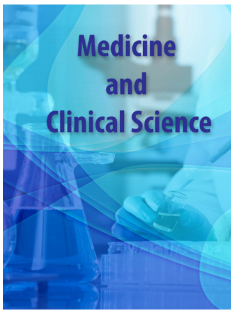
Medicine & Clinical Science

Original Article

# Clinical Evaluation of Stability of Short Deep Threaded Dental Implant During Early Healing Period: A Prospective Controlled Clinical Trial




Nashwan Abdulwahab Alkhawlani[1*], Yahia Abdullah Alhadi[2], Abdulwahab Ismail Al-kholani[3], Arhab Abdulwahab Noman[4]

[1]MSc, Oral and Maxillofacial Surgery. Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Sana'a University, Sana'a, Yemen

[2]Associate Professor of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Sana'a University, Sana'a, Yemen

[3]Professor of Restorative Dentistry, Dental Implant Consultant, Restorative and Esthetic Dentistry Department, Faculty of Dentistry, Sana'a University, Sana'a, Yemen

[4]Assistant Professor of Oral and Maxillofacial Surgery, Faculty of Dentistry, Sana'a University, Sana'a, Yemen

Correspondence

Nashwan Abdulwahab Alkhawlani

MSc, Oral and Maxillofacial Surgery. Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Sana'a University, Sana'a, Yemen.

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Primary stability, short dental implants, deep-threaded implants, insertion torque, implant stability quotient.

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## Abstract

***Objectives:*** *To assess the initial stability of short, deep-threaded dental implants placed in the posterior mandible and to determine the influence of deep-thread design on implant stability during early healing.*

***Methods:*** *Twenty short, deep-threaded implants were placed in the posterior mandibular region of ten patients. Insertion torque value (ITV) was recorded at implant placement. Implant stability quotient (ISQ) was measured immediately post-surgery and at weeks 2, 3, 4, and 5.*

***Results:*** *No significant difference in ITV was observed between short and standard implants. ISQ values did not significantly differ between implant types across the evaluation period ($F = 1.17$, $p = 0.3$).*

***Conclusion;*** *Short, deep-threaded implants demonstrate comparable primary stability to standard implants in the posterior mandible. These findings support their use as a viable treatment option for patients with advanced alveolar ridge resorption.*

## Introduction

Successful implant placement hinges on adequate bone quantity and quality. Unfortunately, alveolar ridge atrophy is a common consequence of tooth loss, particularly in long-term edentulism [1,2]. This bone loss often complicates implant rehabilitation in the posterior mandible, necessitating complex and invasive procedures like bone grafting, sinus lifts, and nerve repositioning. These procedures are associated with significant challenges, including increased cost, time, discomfort, and complications [3,4].

In recent years, short dental implants have emerged as a promising alternative for atrophic ridges. While traditionally associated with higher failure rates, advancements in implant design and surface treatments have led to improved survival rates and reduced complications [5]. Short implants offer the potential for simpler, less invasive procedures with comparable success to bone augmentation techniques [6].

Implant design, particularly thread depth, is believed to influence primary stability, especially in poor bone quality

[7,8]. Implant stability is a crucial factor influencing treatment outcomes [9]. Various methods, including insertion torque (IT) and resonance frequency analysis (RFA), are used to assess this parameter [10,11]. RFA is generally considered more accurate and informative than other methods [12-14].

This study aims to evaluate the primary stability of short, deep-threaded dental implants placed in the posterior mandible. By measuring implant stability quotient (ISQ) and insertion torque value (ITV), we will investigate the impact of deep thread design on implant stability during the early postoperative healing period.

## Materials and methods

### Study Design

This study is a prospective, controlled clinical trial.

### Study Population

**Inclusion Criteria:**

- Patients aged 18 years and older.
- Healed posterior edentulous site for approximately 4-6 months before implant placement.
- Ability and willingness to adhere to all study protocols.

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**Exclusion Criteria:**

- Systemic diseases, medications, or habits known to negatively impact bone healing or dental implant success, including:
    - o Uncontrolled diabetes
    - o History of bisphosphonate use
    - o History of head and neck radiation therapy
    - o Current use of medications that adversely affect healing (e.g., corticosteroids, chemotherapeutic drugs)
- Insufficient bone volume for dental implant placement.
- Presence of osseous lesions at the selected sites.
- Inability or unwillingness to attend follow-up appointments.
- Heavy smokers.

## Materials

- AnyRidge® implant system (MegaGen, Seoul, Korea) with knife edge threads.
- Resonance Frequency Analyzer, Mega ISQ meter.

