

JCO ROUNDTABLE

Skeletal Anchorage Part 2

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DR. CACCIAFESTA Do you load miniscrews immediately?

DR. PAQUETTE Yes, I load them immediately.

DR. BUMANN Yes, we load them on the same day when the placement was done. However, depending on the mounting torque moment, we start with individual forces of 50-150g.

DR. PARK There is no difference in success rate

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between immediate loading and delayed loading, and light immediate loading may actually increase bone contact. I load immediately after placement, but the force is light, less than 50-70g. I normally try to apply the force in the direction of tightening in the early stage.

DR. CHO The implant can be loaded immediately if it achieves sufficient initial stability. If the implant is placed in poor-quality bone, the loading should be delayed. By waiting two months, the peri-implant bone will have sufficient time to remodel, and thus there will be better quality bone around the implant.

DR. GRAHAM There is nothing in the literature to indicate that waiting for any period of time is advantageous for a miniscrew that is not osseointegrated.

DR. SCHEFFLER I load them immediately, but I may start out with a slightly reduced force on the miniscrew than what I may end up eventually loading on it.

DR. CACCIAFESTA What is the maximum load you would place on one miniscrew?

DR. BUMANN This is a question we never ask ourselves, because we don't need a maximum force; we just load the pin with average forces for

orthodontic tooth movement (50-200g). The individual maximum load on a given pin depends on the so-called “tip moment” (the distance from the point of force application to the cortical bone surface times the applied force). Preferably, the tip moment should not exceed 600gmm.

DR. CHO It depends on the diameter of the micro-implant and how good the initial stability is. In poor-quality bone or with less cortical bone thickness—which is one of the major factors that determine the initial stability of the micro-implant—the implant should not be loaded immediately, or minimally loaded. Theoretically, larger-diameter implants can endure more load, but normally no more than 300g of load will be necessary. We just need enough force to overcome the friction and activate the osteoclasts and osteoblasts. With excessive load on the implant, there will be more strain development in the peri-implant bone tissue that can be repaired, and therefore, micro-damage will accumulate in that tissue. Eventually, fatigue failure of the bone will loosen the implant.

DR. GRAHAM All miniscrews are not alike. Miniscrews from different manufacturers all have subtle differences in their diameter, length, and thread architecture. The screws that I currently use can easily maintain a maximum load of 250g. I don’t load the screw with 250g initially, but allow the peri-screw bone to fortify with initial forces of 150g, followed by 250g if such a force is necessary for a given case.

DR. PAQUETTE My maximum is 250g, in a situation where I am distalizing the entire arch—for example, a spring from a miniscrew placed in the lower retromolar area to a hook on the archwire between the molars, or the second premolar and first molar, depending on the individual.

DR. PARK I am using mostly 1.3mm- or 1.4mm-diameter micro-implants for orthodontic anchorage. In young, growing patients, we load a maximum of 200g. In adult patients, the maximum load we apply is 400g. In either case, the implants can be loaded with approximately 50-80g immediately, and one month after placement the force can be



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increased to 150-200g. In adults, the force can be increased to 400g when the micro-implants are osseointegrated, three months after placement.

DR. SCHEFFLER My maximum load is approximately 300g. When I use the Anterior Open Bite Splint* to intrude the posteriors, I use two 150g nickel titanium coil springs or one 250g nickel titanium coil spring from the appliance to the miniscrew.

DR. CACCIAFESTA How do you measure this force load?

DR. SCHEFFLER I use a force gauge.

DR. PARK A stress and tension gauge** can be used for measuring the magnitude of the load.

DR. CHO I can also measure the force extrorally, by measuring the distance between the two points where the force is applied. Then, the coil spring or the elastomeric chain can be stretched to the same distance to measure the force with a gauge.

DR. GRAHAM I use nickel titanium coil springs with predefined force values. In cases where I don’t use coil springs, I do have a force gauge, which I will occasionally dust off and use.

*AOA Laboratories, P.O. Box 725, Sturtevant, WI 53177; www.aolab.com.

**Federwaage Tension Gauge, Part No. 040-712-00, Dentaureum, Turnstrasse 31, 75228 Ispringen, Germany; www.dentaureum.de.

DR. PAQUETTE Based on the manufacturer's listing on springs or elastics, and given the variety of coil springs available and the force consistency of nickel titanium, I do not use a gauge to verify the force.

DR. CACCIAFESTA What are the optimal orthodontic forces for various situations in which miniscrews might be used?

DR. BUMANN For en masse retraction, we use 200g; for space closure from the distal, approximately 150g; for distalization of the upper molars, 200g; and for molar intrusion, 100-150g.

