

Scuba Diving and Dental Implants

More people are electing to have failing or missing teeth replaced by dental implants. Traditional solutions for missing teeth include these types of implants: bridges, removable partial dentures, or full dentures. As a D.D.S. (Doctor of Dental Surgery), I have experienced an increase in the number of questions related to dental implants and scuba diving in my capacity as a dental consultant for DAN, Scubadoc (the Diving Medicine Online website: <http://scuba-doc.com/>) and ScubaBoard (www.scubaboard.com). Found where the scuba regulator ends, dental implants are associated with the very same spaces containing gas that must be equalized during a dive. This results in divers' questions ranging from "How long should I wait after implant surgery before diving?" to "Will the pressure on the bite of my regulator affect the implants in my mouth?"

A Short History of Dental Implants

How old is the art and science of implants? Archeological evidence suggests that certain early civilizations attempted to reimplant lost teeth as well as making tooth substitutes made of carved wood or ivory. In the 1800s, gold - and later, platinum - implants were placed into the human jaw. These proved to be unsuccessful. Dr. Alvin E. Strock at Harvard University placed the first successful implants in 1937. They were made of a type of surgical stainless steel called vitallium, an alloy of chrome, cobalt and molybdenum (a gray metallic element) commonly used in removable partial dentures.

Gustav Dahl of Sweden reported the first subperiosteal implant, an implant on the bone, in 1948. Then in 1967, Leonard Linkow, Ralph Roberts and Harold Roberts introduced the endosteal blade implant, also an implant to the bone. Finally, in 1981, Dr. Per Ingvar BrÖEnemark, an orthopedic surgeon from Sweden, introduced the titanium endosteal root form implant. The root form implant is the prototype of today's most common dental implant. The key to the implant's success is the use of titanium metal. In 1952, while BrÖEnemark was doing bone-healing studies on rabbits, he inserted a small titanium plate with a lens attached into the bone of his experimental animals. This allowed him to peer microscopically into the bone and actually view the healing process.

Osseointegration

At the completion of the experiments, when BrÖEnemark attempted to remove the titanium plate, he found that the surrounding bone had fused to the metal. He called this fusion of bone to metal osseointegration. Through this serendipitous occurrence, successful dental implants and other implantable orthopedic devices became possible.

Surgical Procedures

The first step is to remove the tooth at the problem sites. It might then be necessary to graft bone into socket to create a site suitable for the future implant; or the procedure may require the surgeon to fill in part of the maxillary sinuses to give a patient enough vertical bone height to support implants in the upper back part of the mouth. In extreme cases, it may be necessary to harvest bone from dense areas in the body, such as the hip, or to use artificial sources, to restore bone that has receded. It is the surgery, the requisite healing period, and the prosthetics that affect patients who wish to scuba dive. Generally, if there is a missing tooth and there are appropriate bone dimensions, the surgeon makes a specially sized hole in the bone using precisely sized drills. The implant is then threaded into it. A cover screw or a healing abutment is then screwed into the "top" of the implant. The implant is then allowed to osseointegrate for a period of four to six months. To avoid second-stage surgery, most surgeons now use healing abutments that purposely project through the gums during the healing period. This abutment is simply unscrewed by

the prosthodontist when the implant is ready to be restored. The implant is then surgically re-exposed following the osseointegration period, and parts are attached to the exposed implant to make it possible to complete the restoration.

Avoiding Dive / Bite Pressures

At this point, surgeons have not developed uniform recommendations related to oral surgery and scuba diving: generally, the more complicated the surgery, the longer the wait before diving. Surgical complications will add to this time, as can any underlying medical conditions, tobacco use and alcohol consumption. During post-surgical osseointegration, it is necessary to avoid anything that could apply pressure to the skin over the implant and cover screw or the healing abutment. Diving too soon after surgery with its resultant pressure, no matter how slight, could damage the site. For example, if the regulator's bite tabs are over the implant site, transmitted biting forces can result in implant failure. Besides avoiding diving, it's also advisable to maintain a softer diet while healing and to avoid chewing directly in the surgical area. The risk for damage is greatest during the first four weeks after surgery, then it decreases.

There are other considerations as well. Diving should be suspended for as long as it takes to avoid other complications associated with oral surgery:

- revascularization (resumption of blood flow);
- stabilization of the implant;
- oral and sinus cavity pressure changes;
- ability of the patient to hold a regulator in the mouth; and
- use of medications for pain or infection.

