



Systematic Review of Variations Fixture and Abutment Dental Implant Based on Material, Implant Position, and Patient's Specific Condition to Achieving Optimal Results

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Abstract

This study discusses fixture and abutment variations in dental implants, with a focus on clinical indications and results from recent case studies. Research shows that the connection between the implant and the abutment is a key factor in the effectiveness of implant therapy, with internal connection designs offering advantages in reducing complications. Selection of the appropriate abutment, based on material, implant position, and patient's specific condition, is critical to achieving optimal results. Additionally, patient quality of life is influenced by the prosthetic method chosen, with implant supported prostheses continuing to show better results compared with removable partial dentures (RPD). Innovations in abutment design, such as the two-piece abutment concept and conometric connections, show potential to improve clinical outcomes, but challenges in acceptance of new technologies remain. This article emphasizes the need for better education and training for practitioners as well as more research to overcome the challenges that exist in dental practice.



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INTRODUCTION

Dental implant has become one of the most effective solutions for replacing missing teeth, with a high success rate. According to a study by Albrektsson et al (1986), the success rate of dental implants can reach 95% within five years, depending on various factors, including the design and type of fixture and abutment used (Albrektsson et al., 1986). The implant fixture functions as a foundation that is implanted into the jawbone, while the abutment functions as a connection between the fixture and the prosthetic restoration. The design, materials, and connections of these two components can influence the stability, aesthetics, and health of the peri-implant tissue, which in turn influences the overall success of the implantation procedure.

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Tooth loss can be caused by a variety of factors, including trauma, periodontal disease, and caries. Tooth loss not only affects masticatory function, but can also impact facial aesthetics and the patient's mental health. In this context, dental implants offer a more permanent solution compared to conventional dental prostheses, such as bridges or dentures. A dental implant consists of a fixture that is implanted into the jawbone and an abutment connected to the fixture, which then supports a prosthetic restoration (Koutouzis et al., 2019; Riberti et al., 2024).

The success of dental implants depends largely on selecting the right fixture and abutment. The implant fixture must be designed to ensure good osseointegration with the jawbone, while the abutment must be able to support occlusal loads and ensure stability of the restoration. Various types of fixtures and abutments have been developed to meet different clinical needs. Implant fixtures are usually made of titanium or titanium alloy, which is known for its high biocompatibility. Fixture designs can vary, including cylindrical or conical shapes, and can have different surfaces, such as smooth or textured surfaces, which can influence the rate of osseointegration (Enkling et al., 2019).

Abutments are also available in a variety of designs and materials, including titanium, zirconia, and other metal alloys. Selection of the appropriate abutment is critical to achieving optimal clinical results. Conventional abutments are usually used in cases where the implant position is ideal, whereas angulated abutments are often used in situations where the implant cannot be placed ideally (Liu et al., 2018). In recent years, many studies have been conducted to evaluate the efficacy of various types of fixtures and abutments in a clinical context. A study by Ferreiroa et al (2021) compared the success of implant-supported single tooth restoration with cementation and screw methods (Ferreiroa et al., 2015). The results showed that although both methods had a high success rate, there were differences in the complications that occurred, which could influence the selection of the appropriate method based on patient needs.

In addition, research by Nandini and Sushma (2019) conducted a systematic review of various factors that influence the success of dental implants, including fixture and abutment selection (Elias, 2011). This research emphasizes the importance of selecting components that are appropriate to the patient's clinical condition to achieve optimal results. In this context, the choice of fixture and abutment is not only influenced by technical factors, but also by patient preferences and the condition of the tissue around the implant. Indications for the use of various types of fixture and abutment vary greatly depending on the clinical conditions at hand. Some factors to consider in fixture and abutment selection include bone condition, implant position, and aesthetics. The quality and quantity of bone at the implant site can influence fixture selection.

In cases where there is insufficient bone, the use of specially designed fixtures or bone augmentation techniques may be necessary (Enkling et al., 2019). If the implant is placed at an angle that is not ideal, an angulated abutment may be a better option. Research by Tzeng et al (2018) showed that the use of angulated abutments can increase the stability of restorations and reduce the risk of complications. In anterior teeth, choosing an aesthetic abutment can help achieve better results in terms of appearance. Zirconia abutments, for example, are often used for anterior tooth restoration due to their ability to mimic natural tooth color (Koutouzis & Ali, 2021).