DR. CHO For en masse retraction of the anterior teeth into extraction spaces, 250g on each side for sliding mechanics, or 150g on each side for minimal-friction mechanics; for protraction or distalization of a molar, 150-200g; for molar intrusion, 100-150g; for constriction of the maxillary arch, 150-200g on each molar.

DR. GRAHAM In my opinion, anterior/posterior tooth movements (such as space closure) respond best to forces around 150g. I have found that molar intrusion, both maxillary and mandibular, responds better to forces around 250g.

DR. PAQUETTE I use 150g for small segments or intrusion of a segment of teeth, 250g per side for en masse retraction. Of course, forces are sometimes altered based on treatment response.

DR. PARK For retraction of the six maxillary anterior teeth, 150-200g can be used. To intrude one posterior tooth, 100g is the force I am using. For intrusion of an incisor, 50-60g is the force. For intrusion of all posterior teeth on a side, 200g of force is enough. The force seems to be light, but by moving teeth together, the clinician can complete treatment in a short time. Even though the maximum load for the micro-implant in adults is 400g, I load 200g in most cases. Using light forces may have positive effects on a higher success rate.

DR. CACCIAFESTA How do you usually deliver those forces?

DR. BUMANN We generally use nickel titanium coil springs.

DR. CHO If the coil spring cannot be used, we use power thread or elastomeric chain.

DR. PAQUETTE We use elastics or elastic chains where nickel titanium springs are not feasible due to patient discomfort from the springs irritating the soft tissues.

DR. PARK To apply intrusion forces, I normally tie elastomeric Super Thread*** or Square Thread**** from the micro-implants to the teeth. To apply force to the six anterior teeth for retraction of the maxillary anterior teeth or the entire dentition, I normally use nickel titanium coil springs, which can be connected from the micro-implants to hooks crimped between the lateral incisors and canines. To apply a retraction force to the lower anterior teeth or the whole dentition, I normally use elastomeric thread. If we use nickel titanium coil springs, there is lots of food impaction, especially in the lower arch.

DR. SCHEFFLER I typically prefer to set up force delivery using a continuous nickel titanium coil spring, which frees us from having to change the means of force delivery at subsequent appointments, and because the constant load decreases the risk of failure of the miniscrew.

DR. GRAHAM I prefer nickel titanium coil springs to allow for a light, continuous load. In the anterior, when I'm intruding incisors, I will use clear elastic thread for esthetics. In these cases, however, I have the patient return about every 10-12 days to retie the threads.

DR. CACCIAFESTA In what ways do you use indirect skeletal anchorage?

DR. PAQUETTE For protraction or retraction,

***RMO Europe, B.P. 20334, Rue Geiler de Kaysersberg, 67411 Illkirch Cedex, France; www.rmoeurope.com. Sold as "square elastomeric thread" by Rocky Mountain Orthodontics, Inc., 650 W. Colfax Ave., Denver, CO 80204; www.rmortho.com.

****Dentos, Inc., Daegu, Korea; www.dentos.co.kr. Distributed by Great Lakes Orthodontics, Ltd., P.O. Box 5111, Tonawanda, NY 14151; www.greatlakesortho.com.



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to avoid creating a vertical component. In other words, by using the screw to stabilize the anchor tooth, one can use more traditional archwire mechanics without introducing undesired side effects or having to use very complex biomechanical systems.

DR. GRAHAM When I plan a case, I always prefer using indirect anchorage over direct anchorage because I have more control, less side effects, and less screw failure. Generally speaking, I will ligate a miniscrew to a bracket, and then use the tied tooth as my fixed anchor. Sometimes, however, direct anchorage is the only viable option, such as in cases of molar or incisor intrusion.

DR. BUMANN Whenever possible we use indirect anchorage, because in our hands indirect anchorage shows higher success rates. Usually we combine the cross-slot of our pin with a stabilization wire to the second slot of the attachment. In other cases, we bond the stabilization wire to the surfaces of certain teeth.

DR. CHO If we are starting a segmental approach for uprighting molars or distalizing molars one at a time, we can place indirect anchorage on the micro-implant. The use of implants in conjunction with natural teeth results in a decrease of stress accumulation in the tissues around the implants. Splinting them together can increase the rigidity of the system. We bend an .019" × .025" rectangular stainless steel wire and connect the brackets

to the micro-implant as one unit.

DR. PARK Indirect anchorage can be used for preprosthetic orthodontic treatment, when the number of teeth available for bonding brackets is limited. By connecting a micro-implant to the anchor tooth, the clinician only needs to bond one or two teeth for intrusion of a molar or molars, molar uprighting, space distribution, or forced eruption.