Revascularization Counts

Gas exchange, such as what the body experiences when diving - with subsequent solution and offgassing of nitrogen - is partially a function of the vasculature (arrangement of blood vessels) of the local tissues. Simple extraction sites quickly develop a blood supply. Similarly, extraction socket grafting (socket preservation) also revascularizes rapidly. Diving following a simple extraction usually requires a one- to two-week recuperation time.

Bone Grafts Affect Recuperation Time

Bone grafting procedures and sinus surgery are more complex and will require a longer waiting period. The larger the graft site, the longer the wait. Some doctors will recommend avoiding any activity that causes micro-movement for at least six months. It can actually take up to one year for complete bone healing at an implant site. While diving sooner than one year may not cause a problem, your surgeon should determine the appropriate time period. Even if your surgeon doesn't dive, follow his or her advice. The quantity and quality of the underlying bone also affects implant / dive wait periods. Some people have very hard, dense bone, while others have soft, spongy bone. This affects the primary stability of the implant inserted into it. Implants placed into hard, dense bone are less susceptible to the micromovements described above. The opposite is true for soft, spongy bone. Newly inserted implants are most vulnerable to movement within the first two to four weeks following surgery. The implants actually get looser within the surgical site before they begin to stabilize. Scuba diving must be avoided during the initial stages of osseointegration. A minimum of five weeks to two months is needed to render the implant stable. Longer times would be appropriate if substantial bone grafting has been done.

Making the Final Implant Work

During the implant healing period, the patient generally wears nothing in this area; or he / she may be fitted with a temporary prosthesis that is generally not attached to the healing implant(s). A temporary removable partial denture is an example of this. In the past several years, surgeons have developed protocols to help patients receive their final prostheses more quickly. Any temporary devices will usually be made of plastic and anchored with some sort of temporary cement or temporary screw. It would be safer to be more conservative and delay scuba diving until the final restorations are in place. For example, if the temporary cement were to loosen or the plastic were to break, there is a danger of aspirating (swallowing the temporary prosthesis). Your surgeon makes the final prosthesis - whether it's an implant-supported crown, fixed bridge or fixed detachable denture - after the requisite four to six months of osseointegration.

Once dental implants are fully osseointegrated and the final prostheses have been placed, there is nothing inherent in scuba diving that would pose a threat to either the implants or the restorations. The spaces engineered into the implants to hold the overlying screws, abutments and prostheses are small and are completely contained within the titanium structure. There is no air space communication between the implants and the surrounding tissues. The implant structure is strong enough to withstand any pressure differentials that might occur if small amounts of gas were to migrate into these engineered spaces.

Additional Considerations

The overlying implant prosthetics can exhibit some of the same, albeit extremely rare dental problems associated with scuba diving. Breakage of porcelain or cementation failures can occur and the use of implants affords no special property of the dental restorations to resist such failures. Some implant-supported devices are cemented, and as such, a cementation failure due to pressure changes is possible. Again, this is a rare occurrence. Some dentists prefer to use weaker, temporary cement under the final, permanent implant crowns and bridges. This allows for future removal of the restoration if deemed necessary.

Other dentists treat the cementation to implants just like teeth and use permanent cement. Their philosophy is, "If I wasn't worried about permanent cement for teeth, why worry about it for implants?" It would be wise to know whether your dentist has used temporary or permanent cement under your implant restorations. The likelihood of even the temporarily cemented prosthesis coming off is rare, but you should be aware that it could become a problem. Generally, if you keep an implant and / or restoration for more than a year, in all likelihood, it will not fail as a result of a loss of osseointegration. However, there are other ways restorations can fail. These are unrelated to the surgery, placement and healing of the implants: there are rare instances of implant breakage, abutment breakage or retaining screw failures. This is usually associated with a very strong bite, trauma, poor treatment planning or a failure of materials. Generally, diving would not cause such failures. The increased use of dental implants makes it more than likely that some scuba divers will be diving with these devices. Although there are certain aspects of dental implant procedures and restorations that would temporarily limit a diver's participation in the sport, scuba diving is not forbidden for people who have had successfully healed and restored implants. A thorough discussion with your oral surgeon and dentist should make your implants successful and your diving safe.