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TYPES OF OBTURATORS USED IN THE REHABILITATION OF MAXILLARY DEFECTS

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Annotatsiya. Yuqori jag' nuqsonlari chaynash, yutish, nutq va yuz estetikasi kabi muhim funksiyalarning buzilishiga olib keladi. Bunday bemorlarni reabilitatsiya qilishda obturator protezlari asosiy davolash usullaridan biri hisoblanadi. Ushbu maqolada darhol (jarrohlik), vaqtinchalik va doimiy obturatorlarning klinik xususiyatlari hamda qo'llanilishi yoritilgan. Shuningdek, obturator tayyorlashda qo'llaniladigan PMMA, termoplastik materiallar, kobalt-xrom va titan qotishmalari, PEEK kabi zamonaviy materiallarning afzalliklari va kamchiliklari tahlil qilingan. CAD/CAM texnologiyalari, raqamli skanerlash va 3D bosib chiqarishning protezlash jarayonidagi ahamiyati ko'rib chiqilgan. Zamonaviy materiallar va raqamli texnologiyalar obturator protezlarining funksional samaradorligi, qulayligi va uzoq muddatli natijalarini yaxshilashga xizmat qiladi.

Kalit so'zlar: yuqori jag' nuqsonlari, obturator protezi, PMMA, PEEK, CAD/CAM, ortopedik stomatologiya.

Abstract. Maxillary defects caused by congenital anomalies, trauma, or surgical resection result in significant impairment of mastication, swallowing, speech, and facial aesthetics. Obturator prostheses remain the primary method of functional rehabilitation for such patients. This review summarizes the characteristics and clinical applications of immediate, interim, and definitive obturators. The properties, advantages, and limitations of commonly used materials, including polymethyl methacrylate (PMMA), thermoplastic polymers, cobalt–chromium and titanium alloys, and polyetheretherketone (PEEK), are discussed. Recent advances in digital dentistry, including CAD/CAM technology, intraoral scanning, and additive manufacturing, are also reviewed. Modern materials and digital workflows contribute to improved prosthesis adaptation, reduced weight, enhanced comfort, and better long-term rehabilitation outcomes in patients with maxillary defects.

Keywords: maxillary defects, obturator prosthesis, PMMA, PEEK, CAD/CAM, prosthodontic rehabilitation.

Аннотация. Дефекты верхней челюсти приводят к нарушению жевания, глотания, речи и эстетики лица, существенно снижая качество жизни пациентов. Одним из основных методов реабилитации таких пациентов являются обтураторные протезы. В статье представлен обзор современных видов обтураторов (непосредственных, временных и постоянных), а также материалов, применяемых для их изготовления. Рассмотрены преимущества и недостатки полиметилметакрилата (PMMA), термопластических материалов, кобальт-хромовых и титановых сплавов, а также полиэфирэфиркетона (PEEK). Особое внимание уделено современным цифровым технологиям, включая CAD/CAM-системы, интраоральное сканирование и 3D-печать. Показано, что применение современных материалов и цифровых методов способствует повышению функциональной эффективности, комфорта и долговечности обтураторных протезов.

Ключевые слова: дефекты верхней челюсти, обтураторный протез, PMMA, PEEK, CAD/CAM, ортопедическая стоматология

The maxilla plays a fundamental role in essential oral functions, including mastication, swallowing, and speech production, as it provides support for the dentition, contributes to tongue stability, and maintains proper alignment of maxillofacial structures (1). When defects of the maxilla occur, these functions can be significantly impaired, leading to difficulties in chewing and swallowing, as well as alterations in speech, which may manifest as dysarthria or hypernasality. In addition, such defects can adversely affect facial aesthetics and symmetry. These functional disturbances have a substantial impact on the patient's quality of life, limiting their ability to eat properly and communicate effectively (2–5).

Maxillary defects are generally classified into two main groups: congenital and acquired. Congenital defects, such as cleft lip and palate, are developmental anomalies present at birth and result from disturbances in the embryological formation of facial structures, particularly due to incomplete fusion of the nasal and palatal processes.

