

Journal of Oral Medicine and Dental Research

Genesis-JOMDR-6(2)-97
Volume 6 | Issue 2
Open Access
ISSN: 2583-4061

Multi-Unit Abutment: Why, Where, When?

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Citation: Pakhshan G, and Zahra B. Multi-Unit Abutment: Why, Where, When? J Oral Med and Dent Res. 6(2):1-8.

Received: April 01, 2025 | **Published:** April 15, 2025

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Abstract

Dental implants are a well-documented intervention for both partial and complete edentulism. As the success of dental implant osteointegration led to its widespread and predictable use in dentistry, the need to address challenges with certain prosthetic components has emerged to meet technical and anatomical demands. One key concept is the importance of a passive fit. The implementation of a multi-unit abutment system offers a viable solution for fabricating screw-retained, implant-supported prosthetic structures with a passive fit by providing a short cone external connection. Multi-unit abutments serve as connectors between dental implants and screw-retained restorations, especially when correction of the implant's three-dimensional position is necessary.

Keywords

Multi-unit abutments; Fabricating screw-retained; Three-dimensional position.

Introduction

Dental implantology originated in the mid-20th century, pioneered by Dr. Per-Ingvar Brånemark and Andre Shroeder. Initially, implant systems utilized straight abutments as the connection between the implant-supported prosthesis and the dental implant. As the success of dental implants became widely recognized, challenges related to their prosthetic components also surfaced [1]. To accommodate the technical and anatomical demands, Screw-retained restoration and cement-retained restoration were used, the debate between choosing screw-retained and cement-retained restorations continues, with each method presenting its own set of advantages and disadvantages [2]. One of the main challenges with screw-retained implant-supported full-mouth rehabilitation is passive fit (ideal fit). Passive fit is assumed to be one of the most significant prerequisites for the maintenance of the “bone-implant interface”. To provide a passive fit or a strain-free superstructure, a framework should, theoretically, induce absolute zero strain on the supporting implant components and the surrounding bone in the absence of an applied external load.

This vital requirement may be provided by simultaneous and even mating of the complete intaglio surfaces of implant abutment connection but with contemporary dental technology an absolute passive fit cannot be obtained with an internal connection. Prosthetic complications such as screw loosening or fracture of abutment screws, gold cylinders, frameworks, and veneers have been documented and may be related to poor framework fit [3]. On the other hand, Cement retained restorations can offer passive adaptation due to the cement interstice between the abutment and prosthesis; however, this retention method may lead to complications such as difficulty of maintenance service due to lack of retrievability, and an increased risk of peri-implantitis because of excess cement accumulation in the peri-implant region, particularly within the soft tissue.

The late 20th century witnessed advancements in prosthetic parts for dental implants. One of these component improvements was the development and introduction of Multi-Unit Abutments (MUAs) in 2000 which was designed to overcome the challenge of implant angulation after placement and passive fit of restoration. It has been recognized as a standard implant abutment since then. Multi-unit abutments success was the result of its design specifics, a small cone to accommodate restricted interocclusal space, and a broad shoulder to facilitate the placing of the prosthetic restorations (Figure 1).



Figure 1: Small cone and broad platform shoulder design make the MUAs useful for overcoming the challenges of implant supported screw-retained restorations.

Implementing a multi-unit abutments system is a viable solution for fabricating screw-retained implant-supported prosthetic structures with passive fit by providing a short cone external connection [5,10]. This

innovation has enhanced the ability to customize different angulations and provided superior support for complicated restorations; currently, a diverse array of implant-supported dental treatments exists to restore edentulous patients, including implant-supported restorations inserted directly into the fixture (implant), implant-supported restorations that connect to the fixture (implant) via multi-unit abutments, and overdenture implant-supported restorations. MUAs are frequently employed for full arch reconstruction of complete edentulous patients such as in All-on-4 and the use of zygomatic dental implants. Multi-unit abutments are utilized when conventional straight or angled abutments fail to align with the intended position of the final prosthesis. These abutments are positioned at various angles and heights to accommodate the limitations of implant positioning due to the existing anatomy of the alveolar bone. This facilitates achieving ideal dental aesthetics, passive fit, and gingival health and harmony by offsetting the implant placement and improving the natural shortcoming of the bony housing or the adjacent teeth.