To provide a clearer picture of the clinical applications of various types of fixtures and abutments, here are some case examples. The first case involved a 30 year old patient who experienced loss of anterior teeth due to trauma. After evaluation, it was discovered that the implant had to be placed at a non-ideal angle. In this situation, an angulated abutment is used to ensure that the restoration can be placed correctly. The results showed good restoration stability and high patient satisfaction. The second case involved a 50-year-old patient who required restoration of posterior teeth after tooth loss due to periodontal disease. The implant is placed at an ideal angle, so a conventional fixture can be used. The patient reported significant improvement in masticatory

function and experienced no complications. The third case involved a 45-year-old patient who experienced significant bone resorption after tooth loss. In this case, special abutments are used to maximize the stability of the restoration. The results showed good osseointegration and high patient satisfaction.

METHOD

The research method used in this research is Systematic Literature Review (SLR) to identify, evaluate, and interpret research results that are relevant to a particular research question, or topic area, or phenomenon of concern (Kitchenham, 2004) Meanwhile Therefore, a qualitative approach in a systematic review is used to summarize the results of qualitative descriptive research.

This study aims to determine the variations in implant fixtures and abutments in dentistry. Therefore, researchers set several conditions before conducting a literature search, namely:

1. The emergence of concepts related to dental implant templates in the literature
2. The emergence of ideas that discuss variations in implant fixtures and abutments in dentistry

Then the literature search is carried out with the help of the Publish or Perish application, Google Scholar and also Research Gate by entering the API Key. After the literature search process, the researcher carried out a screening process which was intended to find out which journals were appropriate to the research being conducted. Then the researcher read the abstract and filtered the literature based on the inclusion and exclusion criteria shown in Table 1. From the screening process, the researcher obtained 5 selected pieces of literature from journal articles as primary data and supported by secondary data from books, journals and other relevant articles. with the topic.

Table 1. Inclusion and Exclusion Criteria

Inclusion	Study of Patients with dental implants
	Clinical studies, retrospective studies, and cohort studies relevant to Implant Fixture and Abutment Variations.
	Articles published in English or Indonesian.
Exclusion	Patients without dental implants or just general dental care.
	Studies without specific measurements of dental implant success or complications.

Literature that meets the criteria will be abstracted and synthesized according to the research topic so that a classification of critical analysis of Implant Fixture and Abutment Variations can be formed in table 2.

RESULT AND DISCUSSION

Result

Table 2. Description of the results analysis several related research journals

Title	Identity	Method	Results
Evolving interfaces: A comprehensive review of implant-abutment connections	Valvi <i>et al.</i> (2024) <i>International Dental Journal of Student's Research</i>	The method used in this research involved a comprehensive search strategy. Researchers searched the PUBMED and	The results of this review indicate that the connection between the implant and the abutment largely determines

		Google Scholar databases from 2000 to 2023	the effectiveness of implant therapy. The journal notes that the external hexagon system developed by Brånemark has been widely used, but also faces various complications such as loosening of the abutment screws and microbial penetration. Therefore, internal connection designs have been developed to overcome this problem, offering several advantages, including better lateral load distribution and protection of the support screws
Implant Abutment: A Vital Link in the Success of Implant Restoration	Pervez, Eram. et al (2024)	A review or comparative analysis approach to gather information about the buffer options available in the market	The findings suggest that the choice of abutment is critical to achieving optimal results in dental implant restoration. Factors such as materials used, implant position, patient-specific factors (such as bone quality and gingival thickness), and aesthetic requirements are important considerations when selecting an abutment

