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# Surgical Considerations for Intrathecal Implantation

**Viacheslav Lipatov***

*Department of Operative Surgery and Topography, Anatomy Kursk State Medical University, Russia*

**Abstract**

In humans, intrathecal access is a common clinical procedure. Intrathecal implantation is not a common surgical procedure, and intrathecal access is only used for drug administration in rodents. We effectively used various intrathecal implantation surgical techniques for various implant materials in animals in preclinical settings. However, choosing the best intrathecal implantation technique can be difficult for surgeons because it involves a number of processes, including preoperative assessments and after care. The purpose of this review is to identify, evaluate, and contrast the most widely used recorded surgical techniques for intrathecal implantation in rodents, as well as the related side effects, while emphasizing the most important preoperative and postoperative factors. Overall, this review will give surgeons an understanding of the intrathecal implantation principles that apply to various implant materials.

In comparison to the INBONE II ankle implant, there have been noticeable improvements in the kinematic functions, particularly in internal-external rotation and inversion-eversion, and in the load distribution between the medial and lateral contacts. In terms of restoring internal-external rotation and balancing the medial and lateral contact forces, the design of anatomic ankle implants with the medial peak higher than the lateral peak performed better. For the anatomic ankle implant with a medial border that is higher than a lateral border, the kinematics and loads were not sensitive to the height difference. Anatomic ankle implants should be taken into consideration in future implant design and surgical techniques since their anatomic articular surface design can improve tibiotalar joint kinematics and loading.

**Keywords:** Rats; Intrathecal space; Implant; Anatomic ankle implant; Kinematics; Biomechanics; and Multibody modelling of the musculoskeletal system

## Introduction

In recent years, there has been an increase in interest in accelerating and maximizing the Osseo integration of an orthopedic implant through modification of implant architecture. Laser powder bed fusion (LPBF), which enables the fabrication of porous metallic scaffolds of escalating complexity, has allowed a paradigm change in the topological design of biomedical implants. The creation of porous scaffolds with specified characteristics and patient-specific geometries is now possible thanks to the integration of cutting-edge computational design tools with LBPF [1]. Recent studies on the mechanical characteristics of AM titanium scaffolds with various topologies and porosities have revealed that there is a wide range of stiffness and strength within the bone range. Recent research has also shown that TPMS sheet-based structures, such as the gyroid sheet, offer favorable mechanical qualities by maintaining high strength and fatigue resistance in comparison to strut-based unit cell topologies of the same porosity. The mechanical properties of porous scaffolds are affected by additional topological design elements, including the unit cell size, orientation, and even the ratio of the cell size to the total porous volume. However, the influence of scaffold porosity, which governs the mechanical performance of the scaffold (strength and stiffness) and affects Osseo integration, overrides all of these topological design variables.

In order to restore the upper dental arch in the atrophic maxilla, the Boyne and James procedure known as "maxillary sinus floor elevation" involves raising the maxillary sinus floor over the Schneider's membrane and creating a mucoperiosteal pocket above the maxillary floor. Maxillary sinusitis can occasionally develop as a side effect of maxillary sinus floor elevation, despite the fact that it is a successful treatment.

The apparent modulus of the titanium scaffold can be lowered to be within the range of bone by increasing the porosity of the material; however, there is a corresponding decrease in scaffold strength, which must be balanced to enable implantation and load bearing. In order to maximise load sharing between the two and so promote bone growth, it is seen advantageous to match the stiffness of the implant to that of the bone [2]. To ensure mechanical interlock and successful Osseo integration, stiffness matching alone is not enough, as polyetheretherketone (PEEK) spinal interbody cages have been demonstrated to produce fibrous encapsulation while having a relatively low modulus in the range of bone. Thus, it is thought that interfacial mechanical interlock between the implant and freshly created bone is accomplished through a combination of stiffness matching, surface interaction, and three-dimensional porous networks. Therefore, it is important to examine how best to balance the implants initial load-bearing capacity with its long-term potential for Osseo integration and load-sharing [3].