During the first three weeks following surgery, the soft tissues of the oral cavity undergo considerable changes in both shape and volume. These alterations negatively affect the retention and stability of the initially placed surgical obturator. Therefore, after approximately 3–4 weeks, fabrication of a new prosthesis becomes necessary; this appliance is commonly referred to as an interim obturator (1,2).

The interim obturator can be produced either from a newly obtained impression or by modifying the existing surgical obturator using a soft relining material. Extensive extension of the obturator is generally avoided, as it may interfere with proper tissue healing. For aesthetic improvement, prosthetic teeth may be incorporated, particularly in the anterior region (1,2).

The definitive obturator is typically fabricated about six months after surgery, once complete healing of the oral tissues has occurred. Heat-polymerized acrylic resin or cobalt–chromium alloy is commonly used as the base material for the definitive prosthesis. In recent years, titanium alloys have also been introduced to reduce the overall weight of the prosthesis (1).

In cases of partial edentulism, a cast partial denture design is required. Mohamed Aramany proposed specific design principles for such prostheses: Class I – linear design; Class II – tripodal design; Class III – quadrilateral design; Class IV – linear design; Class V – tripodal design; and Class VI – quadrilateral design (3).

Immediate (surgical) obturator. The immediate (surgical) obturator is a preplanned prosthesis fabricated before maxillary resection and inserted either intraoperatively or immediately after surgery. Its fabrication begins in the preoperative phase, where diagnostic impressions are taken to obtain a working cast of the maxilla and defect area. On this cast, the prosthesis is designed to closely reproduce the expected postoperative anatomy.

In conventional protocols, a wax pattern is first constructed on the model to simulate the obturator bulb and palatal contour. This wax-up is then processed using heat-polymerized acrylic resin, which provides adequate strength and biocompatibility for short-term use. In modern approaches, digital workflows using intraoral scanning and CAD/CAM systems are increasingly applied, allowing more precise adaptation and faster fabrication. During construction, special attention is given to ensuring light weight, adequate retention, and minimal trauma to surgical tissues. The obturator is often designed with a hollow bulb to reduce weight and improve patient comfort. Retention may be achieved using remaining teeth, clasps, or anatomical undercuts, depending on the extent of the defect(8,9).

Clinically, the immediate obturator serves several essential functions. It restores the separation between the oral and nasal cavities, enabling early recovery of swallowing and speech function. It also acts as a surgical dressing, protecting the wound from contamination and mechanical irritation. Moreover, it helps maintain facial contour and provides immediate psychological benefit by reducing the visible defect after surgery.

Interim obturator. The interim obturator is delivered during the postoperative healing phase, typically 3–4 weeks after maxillary resection, when rapid changes in soft tissue morphology are still occurring. At this stage, the primary challenge is maintaining adequate retention and adaptation, as the previously placed surgical obturator often becomes unstable due to tissue shrinkage and wound healing dynamics.

From a fabrication perspective, the interim obturator is commonly constructed either from a new definitive impression or by modifying the existing surgical obturator. When a new impression is taken, a working cast is obtained, and a conventional wax pattern is designed to restore the defect area. The prosthesis is then processed using heat-polymerized polymethyl methacrylate (PMMA), which remains the most widely used material due to its ease of manipulation, acceptable strength, and biocompatibility for temporary use(14,15).

Alternatively, when the existing obturator is retained, a chairside relining procedure is performed using soft or temporary relining materials such as silicone-based or acrylic-based liners. This approach allows rapid adaptation to ongoing anatomical changes without the need for complete prosthesis remaking.

In some cases, hollow bulb design is incorporated to reduce prosthesis weight and improve patient comfort, especially in large maxillary defects. Retention is usually achieved through remaining natural teeth using clasps or occasionally through anatomical undercuts when available.

Clinically, the interim obturator plays a critical role in maintaining speech intelligibility, swallowing efficiency, and separation of the oral and nasal cavities during healing. It also serves as a transitional prosthesis, allowing gradual tissue conditioning before fabrication of the definitive obturator.

Definitive obturator. The definitive obturator is fabricated after complete healing of the surgical site, typically around 6 months postoperatively, when the soft and hard tissues have reached a stable anatomical condition. At this stage, a long-term prosthesis can be designed with improved precision, retention, and functional efficiency.

