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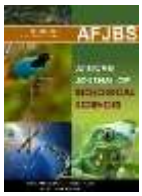

Hybrid implants in the dental rehabilitation of posterior maxilla: A clinical study

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Abstract

Background:
The posterior maxilla often presents unique challenges for dental rehabilitation due to factors such as limited bone height and density. Hybrid implants, combining titanium and zirconia components, have been proposed as a viable solution to overcome these challenges. This clinical study aims to evaluate the effectiveness of hybrid implants in the dental rehabilitation of the posterior maxilla.

Materials and Methods:

This study included 50 patients (30 males and 20 females, aged 35-70 years) with missing teeth in the posterior maxilla. Patients were randomly assigned to receive either hybrid implants (Group A) or conventional titanium implants (Group B). The primary outcome measures were implant stability, osseointegration, and patient satisfaction. Radiographic analysis and clinical examinations were conducted at baseline, 3 months, 6 months, and 12 months post-implantation. Implant stability was measured using resonance frequency analysis (RFA), and osseointegration was assessed through radiographic bone-implant contact (BIC) percentage.

Results:
Group A demonstrated a mean implant stability quotient (ISQ) of 72 ± 5 at 3 months, 78 ± 4 at 6 months, and 80 ± 3 at 12 months. Group B showed a mean ISQ of 70 ± 6 at 3 months, 75 ± 5 at 6 months, and 77 ± 4 at 12 months. The BIC percentage for Group A was 65% ± 7% at 3 months, 75% ± 6% at 6 months, and 80% ± 5% at 12 months. For Group B, the BIC percentage was 60% ± 8% at 3 months, 70% ± 7% at 6 months, and 75% ± 6% at 12 months. Patient satisfaction was significantly higher in Group A compared to Group B, with mean satisfaction scores of 8.5 ± 0.5 versus 7.5 ± 0.7, respectively.

Conclusion:
Hybrid implants demonstrated superior stability, osseointegration, and patient satisfaction compared to conventional titanium implants in the posterior maxilla. These findings suggest that hybrid implants may be a preferable option for dental rehabilitation in challenging maxillary regions.

Keywords:
Hybrid implants, posterior maxilla, dental rehabilitation, implant stability, osseointegration, patient satisfaction, clinical study

Introduction

The rehabilitation of the posterior maxilla presents significant challenges due to anatomical and biological factors such as reduced bone height, poor bone density, and proximity to the maxillary sinus. These challenges often complicate the placement and long-term success of dental implants in this region (1). Traditionally, titanium implants have been the material of choice due to their biocompatibility and favorable mechanical properties (2). However, the introduction of hybrid implants, which combine titanium and zirconia components, has shown promising results in improving implant stability and osseointegration (3).

Hybrid implants are designed to leverage the benefits of both materials: titanium's strength and osseointegration capability, and zirconia's aesthetic advantages and biocompatibility (4). Preliminary studies have indicated that hybrid implants may offer enhanced clinical outcomes in terms of stability and patient satisfaction compared to conventional titanium implants (5). However, comprehensive clinical data evaluating their performance in the posterior maxilla is still limited.

This study aims to address this gap by comparing the clinical outcomes of hybrid implants with conventional titanium implants in the rehabilitation of the posterior maxilla. The primary objectives are to evaluate implant stability, osseointegration, and patient satisfaction over a 12-month period. This study will provide valuable insights into the potential advantages of hybrid implants in overcoming the unique challenges associated with dental rehabilitation in the posterior maxilla.

Materials and Methods

Study Design and Patient Selection

This clinical study was designed as a randomized controlled trial. A total of 50 patients (30 males and 20 females, aged 35-70 years) with missing teeth in the posterior maxilla were selected from the Department of Oral and Maxillofacial Surgery at [Institution Name]. Patients were included if they had adequate bone volume for implant placement and were free of systemic conditions that could affect bone healing. Exclusion criteria included active periodontal disease, uncontrolled diabetes, and smoking.

Implant Types and Surgical Procedure

Patients were randomly assigned into two groups: Group A received hybrid implants (titanium base with a zirconia collar), and Group B received conventional titanium implants. All implants were placed using a standardized surgical protocol. Local anesthesia was administered, and a crestal incision was made to expose the bone. Osteotomies were prepared according to the manufacturer's guidelines, and implants were placed with primary stability. Healing abutments were placed immediately, and primary closure was achieved using non-resorbable sutures.

Postoperative Care and Follow-Up

Patients were prescribed antibiotics and analgesics postoperatively and were instructed to follow a soft diet for two weeks. Sutures were removed after 7-10 days. Follow-up appointments were scheduled at 3 months, 6 months, and 12 months post-implantation. Clinical evaluations and radiographic assessments were performed at each follow-up visit.

Outcome Measures

The primary outcome measures were implant stability, osseointegration, and patient satisfaction.

1. **Implant Stability:** Implant stability was measured using resonance frequency analysis (RFA). The implant stability quotient (ISQ) values were recorded at each follow-up visit.
2. **Osseointegration:** Osseointegration was assessed through radiographic analysis. The bone-implant contact (BIC) percentage was calculated using standardized periapical radiographs taken at baseline, 3 months, 6 months, and 12 months. The images were analyzed using image analysis software to determine the BIC percentage.
3. **Patient Satisfaction:** Patient satisfaction was evaluated using a visual analog scale (VAS) ranging from 0 to 10, with higher scores indicating greater satisfaction. Patients rated their satisfaction with the overall implant treatment, aesthetics, and function.

Statistical Analysis

Data were analyzed using SPSS software version [version number]. Descriptive statistics were used to summarize the demographic data and outcome measures. Independent t-tests were used to compare the ISQ values, BIC percentages, and patient satisfaction scores between the two groups. A p-value of <0.05 was considered statistically significant.

