

JCO ROUNDTABLE

Skeletal Anchorage Part 1

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DR. CACCIAFESTA In what types of cases have you used miniscrews?

DR. BUMANN In all cases where any type of anchorage is necessary. Since the placement of a miniscrew is so fast and easy, we place a miniscrew right away if anchorage is an issue.

DR. CHO In maximum-anchorage cases, for maximum retraction of anterior teeth into extraction spaces, protraction of the whole dentition,

protraction or distalization of posterior teeth, molar intrusion to close an open bite, constriction of the maxillary arch, uprighting of mesially tipped molars, and buccal or lingual uprighting of posterior teeth.

DR. GRAHAM The variety of cases that I treat utilizing temporary anchorage devices (TADs) has been continuously expanding. Some of the cases I have treated have been open bites, deep bites, molar protraction in cases of congenitally missing second bicuspids, single and multiple molar intrusion in adult rehabilitation cases, anterior incisor intrusion for the correction of gummy smiles, leveling occlusal cants, midline correction, and replacement of congenitally missing lateral incisors in growing individuals.

DR. PAQUETTE I use them for anterior open bites, Class II correction (maxillary distalization), Class III (mandibular dentition distalization), vertical asymmetry for extrusion and intrusion, and midline correction.

DR. SCHEFFLER I have used miniscrews for anterior open-bite (Fig. 1) and deep-bite correction, single and/or double molar intrusion, canine extrusion, occlusal-cant and gummy-smile correction, molar uprighting, molar protraction (Fig. 2), anterior retraction, Class III skeletal and dental correction, and temporary tooth replacement.

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DR. PARK Most of all, the bialveolar protrusions in which maximum retraction of the anterior teeth is required are the cases of choice for the micro-implant. In a case of open bite, the intrusion of the posterior teeth produces a bite-closing effect on the anterior teeth. The intrusive force from the micro-implants also can be used for vertical control of the posterior teeth in high-angle premolar-extraction cases. In mild arch-length discrepancies, the decrowding of the anterior or buccal arch deficiency can be performed, and the curve of Spee can be leveled by distalization of the maxillary and mandibular posterior teeth. Class II molar relationships can be corrected by distal movement of the upper posterior teeth. In camouflage treatment of a Class III malocclusion, micro-implants can be placed to retract the entire lower arch. Micro-implants can also be used for correcting a canted occlusal plane in the upper arch by intrusion, or as anchorage for preprosthetic orthodontic treatment by molar intrusion or molar uprighting.

DR. CACCIAFESTA Have you been able to avoid surgical procedures through the use of miniscrews?

DR. SCHEFFLER Yes, for treatment of anterior open bites, gummy smiles, occlusal cants, and skeletal Class III malocclusions, I have seen exciting results that mimic surgical treatment outcomes. We are definitely expanding the envelope of treatment possibilities with the use of temporary skeletal anchorage, and we are now seeing research that verifies that the results are as stable and predictable as surgery.

DR. GRAHAM Patients have been able to avoid



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maxillary impactions to close open bites and reduce gummy smiles, and in many cases they have been able to avoid lower second premolar implants due to miniscrew-assisted molar protraction. I foresee the day where many orthognathic surgical procedures are obviated by the routine use of miniscrews.

DR. BUMANN I've also had to use fewer Le Fort I osteotomies to close open bites. At the same time, lower molar protraction has become a standard procedure in our office.

DR. CHO With distalization of the upper arch in a skeletal Class II with moderate severity, we can avoid either maxillary setback or mandibular advancement surgery. With molar distalization in the lower arch using retromolar implants, we can prevent mandibular setback surgery in moderately severe Class III patients. In cases of severe bimaxillary protrusion, maximum incisor retraction can avoid surgical setback of the anterior segments with subapical osteotomies.



Fig. 1 Patient treated for anterior open bite in six months using skeletal anchorage.

DR. PAQUETTE I have seen several patients who were told they would require maxillary impactions, and simply by placing four miniscrews (two each facial and lingual, between the upper molars) and elastics from the teeth to the screws, we got

complete correction in three or four months. I had another patient who was a full-step Class III where I placed two screws in the retromolar pad area and retracted the entire lower arch under the upper arch in 12 months.



Fig. 2 Molar protraction using direct (A) and indirect (B) skeletal anchorage.



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DR. PARK In Class III surgical patients who need to have two jaw surgeries, the maxillary surgery can be omitted by moving the anterior teeth forward and controlling the position of the anterior teeth. Also, in patients with facial asymmetry, the occlusal plane in the upper jaw may be canted toward the unaffected side, and maxillary surgery would normally be accompanied by mandibular surgery. But with micro-implants, the upper occlusal plane can be corrected by applying an intrusive force to the posterior teeth on the canted side.

DR. CACCIAFESTA Do you sometimes use miniscrews in cases that require less than maximum anchorage?

