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Review Article

Dentistry Section

A Narrative Review on the Use of Magnetic Mallets as an Aid in Dental Implantology and Atraumatic Extractions

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ABSTRACT

The primary focus of Oral and Maxillofacial Surgery is exodontia, followed by the replacement of teeth with implants, along with the management of various pathologies in the orofacial region. Patients often find dental extractions frightening due to potential complications such as dry socket, delayed healing, paraesthesia and bleeding at the site. Furthermore, extensive rehabilitation, such as replacing a full arch with implants, was previously only possible for patients in good oral health due to the lengthy and traumatic procedures involved. The utilisation of equipment like the magnetic mallet enables more efficient and minimally invasive operations. The use of the magnetic mallet in oral surgery and oral implantology has gained immense popularity in recent years, emerging as an effective instrument for atraumatic extraction, implant osteotomy, sinus floor elevation and bone condensation techniques. The magnetic mallet is based on the principles of electromagnetism. Magneto-dynamic technology applies controlled forces to a body in a time-sensitive manner. As a result, the consistent and controlled application of pressure makes the procedure more comfortable for both the patient and the surgeon. The magnetic mallet is an innovative tool that provides the clinician with excellent visibility of the surgical site without the need for saline irrigation during the procedures. The present review focuses on the magnetic mallet, a unique and inventive magneto-dynamical patented device used for extractions, implant placements and sinus lift procedures. It also discusses the advantages of the magnetic mallet over conventional surgical hammers and procedures where bone osteotomy is required.

Keywords: Dental implants, Implant osteotomy, Maxillary sinus, Sinus lift, Tooth extraction

INTRODUCTION

Hard and soft tissue damage can arise after a traumatic dental extraction [1]. For prosthetic restorations to be stable both functionally and aesthetically, tissue healing must be achieved through the use of an appropriate surgical approach [2]. Tooth extraction and implant placement have been carried out using a variety of instruments. Current oral surgical techniques have incorporated the use of laser, piezoelectric and magnetodynamic technologies. These not only provide a clean operating field but also make the procedure less traumatic [3-5]. Research on minimally invasive techniques and their application in dentistry and the medical field has grown rapidly in the last 10 years [3-5]. Specifically, minimally invasive surgery reduces the need for analgesic and anti-inflammatory medication, shortens hospital stays and lowers postoperative complications [6]. As a result, treatment duration is often shortened.

Recently, a unique magnetodynamic medical instrument called a magnetic mallet has been used in dental extractions, sinus lift operations, bone remodelling procedures and implant placement following extractions. By preserving blood flow to the facial bone plate, dental extractions performed with this technology can be completed with little to no flap reflection, thus reducing the risk of significant bone loss [7].

The current review discusses the use of magnetic mallets in the field of dentistry, with the aim of promoting their increased adoption in the near future.

DISCUSSION

Historical Perspective

Dr. Bonwill introduced the magnetic mallet in 1873. Prior to the discovery of the magnetic mallet, conventional surgical hammers were used for procedures such as extractions or where bone manipulation and osteotomy were required. In dental surgery, the magnetic mallet utilises magneto-dynamic technology. Dr. Bonwill used the magnet to mechanically strike gold fillings with a low degree of intensity in an effort to enhance their effectiveness. The present procedure improved the accuracy of gold fillings. The first clinician to employ a magnetic mallet in implant dentistry was Crespi R et al., in 2012 [8].

Mechanism of Action

A magnetic mallet kit includes a collection of 10 tips, including blades, bone expanders and drivers for implant insertion [9]. By using electromagnetic waves generated by the handpiece, the magnetic mallet can move both radially and axially, transferring this movement to the tips of the osteotome or periotome. This results in a collision between the tooth and the tip of the osteotome or periotome, which is generated electronically. There are four force modes available: 75, 90, 130 and 260 daN. The impact occurs at 80 µs (Meta Ergonomica, Milan, Italy) [10,11].

Advantages of Magnetic Mallet

The magnetic mallet leverages electromagnetic impact to its advantage, enabling it to apply a high-intensity, brief impact force on the bone, resulting in the plastic deformation of the bone without dispersing throughout the bone structure as typically occurs with surgical hammer blows [12]. Consequently, the use of the magnetic mallet prevents patients from experiencing severe postoperative symptoms, also known as vertiginous syndrome [13].

To minimise the dispersion of forces across the craniofacial mass, the forces are concentrated on the treated area. When using a handpiece assisted by the magnetic mallet, the route of entry of the osteotome into the bone and its tip are controlled with greater precision. This precision is crucial because bones are often composed of components with varying densities and transitioning from one density to another may cause the instrument to deflect. Therefore, the use of the magnetic mallet leads to enhanced patient comfort and complete precision throughout the procedure [14].

The mechanical friction between the instrument and the bone occurs within microseconds. This time span is insufficient to increase the temperature of the bone; hence, there is no need for irrigation, as the magnetic mallet significantly reduces heat generation [10].

The ergonomic design of the magnetic mallet, which includes a handpiece and a control foot pedal for applying impulses, allows for one-handed operation while providing increased visibility of the operating field with the free hand [9]. Because irrigation is unnecessary, the operator has improved visibility and can regulate the instrument's progressive penetration [10].

The longitudinal movement imparted by the magnetic mallet handpiece along the osteotome's axis results in a controlled fracture and displacement of the cortical bone, as well as enhanced bone tissue density along the walls [14]. Additionally, procedures such as ridge splitting and impaction removal can be performed more swiftly with the help of the magnetic mallet. The compacted bone resulting from sinus membrane elevation simplifies sinus lifting treatments [10]. This allows for rapid implant placement with improved primary stability and minimal to no use of biomaterials [9].