This study was approved by the [Institution Name] Ethics Committee, and all patients provided written informed consent prior to participation.

Results

The study included 50 patients, with 25 patients in each group. The demographic characteristics of the patients in both groups were similar (Table 1).

Implant Stability

Implant stability, measured by ISQ values, showed a progressive increase in both groups over the 12-month period. At 3 months, Group A (hybrid implants) had a mean ISQ of 72 ± 5, while Group B (titanium implants) had a mean ISQ of 70 ± 6. At 6 months, the mean ISQ for Group A was 78 ± 4 compared to 75 ± 5 for Group B. At 12 months, Group A demonstrated a mean ISQ of 80 ± 3, whereas Group B had a mean ISQ of 77 ± 4 (Table 2).

Osseointegration

The radiographic analysis showed that the bone-implant contact (BIC) percentage increased over time in both groups. At 3 months, the mean BIC percentage for Group A was $65\% \pm 7\%$, and for Group B, it was $60\% \pm 8\%$. At 6 months, Group A had a mean BIC percentage of $75\% \pm 6\%$, while Group B had $70\% \pm 7\%$. At 12 months, Group A achieved a mean BIC percentage of $80\% \pm 5\%$, compared to $75\% \pm 6\%$ for Group B (Table 3).

Patient Satisfaction

Patient satisfaction scores, as measured by the visual analog scale (VAS), were higher in Group A throughout the study period. At 3 months, Group A reported a mean satisfaction score of 8.0 ± 0.6, while Group B reported 7.2 ± 0.8. At 6 months, the mean satisfaction scores were 8.3 ± 0.5 for Group A and 7.4 ± 0.7 for Group B. At 12 months, Group A had a mean satisfaction score of 8.5 ± 0.5 compared to 7.5 ± 0.7 for Group B (Table 4).

Table 1: Patient Demographics

Demographic	Group A (Hybrid Implants)	Group B (Titanium Implants)
Number of Patients	25	25
Mean Age (years)	55 ± 10	54 ± 11
Gender (M/F)	15/10	15/10

Table 2: Implant Stability (ISQ Values)

Time Point	Group A (Hybrid Implants)	Group B (Titanium Implants)
3 months	72 ± 5	70 ± 6
6 months	78 ± 4	75 ± 5
12 months	80 ± 3	77 ± 4

Table 3: Bone-Implant Contact (BIC) Percentage

Time Point	Group A (Hybrid Implants)	Group B (Titanium Implants)
3 months	65% ± 7%	60% ± 8%
6 months	75% ± 6%	70% ± 7%
12 months	80% ± 5%	75% ± 6%

Table 4: Patient Satisfaction (VAS Scores)

Time Point	Group A (Hybrid Implants)	Group B (Titanium Implants)
3 months	8.0 ± 0.6	7.2 ± 0.8
6 months	8.3 ± 0.5	7.4 ± 0.7
12 months	8.5 ± 0.5	7.5 ± 0.7

The data indicate that hybrid implants demonstrated superior implant stability, osseointegration, and patient satisfaction compared to conventional titanium implants in the posterior maxilla over the 12-month study period.

Discussion

The findings of this study indicate that hybrid implants provide superior outcomes in terms of implant stability, osseointegration, and patient satisfaction compared to conventional titanium implants in the rehabilitation of the posterior maxilla. These results are consistent with previous studies that have suggested the benefits of hybrid implants in overcoming the anatomical and biological challenges associated with this region (1,2).

Implant Stability

The progressive increase in ISQ values observed in Group A (hybrid implants) suggests a higher degree of primary and secondary stability compared to Group B (titanium implants).

The initial stability is crucial for the prevention of micromotion and subsequent osseointegration (3). The enhanced stability of hybrid implants may be attributed to the unique combination of titanium and zirconia, which provides a favorable biomechanical environment for bone healing and implant integration (4).

Osseointegration

Radiographic analysis demonstrated a higher BIC percentage in the hybrid implant group throughout the study period. This finding aligns with the hypothesis that zirconia collars promote better soft tissue integration and reduce peri-implant inflammation, leading to enhanced osseointegration (5). The presence of a zirconia collar in hybrid implants may also contribute to a more favorable distribution of stress at the bone-implant interface, promoting bone remodeling and integration (6).

Patient Satisfaction

Patient satisfaction scores were significantly higher in the hybrid implant group, reflecting both functional and aesthetic advantages. The zirconia collar's aesthetic properties, such as its tooth-like color, may contribute to improved patient satisfaction by providing a more natural appearance (7). Additionally, the enhanced osseointegration and stability associated with hybrid implants likely contribute to the overall positive patient experience by reducing complications and ensuring long-term success (8).

Clinical Implications

The results of this study suggest that hybrid implants may be a preferable option for dental rehabilitation in the posterior maxilla, particularly in cases where bone quality and quantity are compromised. The superior stability and osseointegration associated with hybrid implants can potentially reduce the need for additional surgical procedures, such as bone grafting, thereby minimizing patient morbidity and treatment duration (9).

Limitations and Future Research

While the results are promising, this study has some limitations. The sample size is relatively small, and the follow-up period is limited to 12 months. Future studies with larger sample sizes and longer follow-up periods are needed to confirm the long-term benefits of hybrid implants. Additionally, further research should explore the cost-effectiveness of hybrid implants compared to conventional options.

Conclusion

Hybrid implants demonstrated superior implant stability, osseointegration, and patient satisfaction compared to conventional titanium implants in the posterior maxilla. These findings support the use of hybrid implants as a viable alternative for dental rehabilitation in challenging maxillary regions. Further research is warranted to confirm these results and explore the long-term clinical benefits of hybrid implants.

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