DR. CHO Yes, to minimize side effects of other, less desirable mechanics. For example, in correcting a Class II occlusion with deep bite, protruded lower anteriors, or a high mandibular plane angle, micro-implants may be utilized to prevent side effects of Class II elastics, such as extrusion of the maxillary anteriors, protrusion of the lower anteriors, and lower molar extrusion.

DR. BUMANN If possible, we usually start the case with reciprocal space closure, and as soon as anchorage is needed, we place a mini-pin.

DR. PAQUETTE We use them in cases involving non-compliance or for use with auxiliaries. For instance, with Class II patients who are in treatment with aligners, it sometimes is troublesome

for patients to wear elastics with their aligners. As an alternative, I will use a Carrière distalizer* on the upper arch and place a miniscrew between the lower first and second molars on the facial for the patient to connect their elastics. Most find this much easier than connecting to the aligners, and the treatment results are very predictable.

DR. PARK In a case of distal retraction of the upper six anterior teeth with straightwire appliances, most of the premolar extraction space can be closed by anchorage loss—in other words, mesial movement of the posterior teeth in the maxilla. With micro-implant anchorage, the clinician can control precisely the amount of distal retraction of the anterior teeth by the duration of force application from the micro-implants. When the patient is satisfied with their profile, the retraction of anterior teeth can be stopped.

In an extraction case, micro-implant anchorage makes it possible to change the extractions according to the health of the teeth. For instance, to resolve anterior crowding, the clinician can extract a second premolar instead of a first premolar if the patient has a decayed second premolar.

DR. SCHEFFLER Unfortunately, there are sometimes non-compliant patients who refuse to wear elastics. Also, in some cases elastics could have detrimental side effects, so TADs are now a solution to these problems to make it easier to achieve our orthodontic goals.

DR. GRAHAM Orthodontic anchorage is generally defined within the context of tooth unit vs. tooth unit; therefore, doing something such as intrusion of the entire maxillary dentition is not accurately described in terms of maximum, minimum, or differential anchorage. Simply put, I have used miniscrews anywhere necessary to allow me to achieve results otherwise not possible or timely.

DR. CACCIAFESTA Is there a minimum or maximum age for using miniscrews?

*ClassOne Orthodontics, 5064 50th St., Lubbock, TX 79414; www.classoneortho.com.

DR. CHO Age is not the variable for micro-implant placement, but bone quality is. The younger patients tend to have softer bone. Personally, the minimum age where a micro-implant was used was 10 years old. I have no maximum age.

DR. PARK In younger patients with a high metabolic rate, the success rate for micro-implants is low.

DR. PAQUETTE Generally, under 11 years old the bone is not dense enough to retain the screw for a long enough duration for treatment success. If the patient has good bone density and healthy bone metabolism, I don't believe there is a maximum age. I have successfully treated several young teenagers with miniscrews, and as I recall I have had only one screw fail, likely due to a placement error on my part.

DR. SCHEFFLER Due to increased bone remodeling, I would prefer not to place miniscrews in children less than 12 years of age. However, I have placed them, well away from developing roots, in a couple of 10-year-old patients with the patients' and parents' understanding that there was an increased potential for failure or mobility of the miniscrews. I do not feel there is a maximum age for miniscrews as long as the individual has good bone density.

DR. CACCIAFESTA Are there any other contraindications to the use of miniscrews?

DR. BUMANN Theoretically, yes, but those patients usually don't show up in an orthodontic office.

DR. PARK Systemic disease including diabetes, osteoporosis, and immunodepressant use might be contraindications. Smoking is also a risk factor for failure, but with careful examination and suitable prophylaxis, we can place micro-implants in these patients. Even though it is very rare, some implants may have repeated failures; allergic reaction might be a cause.

DR. PAQUETTE Artificial valves or other conditions that would require subacute bacterial endocarditis (SBE) coverage would require consultation



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with the patient's physician to determine if placement is advisable and if antibiotics would be required for placement and during the course of treatment. I had one patient develop SBE after screw placement from a condition that would not normally require antibiotics for dental treatment, following the current American Heart Association recommendations.

DR. CHO Another contraindication would be if there isn't sufficient interradicular space to allow clearance of the micro-implant, or if the bone quality is poor, with low mineral density.

DR. SCHEFFLER Some absolute contraindications would be placing a TAD on those with osteoporosis, those with poor bone quality, or those taking intravenous bisphosphonates. Some relative contraindications would be for those taking oral bisphosphonates, smokers, and those with poor oral hygiene. I diverge roots to make room for miniscrews in places I prefer to place them, so insufficient interradicular space is typically not a contraindication for me.

DR. GRAHAM An absolute contraindication would be placing a miniscrew in the area of a developing permanent tooth. Younger patients, as well as patients with osteopenia of any etiology, are poor candidates due to their poor cortical bone quality. Patients who are currently taking bisphosphonates must be evaluated on a case-by-case basis to determine the relative risk of miniscrew treatment.