DR. SCHEFFLER I typically use indirect anchorage for molar protraction in the mandibular arch, because the vestibule is so shallow that it is difficult to use a power arm to translate the molars forward. I will also use indirect skeletal anchorage if I need to use interarch elastics, so I do not introduce a noncontinuous force on a miniscrew.

DR. CACCIAFESTA Have you ever used mini-screw-retained pontics to replace missing lateral incisors in growing individuals?

DR. CHO No, but I will if I have a good candidate for such treatment.

DR. BUMANN We don't see a need for this, because there are less invasive methods available.

DR. PARK I don't think it seems to be a good way to maintain space for the incisors in growing patients. Dental implants can interfere with vertical growth of the alveolar bone and generate vertical bone defects, and the same might be true with micro-implants.

DR. SCHEFFLER I use them for selected patients who I know will take care of the temporarily placed miniscrews and pontics and will replace them when they can have permanent implants placed (Fig. 3). I have had good success so far with those that I have placed them on with no failures of the miniscrews, but I have had the pontics break, which were repaired or refabricated.

DR. GRAHAM I am using this technique more and more frequently, as the results I'm observing are very promising, and patients are very happy. For too long orthodontists have provided two options for congenitally missing lateral incisors:



Fig. 3 Miniscrew-retained pontic replacing missing lateral incisor in adolescent patient.

flippers or resin-bonded bridges—both of which are problematic on their own as temporary restorative options, neither of which address the continued atrophy of alveolar bone. Now, with cone-beam data becoming more readily available to orthodontists, it will be very interesting to see if indeed we are preserving alveolar bone with this technique.

DR. PAQUETTE I have treated multiple patients now using the miniscrew-lateral technique, with great success. The first one I placed failed the next day, but the technique I now use is much more predictable, and the patients and parents have been really pleased with the results.

DR. CACCIAFESTA In what percentage of cases in which you have used miniscrews have you achieved your desired outcome?

DR. BUMANN 94%.

DR. CHO Approximately 80-90%.

DR. SCHEFFLER Greater than 95%.

DR. GRAHAM Also greater than 95%.

DR. PAQUETTE In my practice, 95%. I treated my first miniscrew patient in 1992 by having my

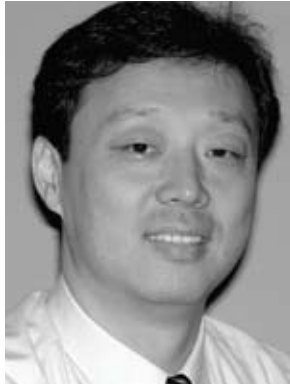
local oral surgeon place two bone screws for me to connect springs to. We treated one other patient then, but the screw design was not all that good, and unfortunately we did not use many more until the current generation of screws became available around 2003.

DR. PARK In terms of success of the microimplants, the success rate is approximately 90%, but in terms of success of treatment, we can have almost 100% success by placing the micro-implant in a different location. For instance, the upper molar can be distalized using buccal microimplants, but if a buccal one fails, the palatal side is a good site for another micro-implant to continue the distalization.

DR. CACCIAFESTA In cases where you did not achieve your desired outcome, what were the causes?

DR. BUMANN Mainly pin failure. In some cases, intrusion of molars is not predictable.

DR. GRAHAM Either because of poor treatment planning on my part, or because of poor bone quality or cooperation on the patient's part.



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DR. CHO Implant failures can come mostly from lack of patient cooperation, bad oral hygiene, and inadequate post-placement care, which could lead to multiple failures. Another possible cause is the accidental hitting of the micro-implant with a toothbrush. Less common causes are when the bone quality is poor or there is a very tight interdental space.

DR. PARK Fracture of the micro-implants during placement may interfere with proper use. This can be prevented by careful consideration of bone density and modification of the insertion methods. The impingement of micro-implants into the periodontal ligament or contact with the root may also increase the chance of failure. Infection is another cause of failure that may arise more frequently in the lower arch than in the upper arch, and with a flap operation than with a non-flap operation.

DR. PAQUETTE Placing a screw interproximally in the upper arch, early on I sometimes found myself placing them too close to the crest of the gingiva, even though clinically I thought I was in the correct place. Another area that may cause problems is in the maxilla between molars, when the sinus has pneumatized palatal to the facial plate. Occasionally on a panoramic image, it appears that there is plenty of bone, but when viewed on a cone-beam computed tomography (CBCT) scan, there is actually very thin bone, which leads to screw failure. If the resistance changes during insertion, and suddenly it is quite

easy to complete insertion, the screw needs to be removed and a better site selected. In the case of lack of compliance, generally with elastics that the patient is supposed to attach to the screw, a different biomechanical system needs to be developed that does not require patient participation.