Multi-unit abutment Types

MUAs are available by most implant brands in various sizes and angulations including straight ones. Depending on the angulation of the implant placed, and the need for correcting it to serve the prosthesis, the proper angle can be selected from 0°, 17°, 30°, and 45° (Figure 2).

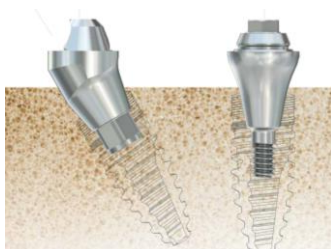


Figure 2: Multi-unit abutments (MUA) are engineered with various angle correction options and are compatible with nearly all implant platforms.

Multi-unit abutments Indications

1. **Angulation Correction:** They are used to correct the angulation of the implant, allowing for better alignment with adjacent teeth and improved aesthetics.
2. **Implant-Supported Bridges:** MUAs are commonly used in cases where multiple implants support a dental bridge. Their adjustable angles and heights, help achieve a harmonious and functional restoration.
3. **Overdentures:** These abutments are employed in the fabrication of implant-supported overdentures, providing stability and support for the superstructure bars that support the removable prosthesis.

Advantages of using multi-unit abutments

1. **Compensate for the alveolar bone deficiency:** In situations where the implant is not placed in alignment with the natural teeth with various inclinations because of bone defect, MUAs

- help compensate for the tilted or inclined positions of the implant fixtures. They make it possible to customize in cases where a standard straight abutment may not fit optimally due to anatomical variations.
2. **Optimizing Esthetics:** Multi-unit abutments aid in achieving better esthetics by accommodating the natural contours and angulations of the patient's dentition.
 3. **Compatibility:** MAUs are compatible with various implant systems possible, enabling dentists to coordinate diverse implant systems.
 4. **Gingival Harmony and health:** the installation of intraoperative MUAs safeguards peri-implant soft tissues from harm caused by the repeated screwing and unscrewing of implant super-structures (10), as all procedures occur above implant platform on MUA and the shoulder of MUA at the level of free gingival margin.
 5. **Ease of Prosthesis Management:** MUAs facilitates achieving a more straightforward and predictable placement of the final restoration. The removal and replacement of the prosthesis is also facilitated with this treatment modality.
 6. **Expanding the implant treatment to more patients:** MUAs are available in straight and angled forms of 0°, 17°, 30°, and 45° with different collar heights to help the clinicians achieve their treatment goals often with graft less techniques in cases of limited bone quality and quantity, thereby enabling a greater number of patients experience the established benefits of implant dentistry.

How to use multi-unit abutments

The MUAs can be positioned either by the surgeon at the surgery for immediate loading or by the restorative dentist after the healing period of implants. If the surgeon chooses not to install the MUAs during the surgical procedure, the restorative dentist may subsequently add the MUAs and obtain an abutment-level impression using the MUA impression coping. Typically, there are 3 to 4 angle correction options available, spanning from 0 degrees to 45 degrees. Clinicians may make selections during the denture conversion appointment or at the initial prosthetic impression appointment. Clinicians may need to adjust one or more angulations during the restorative procedure to optimally support the final prosthetic. The essential aspect is that when prosthodontist place multi-unit impression copings and secure them to the MUAs to take abutment level impression, the pins of impression coping must be clinically parallel [8].

Followings are Clinical Cases Demonstrating the use of MUAs

Case 1

Fully edentulous patient case; A 57-year-old male presented to the private clinic. (Manhattan, NY) with a chief complaint of "All my teeth are broken and I want to replace them with fixed bridges." The Patient reported that he was in good health and had no known allergy. However, he was a heavy smoker. All his remaining teeth Except #22-27, and #1,16 appeared to have second to third-degree mobility or severe loss of tooth structure. They are diagnosed as hopeless or non-restorable. A treatment plan was offered including removal of all his upper teeth (except #1,16 the patient insisted on keeping them) and lower remaining teeth (except #22,23,24,25,26,27), immediate complete dentures, and implant placement. A

CAD/CAM technology was used to provide optimal accuracy in selecting the dimensions and positioning of dental implants, while also facilitating accurate implant placement by preoperative planning. At the time of planning, it was determined that parallel implant placement in the maxilla wasn't possible due to the long span arch curvature. For the type of the prosthesis, considering all the benefits, a screw-retained full zirconia restoration was chosen as the final prosthesis. The concern about the passivity of the fit was addressed with the use of MUAs to correct the different degrees of divergence of the implant's axes.