DR. CACCIAFESTA What are the effects of bisphosphonates?

DR. CHO Bisphosphonates can inhibit bone resorption, which is the initial phase of bone turnover. If a patient requires invasive dental care, treatment should be done before the bisphosphonate therapy is commenced. If patients are already on long-term bisphosphonates, especially the injectable forms, and treatment cannot be delayed, they have to be trailed off the medication before micro-implants are to be incorporated into the treatment plan, to prevent bisphosphonate-related bone exposure.

DR. GRAHAM While the risk of bisphosphonate-associated osteonecrosis is relatively low in patients on oral regimens, the consequences can be devastating. Fortunately, diagnostic techniques are available and have shown promise in assisting clinicians in determining if a patient is at risk. A hematologic marker known as serum C-terminal telopeptide (CTX) not only provides a correlation to the duration of oral bisphosphonate use, but could indicate a recovery of bone remodeling after the oral bisphosphonate is temporarily discontinued. A stratification of relative risk has been noted, with CTX values less than 100pg/ml representing high risk, CTX values between 100pg/ml and 150pg/ml representing moderate risk, and CTX values above 150pg/ml representing minimal risk. The CTX values were noted to increase from 25.9 to 26.4pg/ml for each month of a drug holiday, indicating a recovery of bone remodeling and a guideline as to when oral surgical procedures can be accomplished with the least risk. In addition, drug holidays associated with CTX values rising above the 150pg/ml threshold were observed to correlate to either spontaneous bone healing or a complete healing response after an office-based debridement procedure.¹

DR. CACCIAFESTA What is the risk with diabetic patients?

DR. GRAHAM Diabetics are at no greater risk than the general population, so long as they are well controlled. If there is any question as to the



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quality of the patient's glucose control, requesting a hemoglobin A1c test in cooperation with the primary-care physician is appropriate. The American Diabetes Association currently recommends an A1c goal of less than 7.0%, while other groups such as the American Association of Clinical Endocrinologists recommend a goal of less than 6.5% to reduce complications secondary to microvascular disease.

DR. BUMANN We have used many pins successfully in patients with diabetes.

DR. SCHEFFLER I would place a miniscrew in a diabetic patient, with the understanding that it may be more likely to fail.

DR. CHO The main concern about diabetics would be the host immunity and the potential of infection after the placement procedure, especially if it is uncontrolled diabetes. The blood glucose level should be checked, and if the diabetes is well controlled, with the primary physician's medical consultation, micro-implants are not contraindicated.

DR. PARK In a case of diabetes, prophylactic administration of antibiotics should be done for the surgical placement procedure. Meticulous control of oral hygiene is also important.

DR. PAQUETTE Uncontrolled diabetics, or patients who may be controlled, but place themselves at a higher risk for infection due to poor oral

hygiene, would not be candidates for miniscrews in my office.

DR. CACCIAFESTA Please describe your preferred screw design.

DR. PAQUETTE I use the VectorTAS** system and generally follow the company's color-coded anatomical guide.

DR. SCHEFFLER For the majority of cases, I use an 8mm × 1.2mm VectorTAS self-drilling miniscrew with a delta head, and I hook a delta-eyelet nickel titanium coil spring over the top of the delta head.

DR. BUMANN I use the self-drilling tomas screw*** with either 6mm or 8mm length, 1.6mm outer diameter, and a bracket head, but with cortical bone perforation if needed. Bracket-head designs have multiple advantages over other head designs, especially in segmented biomechanics and for three-dimensional control of tooth movement. Patient discomfort has never been an issue with us.

DR. CHO I use a 6-7mm-long AbsoAnchor**** by Dentos. According to Wilmes and colleagues, the implant length does not contribute to its stability.² In fact, longer implants pose a higher risk of root damage if the angulation of insertion is not perfectly straight between the roots. My preferred diameter is 1.3-1.6mm with a tapered design, but in some interradiolar spaces of the posterior dentition, the implant may not have enough clearance. A round head with a hole is preferred for the comfort of the patient. Usually self-drilling is preferred over self-tapping; a self-tapping screw requires a pilot hole, which can be more destructive to the cortical bone, hence reducing the peri-implant bone quantity and quality. We also recently tried sandblasting the threads on the micro-implants to increase the surface area.

DR. PARK I prefer the tapered, self-drilling micro-implant with a 1.3mm diameter at the neck and 1.2mm diameter at the apex (AbsoAnchor). On the buccal side of the maxillary posterior teeth, I normally place implants that are 7-8mm long (at

the threaded part). On the palatal slope of the maxillary posterior teeth, with its thicker soft tissue, I prefer to place implants that are 10-12mm long. For the anterior teeth in both the maxillary and mandibular arches, I use 6-7mm-long tapered, self-drilling micro-implants. In the buccal alveolar bone of the posterior teeth, I prefer to place 6-7mm-long and 1.3-1.2mm or 1.4-1.3mm tapered or 1.3mm cylindrical micro-implants. On the palatal slope of the maxillary posterior teeth and in the mandibular posterior area, including the retromolar area, I use self-tapping screws that require pilot drilling.