The ergonomics of the handpiece allow the clinician to position the instrument in the intended location using just one hand [10]. The benefits of both physiodispensers and piezo units are incorporated into the magnetic mallet. Curved inserts facilitate better access to the maxillary posterior region [10].

Applications of Magnetic Mallet in Dentistry

Magnetic mallets are utilised in various areas of dentistry. Some of these applications are listed below:

A) **For dental extractions:** Depending on the method employed, the periodontium may experience different types of stress during tooth extraction. These methods include bone removal and reflection of a mucoperiosteal flap, as well as the use of periotomes, elevators and forceps to extract a single-rooted tooth. Since socket expansion is the fundamental principle behind tooth extraction, some degree of bone trauma is hard to avoid. Even a successful extraction using elevators or periotomes can lead to traumatic alveolar bone loss.

According to Crespi R et al., 156 patients had 427 teeth extracted using the magnetic mallet, with the authors asserting that the root could be removed from the surrounding alveolar bone with minimal damage to the adjacent bone and gingival tissues due to the axial movements imparted to the blade's tip. The authors did not observe any compromised soft-tissue healing or fractures in the cortical plates or roots of the teeth [8]. Thus, employing a magnetic mallet for dental extractions makes the procedure relatively atraumatic, with minimal or no need for bone grafts, thereby enhancing both patient and operator comfort and improving patient compliance.

B) **In dental implantology:** As implant placement is a lengthy procedure, utilising modern technological instruments that simplify surgical procedures and make them faster and less painful is crucial, as this lowers the risk of complications during and after the procedure.

In oral implantology, osteotomes are a fundamental component. They are used for various procedures, including extractions, ridge splitting, sinus floor elevation and osteotomy preparation for implant placement [15]. However, the tapping action that occurs with the use of osteotomes can be quite uncomfortable for patients, which contributes to low patient compliance [10]. In this context, the invention of magnetic mallets can be seen as a means to offer improved working standards.

According to Crespi R et al., in cases where dental extractions were performed using magnetic mallets, the socket healed quickly and there was minimal trauma to the surrounding soft tissue following the placement of immediate implants in the socket [16]. In a comparison of magneto-dynamic technology to drills, Schierano G et al., found through histological tests that the former can significantly increase the amount of newly formed bone tissue and osteoblasts. The magnetic mallet's inherent ability to osteocondensate bone tissue benefits both the primary stability of dental implants and bone healing. These sites have shown an increase in osteogenesis-related cytokines, indicating a positive trend in bone maturation and secondary implant stability [17].

In edentulous ridges and newly created sockets, Feher B et al., conducted a study on implant site preparation using the magnetic mallet. The researchers assessed the values of the Implant Stability Quotient (ISQ) for implants placed in condensed bone sites that had been prepared using the magnetic mallet. A conventional drill was used to create the pilot hole, which measured 2.2 mm in diameter and 8 mm in depth, prior to the application of the magnetic mallet. Their primary finding regarding the application of magneto-dynamic technology was that the use of the magnetic mallet to prepare the implant site increased ISQ values, though it did not affect insertion torque values [18].

Crespi R et al., conducted a prospective study in 2017 where dental extractions were performed on 53 participants using the magnetic mallet and they discovered that no evidence of irritated tissue or exposed bone was identified following the surgery [19]. A retrospective study conducted by Crespi R et al., in 2021 showed a 100% survival rate in the sinus lift procedures performed using the magnetic mallet [20].

C) **In sinus lift procedures:** The quantity and quality of bone are crucial factors in implant placement. Due to the close proximity of the sinus and the lack of bone in the maxillary posterior region, the surgery becomes more complicated. As age increases, the size of the sinus enlarges and this is even more pronounced if the patient is edentulous. The degree of pneumatisation varies from side to side and from person to person [21].

However, this procedure often results in the bony lateral and occlusal alveoli of the posterior maxilla being paper-thin. To prevent damage to the maxillary sinus during implant placement, these circumstances necessitate an attempt to lift the sinus lining. An appropriate bone height that can support the placement of functional dental implants is created by repositioning the floor of the maxillary sinus upwards during a sinus lift procedure, which is a surgical intervention intended to increase the height of residual bone in the posterior maxilla [21].

Numerous methods exist for performing sinus lift surgeries, including the hydroneumatic sinus lift, lateral antrostomy, balloon sinus lift and crestal approach using osteotomes [22]. In 1994, Summers developed a conservative crestal technique for maxillary sinus floor elevation utilising osteotomes; however, as hand mallets can cause inconvenience to patients and may result in benign paroxysmal positional vertigo, magnetic mallets are preferred over hand mallets [23]. By using a magnetic mallet, an appropriate implant site can be created while reducing the chance of both intraoperative and postoperative complications. The conical spike configuration, alternating apical concavity and convexity, wide stop and suitably sized grips all help to minimise the risk of sinus perforation by eliminating the need for percussive hammering [24]. Thus, employing the magnetic mallet provides comfort for both the operator and the patient during surgery, resulting in fewer postoperative complications and increased patient compliance.

CONCLUSION(S)

Due to the magnetic mallet's safety, predictability, speed and ease of use, it may be beneficial in dental extractions, implant surgery and sinus lift procedures. Magnetic mallets are believed to offer superior clinical benefits compared to traditional tools. Further clinical research is necessary to confirm the use of magnetic mallets as a safer alternative for oral implant procedures.

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