DR. SCHEFFLER In some cases, I needed to use miniscrews on a transfer patient or after a patient had been in braces for almost two years. Often the patient was ready to be done with treatment and was satisfied with a less-than-perfect result, though I might have wished to see the case go to completion. Occasionally we have used miniscrews as a bailout for difficult cases at the end rather than at the beginning of treatment. If cases are planned properly from the beginning and the treatment plan is realistic, I feel that the desired outcome is generally achieved.

DR. CACCIAFESTA How often do you experience loosening of a miniscrew?

DR. PAQUETTE Rarely—less than 5%. I have taught numerous orthodontists to place screws in hands-on courses, and I find that there are common errors that lead to failure. Experience tends to make placement more predictable.

DR. BUMANN I'd say 5-6%.

DR. GRAHAM My failure rate is consistently around 4-6%. This wasn't always the case, as the learning curve takes a toll. However with time and experience, all orthodontists should expect a failure rate in this range. We must keep in mind that miniscrews can and do come loose, just like bracket failure. It happens to the most seasoned practitioners, and should never get us down.

DR. SCHEFFLER I have been keeping track of all miniscrews I have placed, and only 6% of those I placed in the past six years have failed. Occasionally some that became loose were retightened and the final objective obtained, but typically if the miniscrew became loose, it failed and needed to be removed or it fell out on its own.

DR. PARK My failure rate is about 7%, but loosening means failure. Once a micro-implant

becomes loose, the mobility increases over time, and it will fall out.

DR. CHO Overall, I see about a 20-30% rate of micro-implant loosening.

DR. CACCIAFESTA What do you think causes this loosening?

DR. GRAHAM Root proximity, poor hygiene, initial lack of primary cortical stability, cyclical forces directed to the screw, detrimental torque and moments applied to the screws, just to name a few factors.

DR. CHO There are different causes for initial instability and late instability. Three types of factors contribute to initial instability: material (thread design of the micro-implant), host (bone quantity and quality), and operator (placement technique, such as placing micro-implants in narrow interdicular spaces so they are touching the roots). Two factors contribute to late instability: inadvertent hitting of the implant head from chewing or with the toothbrush head, and the patient not brushing around the implant head, which will cause inflammation of the peri-implant soft tissue.

DR. PARK I agree it is multifactorial. According to studies, the major risk factors for failure are placement in the mandibular posterior area, placement in unkeratinized gingiva, and inflammation.¹²⁻¹⁴ Because most failures occur within three months of placement, however, the surgical technique is of the utmost importance. The most important point is preservation of the cortical bone during placement. If we cause mechanical and/or thermal damage to the bone, the bone will be resorbed, and failure may occur. Copious coolant irrigation is essential with self-tapping screws, and intermittent rather than continuous drilling should be used to reduce heat generation. If the torque or resistance decreases at the end of insertion, the implant is overtightened, which will cause stripping of the bone. The micro-implant should have initial stability—in other words, should be firm just after placement. In the palatal area, for instance, where the soft tissue is thick, it is common for a micro-implant not to be seated firmly.

Local inflammation is another cause of failure. Inflammation may resorb bone and spread to the interface, so that failure of the micro-implant occurs. Oral hygiene should be carefully controlled, with meticulous attention not to apply heavy force. Food thrusting against the micro-implants is also thought to be a cause of failure in the lower posterior area, and accidental force from a finger or fork may be another cause. Host factors such as systemic disease and smoking may be involved as well.

DR. BUMANN I find the most common problems are inadequate space between the roots, high mounting torque moments, micromotion, tip moments, and placement within the mucosa.

DR. SCHEFFLER In some cases of loosening, I feel that the miniscrews were placed near roots and their periodontal ligaments.¹¹ Loading the miniscrew with too heavy a force and/or infection from placement in unattached mucosa may cause the miniscrew to loosen. I also believe an inexperienced clinician placing a miniscrew may not realize that they did not obtain good primary stability, possibly due to poor bone density, inaccurate placement (in soft tissue or just crestal bone), or because they caused a widening of the hole during placement.