DR. GRAHAM My length and diameter are also determined by the location of placement. Diameters of less than 1.5mm are necessary for interradiolar placement, and larger diameters with cutting flutes are advantageous for thicker cortical bone. The VectorTAS color-coded screws provide for these variables. Screw heads that allow for the "locking" of attachments while providing rotational freedom are advantageous, while bracket-head designs are distinctly disadvantageous due to the significant patient discomfort associated with sharp edges and the unwanted loosening or stripping forces that may occur.

DR. CACCIAFESTA When is it necessary to drill a pilot hole to insert a miniscrew?

DR. GRAHAM I never drill a pilot hole, as it is a recipe for failure. In areas of dense cortical bone, I will make a starter notch with a bur† created for just that purpose.

DR. SCHEFFLER I will only drill a pilot notch into dense cortical bone where it is difficult to penetrate the periosteum.

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†Initiator bur, Part No. 601-0002, Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com.

DR. CHO We need a pilot hole for the bones with very thick and dense cortical bone to avoid extreme insertion torques and the consequent risk of screw fracture. The diameter of the pilot drill impacts the initial stability. Ideally, it should be at least .3mm smaller than the micro-implant diameter.² If we plan to place the micro-implant obliquely, then a pilot hole is required to prevent slippage.

DR. PARK In areas of thin cortical bone—for instance, the maxilla—the self-drilling placement is better. On the other hand, angular insertion of a self-drilling micro-implant may cause breakage of the surface bone, especially in areas of thick cortical bone. Placing the micro-implants at an angle to the long axis of the tooth reduces the chance of root contact and increases the bone contact area. In this situation, the self-tapping (predrilling) method seems better.

DR. CACCIAFESTA Do you ever use miniplates for anchorage?

DR. GRAHAM No, but there certainly may be instances where a practitioner may elect to use them. In my practice, miniscrews have met my clinical needs.

DR. CHO I don't use miniplates, mainly because they do not offer anything more than micro-implants do. They also require a more invasive procedure, in which an open flap is always required, and miniplates cannot be guaranteed to be stable.

DR. PARK I tried a microplate in one patient who required protraction of the lower dentition for decompensation in skeletal Class III orthognathic surgery. It was good, but one of the four screws failed, and the miniplate became mobile, producing inflammation and infections. The success rate of anchor screws is approximately 90-93%, while the success rate for miniplates is not much higher, about 95%. The miniplate is much more expensive than the anchor screws; the surgical procedure is too extensive to be done by an orthodontist, and therefore requires an extra treatment fee for placement by an oral surgeon. The main difference between miniplates and miniscrews is the amount



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of force that can be delivered, but for tooth movement, there is no need to apply a force heavier than 200g. The miniscrews are also small enough to be placed in most sites in the mouth, including buccal and palatal interradicular bone, the retromolar area, and the palate, expanding potential clinical applications. The ability to load the orthodontic force immediately also shortens treatment time.

DR. PAQUETTE I have not used miniplates; however, I am considering placing maxillary buttress plates to treat skeletal Class IIIs, following Dr. Hugo De Clerck's protocol. At the AAO and the PCSO meetings this past year, he described managing Class III malocclusions with four miniplates and elastics, without any other appliances.³ His results were stunning.

DR. SCHEFFLER I will use miniplates when I need to increase the force load over 300g or use elastics that have noncontinuous properties. I was fortunate to be able to observe and learn about miniplate use for skeletal anchorage from Professor De Clerck back in 2002, and I therefore used miniplates when I first started using TADs. However, since then I have found I can place miniscrews with more reliability than oral surgeons placing miniplates for almost all indications. Thanks to Professor De Clerck's teachings, though, I will use four miniplates instead of miniscrews for skeletal Class III maxillary protraction cases, where the patient hooks elastics from upper to lower miniplates in a Class III force vector. I also

sometimes use two miniplates for difficult anterior open-bite cases where I would like to move the maxillary molars in an anteroposterior direction at the same time I am intruding them, rather than have the patient wear elastics to extrude any of the molars.

DR. BUMANN In certain cases, we use miniplates at the infrazygomatic crest for molar intrusion or distalization of posterior segments. With miniplates, we have no pins between the roots, avoiding a change in biomechanics. In the upper jaw, however, nowadays we use exclusively miniscrews in the anterior palate. Thus, we don't see a need for miniplates any more.

DR. CACCIAFESTA Before placing a miniscrew, do you take any diagnostic records in addition to your normal pretreatment records?

DR. BUMANN No, since we routinely have cone-beam computed tomographs (CBCTs) and plaster casts, we don't need additional records.

DR. CHO Right before the placement appointment, a panoramic x-ray is taken to evaluate the available interradicular space in the desired implant placement location. Ideally, a CBCT is preferred so that the interradicular space and cortical bone thickness can be measured before placement.

