main archwire tend to tip or intrude the teeth adjacent to the impacted tooth, affecting the occlusal plane. With the technique described here, no reciprocal force is generated when traction is performed with elastics attached to a hook from the C-tubes. Fourth, the traction vector is easily modified by relocating the skeletal anchorage. The miniplate can endure a force from any direction, and the neck of C-tube is easily bendable to improve the location of the hook.

The clinician can plan in advance the force magnitude and the position of force application. Optimal force for extrusion ranges from 35 g to 60 g depending on the size of the tooth. We prescribed a force magnitude with consideration on root development stages and the distance between the c-tube and button as the tooth erupted. Patients were instructed to wear elastics more than 14 hours a day on single-rooted tooth and full time on multi-rooted tooth. Since the patient changes elastics regularly the force application was continuous and light, allowing a smooth, efficient eruption of the tooth.

The cases in this presentation showed successful traction of impacted teeth with normal root development without any intervention of dentition. Further studies are necessary regarding the level of optimal force considering the root developmental stage of the impacted tooth.

**Conclusions**

Conventional orthodontics treatment planning can be applied to patients without anatomical limitations but to patients with limitations, Biocreative Strategy can be a solution. Biocreative Orthodontics strategy (BOS) contains 6 principles for physiologically stable Occlusion. BOS is about **ACTION**: Alveolar bone limitation, **Therapeutic Condylar position**, **Target tooth approach**, **Importance of minimum TSADs and maximum impacts**, **Observe the Tongue posture**, **No more tooth born expander**. With thorough evaluation on patient’s anatomical limitations and attention to patient’s eagerness, **6 principles and 5 check list of Biocreative Orthodontic Strategy** could provide strength to overcome challenging cases.

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