DR. PAQUETTE The most common error is to move away from yourself with each turn of the screw. In other words, during the process of rotating the wrist, there is linear movement at the same time. This results in an oval bony entrance hole as opposed to a circular hole. Only two points on the screw are engaged in the bone, so it is doomed to failure. The other problem I have seen is the tendency to place them too close to the crest of the gingiva, not remembering that there are several millimeters of soft tissue before there is bone, and then there needs to be enough bone on each side of the screw to withstand the loading forces.

DR. CACCIAFESTA Has your failure rate decreased over time?

DR. GRAHAM Absolutely, just like any other clinical procedure in dentistry.

DR. PAQUETTE The first year I placed them, I had about 20% failure. Last year, I placed approximately 60 screws and had two fail.

DR. BUMANN Our failure rate has decreased significantly, from 30% in the beginning, but it is important to understand that the 30% were due to the experimental development of the system and procedure 10 years ago.

DR. SCHEFFLER Switching predominantly to VectorTAS[†] miniscrews and diverging the roots prior to miniscrew placement seem to have dramatically reduced my failure rate, as well as made miniscrew placement more comfortable for the patient and easier for me.

DR. PARK At the Department of Orthodontics where I am working, the experienced professors have higher success rates than the postgraduate students. I have checked my own success rate over time—in 1999, it was 80%; in 2003, it was 93%; and in 2006, the success rate was 92%. I think it follows a learning curve.

DR. CHO Of course, there is a learning curve in the placement technique. It is important to have a minimally destructive technique to conserve the cortical bone, which is one of the major determinants of initial stability.

DR. CACCIAFESTA What do you do if a screw loosens?

DR. BUMANN We take it out and replace it with a new one.

DR. PAQUETTE I either tighten it or replace it.

DR. GRAHAM If a screw is loose, I will tighten it down gently. If it remains mobile, I will continue to use it as long as it is stable and isn't going to cause adjacent tooth damage or gingival irritation. Otherwise, I remove it and place a new miniscrew in a nearby location.

DR. SCHEFFLER I may take it out immediately if I need absolute anchorage and do not want



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to risk the chance of any undesired tooth movement. Typically, I will retighten the screw and decrease the load, then see if it will retighten and provide enough anchorage for me to obtain my desired result. If it does not retighten, I will remove it and allow the tissue to heal and be rid of any potential infection, then replace the screw in a slightly different position.

DR. CHO If the micro-implant must be replaced at the previous location for biomechanical necessity, the peri-implant bone should have an adequate healing time of two months, in which the woven bone at the removal site can mature. If another location can be found with little change in the previous biomechanics, the implant can be placed in another location on the same day.

DR. PARK If there is mobility one or two months after placement, I tighten the micro-implant and load very light force in the tightening direction until the implant has osseointegrated. A report that uninfected dental implants were re-osseointegrated after unscrewing and screwing supports this procedure.¹⁵ A micro-implant that showed mobility one month after placement was tightened with the tip of the screwdriver, and it became firm after several months of observation. The removal torque for this micro-implant was over 10g, meaning that it was osseointegrated. In my clinical experience, 50% of mobile micro-implants have been saved with this procedure.

[†]Trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com.

DR. CACCIAFESTA If you have used miniscrews with bracket heads, as opposed to button-top screws, have you noticed loosening or stripping due to clockwise or counterclockwise rotational moments?

DR. GRAHAM Yes, I have, and this has been supported in the literature.¹⁶ Whether the rotational force is clockwise or counterclockwise, it always seems to increase the failure rate. I have not found this problem with non-bracket-headed miniscrews.

DR. BUMANN We use exclusively bracket heads, but we have never noticed loosening, because this doesn't take place with stabilization wires. In cases where we are uprighting molars with tomas uprighting springs,[‡] we counteract the rotational moments by bonding the wire to the enamel of the adjacent teeth.

DR. CHO Our micro-implants have clockwise and counterclockwise threads for the bracket-head design. Activation of orthodontic appliances, usually rectangular arches, should create further tightening moments on these implants if the force is applied in the direction of tightening. By planning out the biomechanics of the treatment (in other words, the moment to be applied to the micro-implant), the clinician can choose between the clockwise and counterclockwise thread design to prevent loosening.

DR. PARK The prerequisite to using bracket-head micro-implants is firm and solid osseointegration to the bone; otherwise, the implants may rotate. Therefore, if the clinician wants to use these bracket-type micro-implants, the patients should be adults, and enough time should be provided for osseointegration. Then, if a wire is tied into the bracket slot, which produces a big moment, the micro-implant will be able to withstand this moment.

DR. CACCIAFESTA Have you experienced miniscrew breakage on insertion or removal?