DR. PAQUETTE I have an iCAT[‡] in my office. We use a 300-micron, five-second scan, so the radiation exposure is very similar to that of a pano. The difference is that I can evaluate both root position and bone in all planes of space. In addition, we can pull up the scan at the treatment chair, so I have it readily available during the procedure. The scan is included in the price of placing the miniscrew. There are occasions where the pano can give you a false sense of security, either with the perceived amount of bone or with root position due to image distortion.

DR. GRAHAM I, too, have an iCAT, and use the

volumetric data as a tool, but I rely more on my clinical evaluation and feel for safe miniscrew placement.

DR. PARK Periapical radiographs are needed to evaluate the distance between roots. CBCTs and fluoroscopes are also great tools, but these procedures cost a lot.

DR. SCHEFFLER I typically take a progress panoramic radiograph or periapical radiograph prior to placing a miniscrew, just to make sure I have diverged the roots enough and to ensure there are no dilacerated roots to worry about.

DR. CACCIAFESTA What locations do you find the most reliable for successful miniscrew placement for particular types of cases?

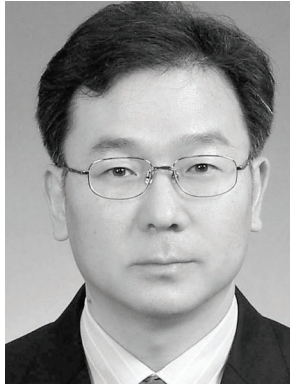
DR. PAQUETTE I find they are all about equal if there is adequate bone.

DR. SCHEFFLER I have found the maxilla to be slightly more reliable than the mandible, and the literature seems to support this as well. I will place the maxillary miniscrews in the palate and between any of the maxillary teeth. In the mandible, the vestibule is more shallow, and there is sometimes a frenum between the canine and first premolar that needs to be avoided. When planning for miniscrew placement, I will place brackets to diverge roots and place the miniscrew in the position that is best biomechanically. I will also attempt to place the miniscrew in attached gingiva rather than unattached mucosa, also to improve the reliability of that miniscrew.

DR. BUMANN In the upper jaw for almost all indications, I prefer the anterior palate; in the lower jaw, between either the two premolars or the two molars.

DR. GRAHAM I love placing miniscrews in the palate, because of the density and uniformity of the bone, along with the lack of mobile mucosa. I routinely place miniscrews throughout the mouth without difficulty, however, as long as the proper screw diameter and length have been chosen for that location.

[‡]Registered trademark of Imaging Sciences International, 1910 N. Penn Road, Hatfield, PA 19440; www.imagingsciences.com.



Dr. Park

DR. CHO For maxillary anchorage in retraction of the anterior teeth, I place the miniscrews between the second premolar and first molar; for maxillary molar intrusion, in the midpalate; for maxillary arch constriction, in the midpalate around the molars. For mandibular molar intrusion, I prefer between the first and second molars, but for retraction of the entire mandibular dentition, I use the retromolar pad. For molar protraction or distalization, I prefer the area between the canine and first premolar; for Class III distalization, the retromolar area of the mandible, or between the second premolar and first molar; for Class II distalization, also between the second premolar and first molar.

DR. PARK I use 1.3mm-diameter micro-implants, which can be placed into most areas of the mouth, even between roots. I have the highest success rate with the maxillary palatal slope of alveolar bone. A micro-implant placed into the palatal alveolar bone between the first and second molars can be used for applying distal retraction force in lingual treatment or for applying intrusive force to the maxillary posterior teeth in open-bite treatment and preprosthetic treatment. If we connect the maxillary first molars with a transpalatal bar, a distal force can be applied from the micro-implants to the transpalatal bar to distalize the molars. The midpalatal area is also a good site for micro-implants, but they need to be connected to teeth for indirect anchorage, and they tend to develop local redness and inflammation.

The maxillary buccal alveolar bone is the site with the next highest success rate. We normally place the micro-implants between the second premolars and first molars, because the interradicular space is wider than between the first and second molars. This site can be used for distal retraction of the six anterior teeth in premolar extraction treatment and for distal retraction of the whole arch in nonextraction treatment.

The third most reliable sites are the interradicular alveolar bone between anterior teeth in the upper and lower arch. These sites are good for applying intrusive force to the anterior teeth. Next are the interradicular bone between the lower posterior teeth. Micro-implants in these sites or the retromolar area can be used for distal retraction of the lower anterior teeth or the entire lower dentition in Class III camouflage treatment or nonextraction treatment. The interradicular space at the mid-root level between the lower first and second molars is the widest in the lower arch.

DR. CACCIAFESTA Which locations are the least reliable?

DR. BUMANN In the upper jaw, between the two molars. In the lower jaw, between the canine and the first premolar, as well as between the central incisors.

DR. SCHEFFLER Due to an increased risk of tissue overgrowth and infection, I have found the areas with mobile mucosa to be less reliable and predictable.