The fabrication process begins with taking a final impression of the maxillary defect using high-precision impression materials such as addition silicone or polyether. A master cast is then poured in dental stone to accurately reproduce the defect anatomy. On this cast, the prosthesis framework is designed, taking into consideration the extent of the defect, remaining dentition, and biomechanical requirements.

Traditionally, the obturator is constructed using a metal framework made of cobalt–chromium alloy, which provides high strength, rigidity, and long-term stability. In some cases, titanium alloys are used due to their superior biocompatibility and reduced weight. The obturator bulb and denture base are typically fabricated from heat-polymerized polymethyl methacrylate (PMMA), which allows aesthetic tooth arrangement and acceptable mechanical properties(3,13).

In modern prosthodontics, digital workflows are increasingly applied. CAD/CAM technology enables the design and milling of both metal and polymer components with high precision. Additive manufacturing (3D printing) is also used in some protocols to fabricate lightweight obturator bulbs and customized structures, improving adaptation and reducing overall prosthesis weight.

For large maxillary defects, hollow bulb designs are commonly employed to enhance comfort and reduce gravitational displacement. Retention is achieved through clasp systems, precision attachments, or, in selected cases, implant-assisted support when anatomical conditions allow.

Clinically, the definitive obturator restores mastication, speech, swallowing, and facial aesthetics on a long-term basis, significantly improving the patient's quality of life and functional rehabilitation.

Acrylic resin prostheses (PMMA). Polymethyl methacrylate (PMMA) remains the most widely used material for obturator fabrication due to its favorable combination of aesthetics, ease of processing, and cost-effectiveness. Acrylic resins allow precise tooth arrangement and satisfactory adaptation to oral tissues. They are also relatively easy to repair and reline, which is particularly important in patients with changing postoperative anatomy(14).

However, PMMA has several limitations, including relatively low fracture resistance, higher weight in large maxillary defects, and potential porosity, which may contribute to microbial colonization and long-term discoloration. Despite these disadvantages, PMMA continues to be the standard material for interim and definitive obturators in many clinical protocols.

Flexible nylon-based prostheses. Thermoplastic nylon materials have been introduced as an alternative to conventional acrylic resins. These materials are characterized by flexibility, improved patient comfort, and enhanced esthetics due to the absence of visible metal clasps.Nevertheless, nylon-based prostheses have limitations such as reduced rigidity, difficulty in adjustment and relining, and potential long-term deformation under functional load. For this reason, their use in obturator prosthodontics is limited mainly to cases with mild to moderate defects or as part of combined designs(2).

Metal frameworks (cobalt–chromium and titanium). Metal frameworks, particularly cobalt–chromium alloys, are widely used in definitive obturator prostheses due to their high strength, rigidity, and long-term stability. They provide excellent support for prosthetic teeth and allow controlled load distribution to the remaining oral structures.

Titanium and titanium alloys have gained increased attention in recent years due to their superior biocompatibility, corrosion resistance, and significantly reduced weight compared to cobalt–chromium. However, titanium is more expensive and requires advanced manufacturing technologies.

Polyetheretherketone (PEEK) and modern hybrid systems. Recent advances in prosthodontics have introduced high-performance polymers such as PEEK as promising materials for obturator frameworks. PEEK is characterized by low weight, high strength-to-weight ratio, biocompatibility, and favorable elastic modulus, which is closer to bone compared to metals.(13)

PEEK-based obturators are often used in combination with acrylic resin and other materials, forming hybrid or combined prosthetic systems. These combinations allow improved stress distribution, enhanced comfort, and better adaptation in complex maxillary defects.

Digital impression techniques and CAD/CAM technology. Traditional impression techniques are increasingly being replaced or supplemented by digital workflows. Intraoral scanning and extraoral 3D scanning of maxillary defects allow accurate digital reproduction of anatomical structures without the discomfort associated with conventional impressions.
The digital data are processed using CAD software, enabling precise design of obturator frameworks, including hollow bulb structures and retention elements. CAM technologies such as milling and additive manufacturing (3D printing) are then used to fabricate the final prosthesis with high accuracy and reproducibility.

Digital approaches reduce clinical steps, improve fit, and allow easier modification and duplication of prostheses, particularly in long-term rehabilitative cases.

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