DR. BUMANN We have never experienced pin breakage. The torque moment at breakage for the tomas pin SD (self-drilling) is approximately 43g, and our common mounting torque is between 10 and 23g.

DR. SCHEFFLER I have only had one screw fracture. In that case, I placed another screw near the site of the fractured screw and left the fractured screw in place.

DR. CHO We have had the tip of the micro-implant break a couple times. In one case, I informed the patient, took an x-ray, and monitored; so far, it has not caused any problems. In the other situation, a surgeon removed the broken thread easily after a small incision of soft tissue. The simple way to remove a micro-implant is by turning the manual screwdriver counterclockwise very gently. One suggestion by Kim and colleagues is to touch the head of the micro-implant with a round carbide bur, which can loosen it so that removal can be swift and safe.¹⁷

DR. GRAHAM I have never personally experienced a miniscrew breakage, although now that I said that, I'm sure it will happen—great.

DR. PAQUETTE I've had no difficulties in removing miniscrews; in fact, I have had a couple of teenagers remove the screws themselves when they knew they were scheduled to have them out.

DR. PARK When I was using surgical micro-screws, I had fractures during placement as well as removal because the inner diameter was very small. The first time, I tried to remove the screw, but it was very difficult to remove; the microscrew was fractured in pieces even during removal. If a micro-implant is broken during placement and some portion is left outside the bone, I tie the ligature wire around the screw, make an extension, and apply the force. To minimize the chance of fracture on removal, the clinician needs to apply a very gentle unwinding force on the initial turn. Once the interface is broken, the micro-implant comes out easily. A micro-implant that is fractured during removal is better left in place, because removal involves a flap opening, grinding of the

[‡]Registered trademark of Dentaurum, Inc., 10 Pheasant Run, Newtown, PA 18940; www.dentaurum.com.

surrounding bone, and grasping and turning the micro-implant with a Weingart plier. Because buccal micro-implants are near the gingival margin, removal of marginal bone may produce periodontal breakdown. The small piece of titanium would not cause serious complications, considering that surgical miniplates are not removed after orthognathic surgery in most cases. If the patient accepts leaving it in place, it is less traumatic. Another strategy that makes it easy to remove a fractured micro-implant is to use an ultrasonic scaler to stir up the interface, then wait for one or two weeks and apply gentle force to remove it.

DR. CACCIAFESTA What do you do to avoid infection around miniscrew placement sites?

DR. BUMANN Rinsing the mouth with any chlorhexidine solution is required prior to the procedure. Also, using a tissue punch for sharp, clean tissue conditions as well as placing the pin within the attached gingiva will lead to perfect soft-tissue adaptation around the transmucosal part of the tomas pin.

DR. PARK During the placement procedure, disinfection procedures are essential. This includes daubing with Zepherine gauze,†† and I also prescribe antibiotics for the patient to take two hours before placement or after surgical placement. One study showed that prophylactic administration of antibiotics increased the success of dental implants.¹⁸ I prefer to use penicillin or cephalosporin. During treatment, I instruct patients to clean the micro-implants with a Waterpik‡‡ and not to apply intentional force with a finger or fork. A toothbrush may irritate the marginal soft tissue and aggravate inflammation. For local inflammation—for instance, redness of the soft-tissue margin at the neck of the micro-implant—I do not prescribe antibiotics, but instruct the patient to maintain better hygiene with a Waterpik.

DR. PAQUETTE I do not use antibiotics before or after placement unless the patient would require SBE coverage, and then I would consult with their physician.

DR. SCHEFFLER Immediately before and after



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I place the miniscrew, I swab the area with .12% chlorhexidine. Then I have the patient swab with a Q-Tip or lightly brush with a toothbrush dipped into a cup of chlorhexidine every night before bedtime until the miniscrew is removed. I have not had to use antibiotics, because I have never seen an infection that chlorhexidine or the removal of the miniscrew couldn't clear up.

DR. GRAHAM I instruct my patients to dip their toothbrush in a small bottle of .12% chlorhexidine that I provide, and brush their miniscrew twice a day. Patients must understand that they shouldn't fear their miniscrew. Proper brushing maintains a firm, healthy gingiva around the miniscrew.

DR. CHO Our patients are given very detailed micro-implant home-care instructions (Fig. 4). The patient is asked to brush the peri-implant area thoroughly with a Microbrush§ and to use a warm salt-water rinse at night.

DR. CACCIAFESTA What marketing methods do you use to gain acceptance of miniscrews by patients and referring doctors?

DR. GRAHAM I have a video on YouTube that

††Samnam Pharm Co., Ltd., Geumsan-Gun, Chungcheong-Namdo, Korea.