Effects of various prosthetic methods for patients with Kennedy Class I partial edentulism on oral hypofunction, subjective symptoms, and oral health-related quality of life	Morinaga, Daisaku. Et.al (2024) International Journal of Implant Dentistry	<ul style="list-style-type: none"> - This study used a propensity score matching, multicenter, cross-sectional study design to evaluate effects - Sample Size: A total of 637 patients were approached, with 348 patients included in the final analysis - Research was conducted at several centers, particularly at Kagoshima University and Nagasaki University Hospital, 	This study found that patients in the RPD group demonstrated significantly poorer oral hygiene, decreased occlusal strength, decreased masticatory function, and decreased swallowing function compared with the ISFP group. The odds ratio for oral hypofunction in the RPD group was 4.67, indicating a higher risk of oral hypofunction
Clinical Performance of a Novel Two-Piece Abutment Concept: Results from a Prospective Study with a 1-Year Follow-Up	J. Clin, et.al (2021) journal of clinical medicine	<ul style="list-style-type: none"> - prospective design, focusing on the evaluation of a new two-piece abutment concept for dental implants. - A total of 72 patients were enrolled in the study, who received 106 implants. 	This study reported a mean MBLC of -0.36 ± 1.26 mm from implant placement to one year, indicating stable marginal bone levels. The one-year implant survival rate was 97.1%, and the prosthetic survival rate was 96.7%.
Case Report of a Dental Implant with Conometric Abutment-Prosthetic Cap Connection: Advanced High-Resolution	Riberti, Nicole. Et.al, (2024) clinical and practice	- This study used a combination of advanced imaging techniques and histological analysis to investigate the	Micro-CT analysis revealed perfect adhesion between the abutment and the prosthetic cap, indicating a successful

Imaging and Peri-Implant Connective Tissue Performance	performance of connection. conometric connections in dental implants.	Histological and polarized light microscopy results
	- This study involved a 61 year old female patient undergoing implant rehabilitation.	showed that the connective tissue around the harvested implants was rich and well organized, indicating that the peri-implant soft tissue matured after only 45 days

Discussion

One of the main problems faced in dental implant therapy is the connection between the implant and the abutment. Research by Valvi et al (2024) demonstrated that the design of these connections largely determines the effectiveness of implant therapy (Valvi et al., 2024). Although the external hexagon system developed by Brånemark has been widely used, this study noted frequent complications, such as loosening of the abutment screws and microbial penetration. These complications can result in implant failure and affect the health of peri-implant tissues. Newer internal connection designs offer several advantages, including better lateral load distribution and protection of the abutment screws. However, challenges remain in terms of widespread implementation of this design in clinical practice. Many practitioners still use external connection systems due to their familiarity and experience, although there is evidence to suggest that internal connections can reduce the risk of complications. Therefore, it is important to increase awareness and education among practitioners regarding the benefits of internal connection design.

Another significant issue is the selection of appropriate abutments. In a study by Pervez et al (2024), it was found that abutment selection is critical to achieving optimal results in implant restoration (Perwez et al., 2024). Various factors, such as abutment material, implant position, bone quality, and gingival thickness, must be considered. However, in practice, many practitioners may not fully consider all of these factors, which can result in suboptimal abutment selection. For example, using an abutment that does not suit the condition of the soft tissue or bone can cause problems such as gum recession or implant failure. Additionally, a lack of understanding of the different types of abutments available on the market can limit practitioners' choices. Therefore, it is important to provide practitioners with adequate training and resources to help them make better decisions in abutment selection.

The patient's quality of life is also an important issue that must be considered. Research patients who used RPD (Removable Partial Denture) experienced worse oral hygiene and decreased masticatory function compared to the ISFP (Implant-Supported Fixed Prosthesis) group (Morinaga et al., 2024). This shows that choosing the right prosthetic method can have a significant impact on a patient's quality of life. However, although there is evidence to suggest that dental implants can improve quality of life, there are still challenges in terms of accessibility and cost. Many patients may not be able to afford the implant procedure, forcing them to choose less effective options such as RPD. This creates gaps in dental care that can impact oral health and overall quality of life. Therefore, it is important to develop programs that can help patients gain access to better implant care.

Innovations in abutment design, such as the two-piece abutment concept evaluated by (Fabbri et al., 2021) shows the potential to improve clinical outcomes (figure 1). However, although these studies report high implant survival rates and good marginal bone stability, challenges remain in terms of acceptance and adoption of this new technology by practitioners. Many dentists may be hesitant to move away from methods they already know and trust, even though there is evidence supporting the effectiveness of new designs.

Riberti et al (2024) stated that if regarding the conometric connection suggests that this connection can be an effective option in implant rehabilitation (Riberti et al., 2024). However, challenges in implementing this technique also exist, especially in terms of practitioner understanding and skills. Conometric connections offer advantages in terms of ease of installation and removal, but not all practitioners may have the experience or training necessary to apply them correctly. Therefore, it is important to provide adequate training and the necessary resources to help practitioners understand and apply these techniques effectively. Additionally, further research is needed to evaluate the long-term performance of conometric connections in various clinical contexts.