This clinical case (Figure 3,4) demonstrates a predictable treatment approach for full-arch screw-retained implant-supported zirconia rehabilitation [6,7]. Seven implants for the maxilla were placed by the surgeon. After the second stage of surgery MUAs were used by the prosthodontist and conventional dentures were converted to screw-retained temporary restoration. Meantime an abutment level impression was taken, after positioning multi-unit impression copings and securing them to the MUAs to take abutment level impression, the pins of the impression coping were clinically parallel [8], otherwise using MUAs would not help in passive fit. A CAD CAM prototype was made by the lab and tried clinically. Once the prosthesis was approved, it was used to fabricate the final prosthesis. A screw-retained full arch implant supported full zirconia was delivered in the patient's mouth. The use of MUAs in this case, facilitated a passive draw and ensured a consistent and uniform seating for all abutment locations.

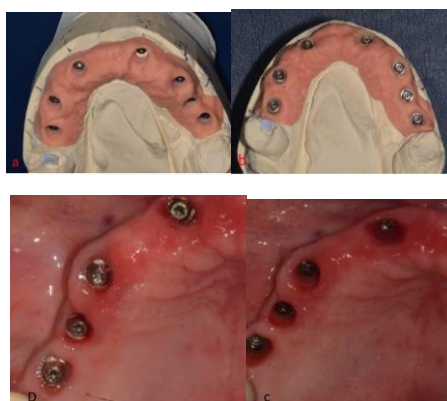


Figure 3: In the restoration of a full arch, screw-retained implant prosthetic case, even a slight discrepancy in the alignment of the implant interface access causes challenges in siting restoration. We utilized multi-unit abutments to address these restorative problems, a-Master cast without MUA, b-Master-cast with MUA in place, c- Implants without MUA, d-Implant upper right with MUA, MUA makes the support for final restoration more accessible.



Figure 4: e-prototype f-Full zirconia restoration g-Final restoration in place screwed with maximum passive fit.

Case II –All on 4 Case

Case-Report. Pakhshan G, et al. *J Oral Med Dent Res.* 2025, 6(2)-97

DOI: [https://doi.org/10.52793/JOMDR.2025.6\(2\)-97](https://doi.org/10.52793/JOMDR.2025.6(2)-97)

A 64-year-old man, edentulous for a long period of time due to periodontal disease, was referred to the clinic, asking for a fixed prosthetic rehabilitation for his upper jaw. His past medical history was uneventful. The panoramic radiograph revealed an advanced alveolar bone resorption, particularly in posterior maxilla. The CT-Scan confirmed bone atrophy. Due to the patient's age, a comprehensive full-mouth rehabilitation plan was advised, involving the placement of four implants in the maxilla with All on 4 design (to avoid sinus lift) and immediate loading, followed by the fabrication of final prostheses. To avoid the sinus site tilted implant concept was used. Tilting the posterior implants in All on 4 circumvents anatomical features, including the mandibular nerve, mental foramen, and maxillary sinus, and diminishing the necessity for bone augmentation [11]. Also tilting the posterior implants repositions the implant abutment connection towards the posterior of the oral cavity, enhancing the anteroposterior dimension; consequently, cantilevers are minimized. This increases support for the prosthesis. For overcoming challenges associated with implant supported screw retained prosthesis, MUAs should be implemented in final design for all on 4. MUAs provide significant versatility in prosthetic reconstruction. This case was planned for all on 4 and the surgeon inserted dental implants into the maxilla without elevating the sinus. This conserved both time and money. The angled MUAs facilitated the tilting of the two posterior implants, enabling the placement of lengthier implants in the anterior bone instead of the posterior where bone resorption had occurred. This enhanced bone-to-implant contact, the cantilevers were also diminished. Surgeon placed the MUAs and prosthodontist converted the denture to temporary implant supported denture and performed immediate load the implants (Figure 5).