‡‡Registered trademark of Water Pik, Inc., 1730 E. Prospect Road, Fort Collins, CO 80553; www.waterpik.com.

§Registered trademark of Microbrush International, 1376 Cheyenne Ave., Grafton, WI 53024; www.microbrush.com.

Post-Operative Instructions for Micro-Implant Care

You have just received one or more micro-implant(s). Your micro-implant will help you greatly in achieving our treatment objectives. However, micro-implants are delicate and can loosen and fall out. Here are some things to watch:

Home Care

- Be careful with an electric toothbrush (especially Sonicare or any vibrating brush), and do not touch the micro-implant with a vibrating brush head.
- Keep the area of the micro-implant clean by gently using the interdental brush that we have provided.
- Use a salt-water rinse before bed.

Food

- Hard, crunchy, chewy, and sticky foods can hit or stick to the micro-implant and cause it to loosen. Please be aware of this, and be careful to avoid this problem.

Habits

- There is a possibility that habits like clenching and bruxing can loosen micro-implants. While this may be hard for you to control, we'd like you to be aware.

Activities

- Trauma to the area can loosen the micro-implant. Be aware that sports may involve injury to the face and can increase the risk of loosening the micro-implant.

Discomfort

- Typically you will not need any medication for discomfort. You may take an ibuprofen only if you need it.

Your micro-implant is an invaluable addition to your orthodontic treatment. Please be in charge of taking care of it, as it is an essential part of your specialized treatment.

Fig. 4 Home-care instructions for patient.

I show patients. I'm placing a miniscrew into myself with only topical anesthetic. After describing the advantages of miniscrews and showing the video, patients are more than willing to have the procedure done.

DR. BUMANN We have a special flyer and several typodonts to demonstrate the method to patients and parents. In addition, we do not talk

about "mini-implants" or "miniscrews", but "mini-pins", because this sounds less frightening to the patients or parents.

DR. PAQUETTE I show them successful results, and we also now describe them as pins rather than screws. I tell patients that it would be similar to getting their ears pierced, except easier for them.

DR. CHO We show them the great outcomes of

treatments utilizing micro-implants. We also show them the actual implants, to assure the patients that the implant is very small and used only to move the teeth, then removed once the treatment is completed.

DR. SCHEFFLER We use more external marketing methods such as giving presentations to our referring doctors to show them what we are now able to do using temporary skeletal anchorage. We have had an increase in patients being referred specifically for skeletal anchorage by these dentists. During the consultation appointment with these patients, we show them other patients who had similar problems and their results utilizing TADs. We also show them typodonts with the miniscrews in place. I also refer to the miniscrews as anchors and have them understand why we need to pull their teeth toward an anchor. The word “anchor” seems to be less frightening to them than words like “screw”, “implant”, “pin”, or “TAD”.

DR. CACCIAFESTA How do you compare patient acceptance of miniscrews with acceptance of other appliances and of surgical procedures?

DR. CHO Micro-implants are well accepted compared to headgear and surgical procedures. Patients understand that the placement is very quick and minimally invasive.

DR. GRAHAM I agree that patients are far more accepting of miniscrews over headgear or extended elastic wear. I have never had a patient refuse the option of having a miniscrew placed.

DR. BUMANN We don't use headgear any more in our office. Patient acceptance is very high, and all patients understand the advantages of the mini-pins and their need. Of course, mini-pins are always preferred when they are compared to surgical procedures.

DR. SCHEFFLER When offering treatment options like headgear, extractions, or surgery, almost all patients choose miniscrews and even miniplates over these more conventional treatment alternatives. As long as the doctor is confident and explains how the TAD will help, patients always



Dr. Park

accept having a miniscrew placed. In fact, I don't think I have ever had a patient decline one.

DR. PAQUETTE I've never had a patient refuse, once I give them adequate information and show them the potential results.

DR. PARK I show the patients two pictures: an extraoral photo wearing headgear and one wearing micro-implants. All patients have chosen the micro-implants so far. I believe it is important for the clinician to explain this treatment to patients with confidence. According to one study, the discomfort or pain experienced during surgical placement of micro-implants is less than that associated with extraction of premolars.

DR. CACCIAFESTA Do you charge an extra fee for miniscrew placement?

DR. SCHEFFLER It depends on the case. If it is a more difficult case, then I typically charge a higher total case fee, but if it reduces treatment time, then I do not. If we are saving them from the cost and morbidity associated with orthognathic surgery, extractions, or implants, then I do charge a higher fee.