DR. GRAHAM The maxillary tuberosity has a paucity of cortical bone and is generally unfit for miniscrew placement. Any area with mobile mucosa requires heightened vigilance due to a tendency to become irritated. The inflammatory response that follows initiates a localized osteopenia and is a prelude to screw failure.

DR. PARK In my practice, the mandibular posterior area has the lowest success rate, but it's still 80-85%. Mastication of food may irritate the micro-implants in this area, and the narrower zone of attached gingiva compared to the upper arch

may produce more inflammation, because micro-implants are more prone to inflammation in the oral mucosa than in the attached gingiva.

DR. CHO According to Dalstra and colleagues' finite-element studies,⁴ cortical bone thickness of less than .5mm and low-density trabecular bone cannot provide sufficient initial stability of a micro-implant, because the peak bone strains reach values associated with pathological overloading, as explained in Frost's mechanostat theory.⁵⁻⁸ According to the findings of Dalstra and colleagues,⁴ Wilmes and colleagues,² and Miyamoto and colleagues,⁹ more cortical bone provides higher initial stability. Location-wise, the maxillary tuberosity area was shown to have poor-quality bone, and the maxillary bone was shown to have generally less cortical bone thickness and mineral density than the mandibular bone. However, many clinicians find more late failures of micro-implants in the mandible. This is because there is more physiological loading in the mandible, and therefore more strain develops in the peri-implant bone tissue of the mandible than in the maxilla.

DR. CACCIAFESTA What anatomical considerations are there in the maxilla regarding miniscrew placement?

DR. BUMANN There must be enough bone available between the roots or in the palate, but this is usually the case between the second premolars and first molars, as well as in the anterior palate area.

DR. CHO The interradicular space between the first and second molars is usually narrow on the buccal side, due to the anatomy of the maxillary molar roots. The interradicular space between the first and second molars is greater on the palatal side than on the buccal side, and the interradicular space is generally narrower in the maxilla than in the mandible. Usually, the greatest interradicular space can be found between the maxillary first molar and second premolar.

DR. SCHEFFLER When placing miniscrews in the buccal alveolus of the maxilla, I look to avoid

frena and a possible pneumatized sinus. In the palate, I recommend avoiding the greater palatine foramina, the nasopalatine canal, and the palatal suture unless it is completely ossified.

DR. PAQUETTE Root proximity and sinus pneumatization can both present problems. Although palatal placement in the molar area may theoretically present an issue with the greater palatine artery, I use a common aspirating syringe in this area to test the site prior to screw placement.

DR. GRAHAM Avoidance of neurovascular bundles is important, but straightforward. The greater palatine foramina and nasopalatine canal are situated such that miniscrew impingement is unlikely, but caution is advised. Pneumatized sinuses are apparent on routine radiographs and should be avoided. In growing individuals, the midline of the palate should be avoided to prevent the possibility of incomplete suture fusion. Ironically, the palatal midline is a great source of thick bone in adults and is a great location for a miniscrew.

DR. PARK The thickness of cortical bone at the mid-root level increases from the anterior teeth to the posterior teeth, but only from 1.3mm to 1.6mm. The bone density is highest at the canine and premolar and lowest at the maxillary tuberosity. When placing a micro-implant into the buccal alveolar bone between roots, the clinician should have information on the available interradicular space, the root shape, the purpose of the micro-implant from a biomechanical standpoint (force direction), the thickness and density of the cortical bone, the thickness of the attached gingiva, and the presence of a frenum.

The vertical height of the micro-implant head, which determines the direction of force, should be 8-10mm apical to the bracket slot in premolar extraction treatment and 5-6mm in non-extraction, whole-arch-retraction cases. Because the root is conical, there is more space in the apical area than in the gingival area. To place the apex of the micro-implant in the apical root area and reduce the chance of root contact, I incline the implant at 30-40° to the long axes of the teeth.

Angulating the micro-implant also allows me to place it in the attached gingival zone.

A micro-implant between the second premolar and first molar should be placed .5-1mm mesial to the crown contact point. The distance from the buccal bone surface to the buccal root surface at the second premolar is wider than that at the first molar because the second premolar has only one buccal root. On the palatal side, the widest interradicular distance is between the second premolar and first molar, but I prefer to place the micro-implant between the first and second molars because the maxillary molar has only one palatal root. This site is good for applying intrusive force to the posterior teeth in open-bite treatment and for applying distal force to the first molars through a transpalatal bar.

The main consideration when placing micro-implants in the palatal slope of the posterior regions is the thickness of soft tissue. I want the micro-implant to extend at least 6mm into the bone, so if the soft tissue is 6mm thick, I need to choose implants that are 12mm long. Another consideration on the palatal slope is the greater palatine nerve and artery, but because an incision is not required and the placement site is gingival to the nerve and artery, they will not usually be damaged. In the palatal slope, I use the same 30-40° angulation to the long axes.

