Custom 3D Printed Dental Surgical Guides with Internally Irrigated Cooling Canals for Temperature Reduction during Dental Implants and Endodontics

Published date: May 16, 2018

Technology description

Technology

Researchers at MUSC have created a method and device that revolutionizes dental implants and endodontic therapies by providing custom 3D printed implant guides with custom 3D irrigated cooling channels that reduce drilling temperatures during these therapies to avoid complications and improve outcomes.

The 3D printed custom surgical guide provides an inflow channel that connects directly to the irrigation tube which usually extends to the surgical hand piece. This novel design allows the direct passage of the irrigating coolant liquid to the intended site which is where the implant drill engages the bone; rather than being blocked by the guide which is the current state of the art. These ports can be customized and modified for each individual scenario depending on surgical approach, drill angulation, etc.

Additionally, the 3D printed custom surgical guide provides outflow channels surrounding the drilling site that allow the incoming fluid to leave the drilling site after cooling (bottom image). The outflow channels, when combined with the inflow channel, ensure that coolant is continuously and rapidly moving through the surgical side to maintain a consistent and effective level of cooling. Further, these

3D printed custom surgical guides can feature multiple drilling channels with corresponding incoming and outgoing irrigation channels, permitting the effective completion of multiple implant sites with a single 3D printed guide.
OverviewDental implants are one of the most common and effective treatment modalities for the replacement of missing teeth. The success of the implant depends on osseointegration of the bone around the implant. Osseointegration is dependent on several factors, but the most important is the essential primary healing around the dental implant (fusion of bone to the implant surface). It is vital that the osteotomy preparation not damage the cells during the drilling process in such a manner that might prevent healing. One universal and critical problem associated with implant failure is thermal damage at the drilling site which can cause osteocyte degeneration, hyperemia, fibrosis, necrosis and increased osteoclastic activity: all preventing implant osseointegration. Heat is always generated during implant drilling, if the heat generation is not limited, the bone will burn, die, and the implant will not integrate.
Most drilling systems, utilize an external irrigation method in which the irrigation tubing is mounted to the surgical hand piece and the fluid is injected toward the rotating drill. However, due to the tight fit between commonly used surgical guides and the burr of the drilling system, little if any fluid reaches the drilling site. With the guide itself blocking the flow of coolant, even rapid exposure of the bone to non-irrigated drilling rapidly increases bone temperature, leading to bone necrosis. An effective solution is necessary to ensure that the drilling site is adequately irrigating when drilling with a surgical guide to ensure bone health and success of the treatment.

Application area

Dental Implants
Endodontics

Advantages

Improved Outcomes: The irrigated channels greatly increase coolant flow through the drilling site keeping temperatures moderated and greatly increasing the likelihood of a successful procedure.
Customizable: The dental implant and irrigated channels are completely customizable providing the opportunity to ensure adequate cooling for a wide range of procedures. Therefore, this technology can be integrated into digital implant guide design software platforms.
Ease of Use: Inflow irrigation channel connects directly and easily to existing irrigated drills.

Institution

Medical University of South Carolina

Inventors

Walter Renne
Assistant Professor
Cooledge of Dental Medicine
Zachery Evans
Assistant Professor
Dental