DR. GRAHAM As orthodontists, we should charge for the service, not the screw. Just as for braces, we are charging for our expertise, treatment planning, and procedure execution, not just for the cost of the brackets. For example, if I am moving posterior molars forward into a congeni-

tally missing second bicuspid space, I charge \$2,000 per space closure on top of the regular treatment fee. I simply explain to the parent that the choice is theirs: I can maintain the space and allow them to have it restored on their own for two to three times the cost, or I can do it for them. When they understand the value that this service provides, they elect to pay the additional fee.

DR. CHO I charge a \$500 fee for the complexity of the treatment, not by how many micro-implants are used.

DR. PARK In our clinic, we charge \$100 for a micro-implant, but nothing for replacement of a micro-implant after failure.

DR. BUMANN My extra fee for a mini-pin is usually 150 euros.

DR. PAQUETTE I do not currently charge a fee, but we will charge \$200 per miniscrew beginning this year.

DR. CACCIAFESTA What side effects of skeletal anchorage have you observed, and how have you overcome these?

DR. PAQUETTE I've experienced no negative side effects, but many favorable side effects. I have avoided the need for jaw surgery in multiple patients. I have been able to provide restorative dentists room for implants and bridges by intruding supererupted upper molars. Treatment sometimes is completed more quickly than I would have anticipated without the use of screws.

DR. CHO The only drawback of micro-implants is the possibility of extended treatment time if the implant loosens.

DR. PARK The major problem is failure or fracture of the micro-implants. The thicker miniscrews (over 1.6mm in diameter) with sharp cutting edges can penetrate into the roots, requiring endodontic treatment or sometimes extraction. The smaller-diameter micro-implants have less chance of root contact and will be broken if they do meet the roots. I recommend using a drill with a good center axis to eliminate wobbling, which produces a



Dr. Scheffler

bigger hole. The drill should be switched to a new one with a sharp edge after 30-40 uses. The most important thing to eliminate fracture is to place the micro-implants very gently, with a steady speed. A torque driver can be used to eliminate the chance of fracture; if the resistance reaches the fracture limit, the driver will rotate freely.

DR. SCHEFFLER It is important to pay attention to the biomechanics, as the same principles do not apply as in conventional treatment. It is important to observe the vertical and transverse directions of pull when attempting anterior retraction and molar protraction. Also, buccal flaring can result if a force is applied only to the facial aspect of a tooth during intrusion. I will attempt to pull through the center of resistance for antero-posterior movements and/or set up the anchorage indirectly. I will also place buttons on the lingual surfaces with an anti-rotational chain to prevent a transverse problem during anteroposterior movements. For anterior open-bite correction, I use the Anterior Open Bite Splint* with two transpalatal arches to intrude the posterior teeth and prevent buccal flaring (Fig. 5).

DR. GRAHAM Unwanted side effects can virtually be eliminated with close attention to biomechanics. This is very simple if using miniscrews for indirect anchorage, because the biomechanics

*AOA Laboratories, P.O. Box 725, Sturtevant, WI 53177; www.aolab.com.



Fig. 5 Anterior Open Bite Splint with two transpalatal arches to intrude posterior teeth and prevent buccal flaring.

are the same that we've always used. When I'm protracting molars into bicuspid spaces, for example, I use a 150g coil spring and an .019" × .025" stainless steel archwire. With this setup, I never get molar tipping or rotations, because the .019" × .025" stainless steel wire wins every time.

DR. BUMANN With movement of mini-pins, I've seen inflammation of the surrounding tissues. The movement can be avoided by using indirect anchorage. Inflammation around the pin can be avoided by placement within the attached gingiva.

DR. CACCIAFFESTA What would you like manufacturers of miniscrews to do to improve or change them?

DR. BUMANN We are absolutely happy with the tomas screw, which has a bracket head for universal use, a high-torque moment at fracture resistance to avoid pin breakage, a torque ratchet to avoid breakage and bone damage, a small applicator to allow convenient pin placement in the posterior segments, and a driver for a contra-angle handpiece for convenient pin placement in the anterior palate.

DR. CHO It would be great if the manufacturers could make surface-treated threads, such as the SLA§§ (sandblasted with large grit and acid-etched).

§§Registered trademark of Institut Straumann AG, Basel, Switzerland; www.straumann.com.

DR. PAQUETTE Perhaps a really narrow one for tight areas, or a longer one that is light-dentin-colored and has a taller, narrow head for lateral replacement.

DR. SCHEFFLER After trying many other types of TADs, I am quite pleased with the VectorTAS miniscrew. I am working with Ormco on a few other attachments that will only make treatment using TADs easier.

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