DR. CACCIAFESTA What anatomical considerations are there in the mandible regarding mini-screw placement?

DR. CHO The interradicular bone space and cortical bone thickness and the location of the mental nerve.

DR. BUMANN Just as with the upper jaw, there must be enough bone available between the roots. This is usually the case between the two premolars and the two molars.

DR. GRAHAM The mental foramina should be avoided, which is not difficult, as they are found well below the depth of the vestibule. Care should be taken when choosing the length of miniscrews in the anterior region, as a screw can easily engage



Dr. Scheffler

and even perforate the opposite cortex if it is too long.

DR. PARK The widest interradicular space in the lower arch is between the first and second molars. I prefer this site for micro-implants to distalize the anterior and/or posterior teeth. The distance from the buccal bone to the buccal surface of the root is wider at the second molar than at the first molar, so it is safer to place the micro-implant .5mm distal to the contact point of the crown. I incline the microimplant 30-60° to the long axes of the teeth buccolingually.

The thickness of cortical bone increases from 1.3mm at the anterior teeth to 3mm at the posterior teeth. I prefer to place 6mm-long micro-implants in the lower arch, and if I angulate 30°, the vertical depth of the implant is only 3.2mm, so it probably will not contact the roots. Because the roots of the first and second molars are curved distally, I recommend using a 10° distal angulation when placing micro-implants between the first and second molars.

The distance from the outer bone surface to the outer surface of the root is 2.5mm at the first molar and 5.3mm at the second molar. Therefore, a micro-implant can be placed just buccal to the second molar to apply buccal uprighting and intrusive forces in treatment of crossbite.

DR. PAQUETTE Root proximity and the mental foramen can both present problems. The CBCT can be very useful in identifying potential ana-

tomic issues. The other issue in the mandible is that the bone tends to be a little denser, so one must use a screw with cutting threads as well as deliver the screw a little slower to allow the stress to disperse.

DR. SCHEFFLER When placing miniscrews in the mandible, I look to avoid frena and the mental foramen below the apices of the lower premolars, and I never place miniscrews on the lingual.

DR. CACCIAFESTA Do you place your own miniscrews?

DR. GRAHAM Absolutely, as should all orthodontists. Relinquishing this duty to another practitioner is fraught with complication for the orthodontist and the patient, not to mention the specialty. Patients deserve to have the orthodontist's knowledge of biomechanics in play as the screw is placed. Orthodontists owe it to the patient to be able to replace a loose screw or remove and reinsert a screw that is no longer useful, instead of having to rely on another doctor to perform this service. Orthodontics as a profession needs to hold on to anything that it can (read: miniscrews) in order to further the cause of the specialist.

DR. CHO Yes, we place the micro-implants ourselves.

DR. BUMANN We have also placed our own pins for 10 years.

DR. PAQUETTE I began placing them in 2005 when I found the cost and the inconvenience to the patient of relying on a surgeon to place them tended to cause patients not to proceed with placement. I also had several occasions where the initial site did not work out and the surgeon, meaning well, placed them in an area that was not helpful biomechanically.

DR. SCHEFFLER I definitely place my own miniscrews, so I can place them in the best biomechanical position.

DR. PARK I have placed the micro-implants for 10 years. I agree that orthodontists know the exact position needed for the micro-implants for ortho-

dontic treatment. When there is a need to modify the position of the micro-implant owing to soft tissue, the frenum, or not enough space, close communication is required. If a micro-implant placed by the oral surgeon fails, it is difficult to find out who is responsible for the failure. This causes patient frustration and additional visits to the surgeon's clinic.

DR. CACCIAFESTA Do you use a topical anesthetic or local infiltration, or both, before miniscrew insertion?

DR. BUMANN We use a topical anesthetic (Tetracaine/Lidocaine) and local infiltration (Ultracaine).

DR. GRAHAM I use a strong topical anesthetic, usually followed by needle-less infiltration with a Syrijet.†† I use ProfoundPET from www.stevensrx.com‡‡ as described in a previous JCO article.¹⁰

DR. PAQUETTE I also use the profound topical from Steven's Formulating Pharmacy, and I use the Madajet§ in addition. On the palatal, I will use an aspirating syringe.

DR. SCHEFFLER I use a topical anesthetic gel (10% Prilocaine, 10% Lidocaine, 4% Tetracaine) that a compounding agency§§ makes for me, prior to a spray of anesthetic (2% Lidocaine with 1:50,000 epinephrine) under pressurized air, using a Syrijet Mark II.

DR. PARK In very nervous patients, I will apply a topical anesthetic (10% Xylocaine) before local infiltration of Lidocaine anesthetic, but it is very rare. Sometimes an anesthetic patch or topical anesthetic solution can be applied to the mucosa after drying the surface. Because of the nociceptive nerve fiber at the mucosa and periosteum, we can obtain enough anesthesia with local infiltra-

††Trademark of Keystone Industries, 616 Hollywood Ave., Cherry Hill, NJ 08002; www.syrijetinc.com.