To optimize implant design, it is necessary to have a better understanding of the mechanical and biomechanical trade-offs imposed by implant porosity. In this study, LPBF of medical-grade titanium alloy was used to create porous titanium implants with gyroid architecture that had porosity variations throughout a physiologically relevant range (Ti6Al4V). To ascertain the trade-off between the implant's load bearing capacity and the biomechanics at the bone-implant interface after 4 and 12 weeks, bench top mechanical evaluation was carried out concurrently with an ovine Osseo integration model. The volume and location of bone ingrowth into the porous implants in the

***Corresponding author:** Viacheslav Lipatov, Department of Operative Surgery and Topography Anatomy, Kursk State Medical University, Russia Tel: +7 7890436789; E-mail: Lipatov.v@gmail.com

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cortical and cancellous locations were evaluated using histological and histomorphometric techniques. The current findings have implications for the design of orthopedic implants in different clinical settings [4].

## Materials and Method

Using computer-aided design/computer-aided manufacturing technologies, six different varieties of dental implants were created. These implants included two different types of screw features and three different types of cutting flute shapes (spiral, straight, and non-self-tapping). Initial stability levels were then assessed utilising an electrodynamics test system in terms of the maximum force and resistance to lateral loads after peak insertion torque values were first recorded [5].

To find all randomized clinical trials contrasting the impact of at least two different implant abutment connection designs published between 2009 and May 2020, an electronic search was conducted [6]. At 12 months following prosthetic loading, outcome variables included the implant survival rate, peri-implant marginal bone loss, and rates of biologic and prosthetic complications. The quality and bias risk of the relevant data were evaluated once it was extracted. To evaluate the comparisons, pairwise meta-analyses and network meta-analyses built on a multivariate random-effects meta-regression were conducted (=.05 for all analyses) [7].

## Discussion

We assume that the left POMC is not connected to the placement of the oral implants, but rather to the Caldwell-Luc procedure carried out for the treatment of chronic sinusitis when the patient was 28 years old, as we retrospectively identified the POMC via CT imaging prior to the insertion of the implants. In the absence of this, we would be concerned that an unremoved odontogenic cyst from a tooth extraction would migrate into the maxillary sinus [6]. In some instances, patients with POMC had their dental implants successfully preserved by having their POMC removed, but in other reports, it was not able to keep the dental implant by having both the POMC and the implant next to it removed [7]. As a result, there is still disagreement over whether enucleation can preserve the dental implant close to the POMC. On the other hand, Otorhinolaryngologists have favored treating POMC along with chronic sinusitis with nasal endoscopy.

Patients with unilocular cysts close to the nasal cavity have been treated using the endonasal technique. Enucleation is still required, nevertheless, for multilocular cysts or cysts that are not close to the nasal cavity. We decided on marsupialization with POMC drainage via nasal endoscopy for the treatment of the left POMC as an alternative to enucleation because the POMC in this case was a unilocular cyst that was close to the nasal cavity and the patient hoped for both the disappearance of swelling in his left cheek and the preservation of his dental implant close to the POMC. Even if the bone volume is sufficient to sustain the dental implant, in our opinion, marsupialization with draining of POMC should be carried out before the implant is placed [8].

## Results

Conical interfaces were found to be the most beneficial for peri-implant marginal bone loss and prosthetic problems, with significant differences when compared with external hexagonal connections (P=.011 and P=.038, respectively). In terms of survival and biological problems, there were no discernible differences among the implant abutment connections (P>.05 in all direct, indirect, and mixed comparisons) [9-10].

## Conclusion

Conical connections demonstrated less marginal bone loss and had fewer prosthetic problems after a year of loading than external hexagonal connections. The implant survival and biologic complication rates, however, were unaffected by the implant abutment connection architecture.

After the modified Cryo-Maze operation, older age and longer-lasting atrial fibrillation are risk factors for late-onset pacemaker placement. However, the prevalence of pacemaker implantation is not linked to an increase in morbidity or the recurrence of atrial fibrillation.

## Declaration of competing interest

The following financial and interpersonal relationships are disclosed by the authors and could be viewed as potential competing interests: Cambre Kelly discloses having equity or stock-based relationship with restor3d, Inc. Ken Gall discloses a connection to restor3d, Inc. that involves either equity or stocks. With respect to restor3d, Inc., Samuel B. Adams discloses a relationship that may include equity or stocks.

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## Conflict of interest

None

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