Figure 5: all on 4: a-Fixture, b-Multi unite abutment, c- Temporary restorative abutment, d- Temporary restorative abutment in converted Denture, f-Denture were converted to screw retained temporary restoration.

Case III

Partially Edentulous Patient case: Misalignment and height discrepancies can occur after implant placement for patients that makes implant-supported screw-retained restoration a challenge [9]. Taking “implant level impression” (bone level) form implants that has been placed deep is very painful for the patient. Using MUAs not only provides all the benefits for implant supported screw retained restoration but also brings the implant platform closer to the free gingival margin, eliminating the painful manipulation of the soft tissue at impression making.

72-year-old men presented to private practice (Manhattan NY) fully dentulous with old restorations, for full-mouth rehabilitation. Upon clinical examination, it was determined that #29,30,31 was not restorable. These teeth were extracted, and implant were placed, implant has been placed very deep. The case was treatment planned for screw retained implant supported restoration with implementing Multiunit abutment to coordinate the platform shoulder of implants and use benefit of passive fit.

Pictures (6,7) show MUAs are employed to address height discrepancies. The objective was to ensure that all MUAs were approximately positioned at tissue level and were leveled. This method ensures the prosthesis is seated more securely and reliably. MUAs compensated for height discrepancies thanks to their variety of height profiles. The concept involves utilizing low-profile multi-unit abutments for implants positioned higher in the tissue relative to occlusal plane, while employing taller profile multi-unit abutments for implants situated deeper inside the bone. Various sizes and angles of MUAs are used for this patient. The utilization of MUAs in this case rectified both angulation and height discrepancies.

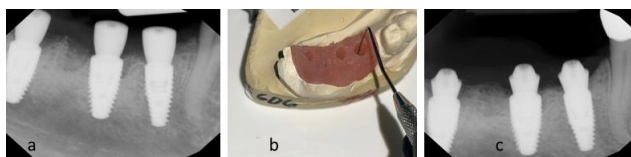


Figure 6: Deep tissue and nonparallel implant make using MUAs necessary to achieve passive fit: a-implant with healing abutment, b-soft tissue depth more than 8mm, c-Implant with MUAs

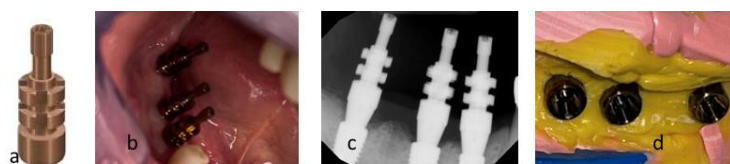


Figure 7: Using MUAs impression coping to take impression at the abutment level: a-MUA impression coping, b- Impression copings secured on MUAs inside the mouth, c-x-ray, d-abutment level final impression

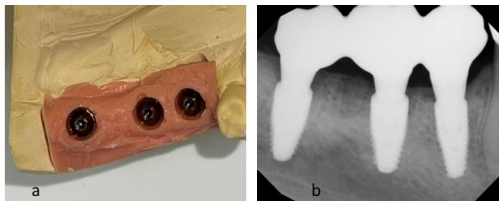


Figure 8: a-Mater cast with MUA analog; b-Final restoration screwed on MUA

Conclusion

The adaptability of multi-unit abutments renders them indispensable in diverse screw-retained implant-supported restorations in implant dentistry. MUAs connect dental implants and screw-retained restorations when correction for implant 3D position is necessary. The MUAs is meticulously engineered to restore both edentulous and partially edentulous arches, especially when employing the clinically and scientifically validated all-on-4 treatment. Currently, MUAs are extensively utilized in implant dentistry, providing practitioners enhanced flexibility and accuracy in managing the various anatomical obstacles encountered by patients desiring implant-supported restorations. To accommodate implant angulation and various soft tissue anatomies, MUAs are available in straight and angled forms of 0°, 17°, 30°, and 45° with different collar heights. Extended versions with shorter, longer, and wider dimensions have been incorporated into an enhanced range aimed at assisting clinicians in employing a graft-less technique to attain cortical or bi-cortical anchorage in cases of limited bone quality and quantity, thereby enabling a greater number of patients to experience the established benefits of the multi-unit abutments treatment

paradigm. Using MUAs is strongly advised when constructing a full arch screw-retained implant-supported restoration.

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