‡‡Steven's Pharmacy, 1525 Mesa Verde Drive E., Costa Mesa, CA 92626; www.stevensrx.com.

§Trademark of Mada, Inc., 625 Washington Ave., Carlstadt, NJ 07072; www.madamedical.com.

§§John Hollis Pharmacy, 1923 Hayes St., Nashville, TN 37203.

tion. By infiltrating only a small amount of anesthetic, the periodontal ligament is intact for sensation, and this may be an indicator to avoid root contact.

DR. CHO We use a minimal amount ($1/20$ – $1/10$ of an ampule) of anesthetic (2% Lidocaine, 1:100,000 epinephrine) for local infiltration, just enough to numb the soft tissue.

DR. CACCIAFESTA Do you use a miniscrew placement guide?

DR. GRAHAM Absolutely not. It is my opinion that placement guides are inaccurate and potentially more risky than not using a guide at all. Two-dimensional radiography cannot provide the information necessary to accurately interpret the location of a positioning auxiliary. What placement guides do provide is a false sense of security for the practitioner. Contact with a tooth root heralded by an increase in resistance might be ignored by a clinician because a placement guide “told” them that they were clear of roots.

DR. SCHEFFLER I have also found them unnecessary, misleading, and often obstructive.

DR. PARK I used a guide when I started to place micro-implants, but after placing 20 implants, I did not use one any more. The guide requires time to prepare and to take radiographs.

DR. BUMANN They don’t work, since every patient has individual anatomical dimensions.

DR. PAQUETTE The concept is actually impractical if one thinks about it. Unlike a typical implant, the screw is quite short and generally tapered toward the tip. In addition, the driver head is quite large compared to the actual screw itself. Because of these issues, the amount of play or freedom of movement within the guide would generally be greater than the typical error of free-hand placement.

DR. CACCIAFESTA Have you ever hit a root during miniscrew insertion?

DR. PAQUETTE Yes, I have. I simply redi-

rected the screw away from the root if it was at the initial stage of insertion. If it happens in the later stage of insertion, then the screw needs to be backed out and another site located—otherwise, the screw hole would be hollowed out, and the screw would likely fail. I have had this happen a few times, and sometimes it can be unclear if the screw is actually touching the root or if they are feeling residual pressure in the bone. If the patient complains of this, I will take a radiograph and evaluate if there is any likelihood that the screw is in contact with the root. If it is, then I move the screw.

DR. CHO Sometimes if my patient tells me that they feel some pain during placement, it is possible that the root was touched by the micro-implant, because I only anesthetize the soft tissue through the infiltration technique. Then, I check the insertion path and retrieve and redirect if necessary. Also, the clinician can feel a sudden large resistance to driving of the thread if the root is touched.

DR. PARK With a hand screwdriver, you will notice the difference in resistance when the micro-implant meets the root. If there is very strong resistance, you need to unscrew the micro-implant and change the direction. If you tighten it further after strong resistance, the screw may damage the root, or a smaller-diameter micro-implant may be broken. It happens more in the lower arch; because the mandible has thick and dense cortical bone, it is difficult to differentiate between resistance from the cortical bone and resistance from the root.

DR. GRAHAM Hitting roots isn’t terribly uncommon and shouldn’t be feared. Simply redirecting the miniscrew corrects this problem. Perforating roots is what should never happen and, with proper training, won’t. It happened to me once, several years ago when just learning the technique on my own through trial and error. In that instance, I removed and redirected the screw without incident.

DR. BUMANN Yes, we left the pin, because usually nothing happens. In the worst case, the pin gets loose.

DR. SCHEFFLER If I hit the root before the full diameter of the miniscrew is inserted, I back the miniscrew out and re-angle it. However, if the full diameter of the miniscrew is in bone before I hit a root, I back the entire miniscrew out and move it to another location.

DR. CACCIAFESTA Have you ever moved a root into a miniscrew?

DR. SCHEFFLER Yes, I removed the screw and allowed the root to heal and repair with cellular cementum.

DR. GRAHAM I removed the screw and repositioned it without any problems.

DR. BUMANN Again, we did nothing, because either the pin is getting loosened or the tooth is tipped.

DR. CHO Yes, either the micro-implant will loosen or the implant will actually migrate a bit while it maintains its stability. According to Kuroda and colleagues, root proximity is a risk factor for late failure of a micro-implant.¹¹ But even if the root touches the implant, sometimes the strain development from root contact does not overwhelm the remodeling capacity of the peri-implant bone tissue. In this case, the micro-implant can be migrated while it still maintains clinical stability.

DR. PAQUETTE I had a patient who came in complaining that they felt the screw with their tooth when they bit down. I took a radiograph to

confirm it, and then I moved the screw to a new location—which I describe to patients as “leap-frogging”.

(TO BE CONTINUED)

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