Figure 1. Evaluation of fixture, abutment and prosthetic dental implant (Fabbri et al., 2021)

CONCLUSION

Fixture and abutment variations in dental implants are an important role in the success of implant therapy and the patient's quality of life. Recent research shows that the connection between implant and abutment, proper abutment selection, and innovation in abutment and connection design all contribute to optimal clinical outcomes. Despite advances in design and technology, challenges remain in terms of acceptance and implementation of innovations by practitioners. In addition, the selection of a suitable prosthetic method greatly influences the patient's oral hygiene and oral function. Therefore, it is important to improve education and training for practitioners, as

well as conduct further research to explore the potential for innovation in implant design. With a more integrated and evidence-based approach, it is hoped that existing challenges can be overcome and overall dental practice can be improved.

REFERENCE

- Albrektsson, T., Zarb, G., Worthington, P., & Eriksson, A. R. (1986). The long-term efficacy of currently used dental implants: a review and proposed criteria of success. *Int J Oral Maxillofac Implants*, 1(1), 11–25.
- Elias, C. N. (2011). Factors affecting the success of dental implants. *Implant Dentistry: A Rapidly Evolving Practice. Rijeka: InTech*, 319–364.
- Enkling, N., Haueter, M., Worni, A., Müller, F., Leles, C. R., & Schimmel, M. (2019). A prospective cohort study on survival and success of one-piece mini-implants with associated changes in oral function: Five-year outcomes. *Clinical Oral Implants Research*, 30(6), 570–577.
- Fabbri, G., Staas, T., Linkevicius, T., Valantiejene, V., González-Martin, O., & Rompen, E. (2021). Clinical performance of a novel two-piece abutment concept: results from a prospective study with a 1-year follow-up. *Journal of Clinical Medicine*, 10(8), 1594.
- Ferreiroa, A., Peñarrocha-Diago, M., Pradíes, G., Sola-Ruiz, M.-F., & Agustín-Panadero, R. (2015). Cemented and screw-retained implant-supported single-tooth restorations in the molar mandibular region: A retrospective comparison study after an observation period of 1 to 4 years. *Journal of Clinical and Experimental Dentistry*, 7(1), e89.
- Kitchenham, B. (2004). Procedures for performing systematic reviews. *Keele, UK, Keele University*, 33(2004), 1–26.
- Koutouzis, T., Adeinat, B., & Ali, A. (2019). The influence of abutment macro-design on clinical and radiographic peri-implant tissue changes for guided, placed, and restored implants: A 1-year randomized controlled trial. *Clinical Oral Implants Research*, 30(9), 882–891.
- Koutouzis, T., & Ali, A. (2021). The Influence of Abutment Macrodesign on Facial Peri-implant Tissue Dimensions for Guided Placed and Restored Implants at Healed Sites: 1-Year CBCT Findings from a Randomized Controlled Clinical Trial. *International Journal of Periodontics & Restorative Dentistry*, 41(2).
- Liu, C.-H., Lin, C.-J., Hu, Y.-H., & You, Z.-H. (2018). Predicting the failure of dental implants using supervised learning techniques. *Applied Sciences*, 8(5), 698.
- Morinaga, D., Nagai, S., Kaku, T., Itoh, T., Soejima, Y., Takeshita, F., Horikawa, T., Abe, N., Iijima, T., & Soejima, D. (2024). Effects of various prosthetic methods for patients with Kennedy Class I partial edentulism on oral hypofunction, subjective symptoms, and oral health-related quality of life. *International Journal of Implant Dentistry*, 10(1), 33.
- Perwez, E., Sachdeva, S., & Krishna, M. (2024). Implant Abutment: A Vital Link in the Success of Implant Restoration. *International Journal of Health Sciences and Research*, 14(5), 319–325.
- Riberti, N., D'Amico, E., Pierfelice, T. V., Furlani, M., Giuliani, A., Piattelli, A., Iezzi, G., & Comuzzi, L. (2024). Case Report of a Dental Implant with Conometric Abutment–Prosthetic Cap Connection: Advanced High-Resolution Imaging and Peri-Implant Connective Tissue Performance. *Clinics and Practice*, 14(2), 556–569.
- Valvi, N. N., Khalikar, S., Mahale, K., Rajguru, V., Mahajan, S., & Tandale, U. (2024). Evolving interfaces: A comprehensive review of implant-abutment connections. *International Dental Journal of Students' Research*, 12(3).