## Methods

**Pre-Surgical Phase**

1. Patient Data Collection: Detailed patient information, including medical, dental, and family history, was recorded.
2. Clinical Examination: A thorough examination of the implant site, adjacent and opposing teeth, surrounding structures, and occlusion was conducted.
3. Diagnostic Model: A study model was created for preoperative assessment and to fabricate a manual surgical guide (Figure a).
4. Imaging: Cone beam computed tomography (CBCT) was performed on all patients to evaluate bone dimensions, density, edentulous area, proximity to anatomical structures, pathological conditions, and overall tooth and bone health.

**Operative Phase**

1. ***Asepsis:*** The perioral area was disinfected with povidone-iodine, and the oral cavity was irrigated with 0.2% chlorhexidine solution.
2. ***Anesthesia:*** Local anesthesia was administered using a regional nerve block with 2% lidocaine hydrochloride with epinephrine 1:100,000 for the inferior alveolar nerve, and infiltration anesthesia with 2% lidocaine hydrochloride with epinephrine 1:100,000 for the buccal sulcus.
3. ***Surgical Procedure:*** A full thickness mucoperiosteal flap was elevated to expose the alveolar bone (Figure c). Implant placement was performed by a single surgeon according to the manufacturer's protocol, utilizing a manual surgical guide (Figure d).

With a surgical stent in place, the implant site was marked and an osteotomy initiated using a marking drill to ensure accurate positioning and angulation of subsequent drills. Copious sterile saline was used during pilot drilling (Figure d).

The stent was removed, and the osteotomy was sequentially enlarged to the desired diameter for implant placement. The implant fixture was inserted into the prepared site using a handpiece, followed by tightening with an over hex driver and manual calibrated ratchet wrench.

Implants were positioned to the planned bone level, and the insertion torque was recorded.

A manual ratchet wrench with 5 Ncm incremental markings, ranging from 10 to 50 Ncm, was employed. (Figure 2) The peak insertion torque value (ITV) was captured during the final 90° of rotation before achieving the intended insertion depth

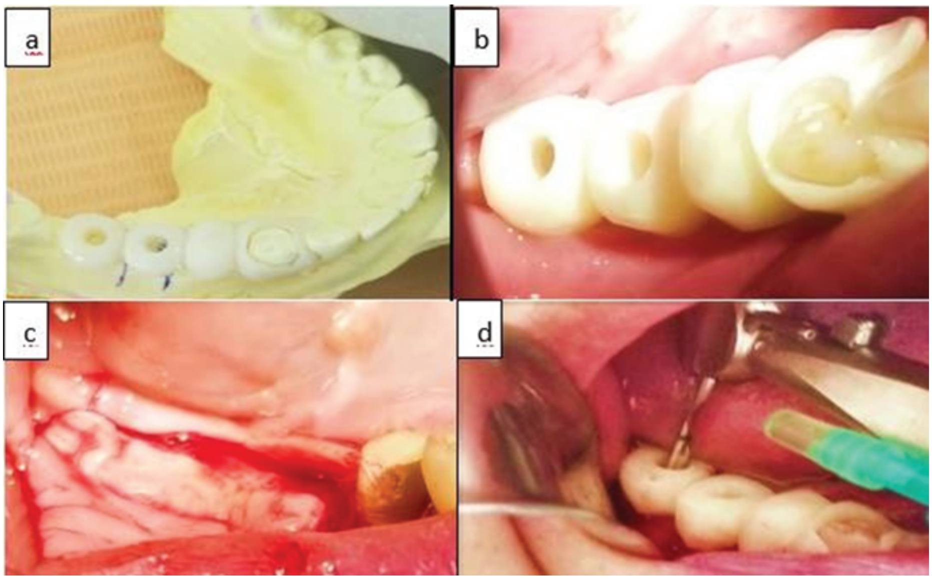


***Figure 1.*** *Implant placement planning (a, b), manual surgical stent on the cast and in the patient mouth (c), mucoperiosteal flap, and (d) drilling using the manual surgical guid*

***Figure 2.*** *Manual Calibrated Ratchet.*

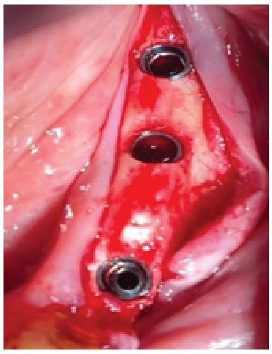

***Figure 3.*** *Dental implants in Sites*

***Figure 4.*** *Smart peg in site and Mega Osstell meter*

***Figure 5.*** *Flap closure and Healing Abutment in site*

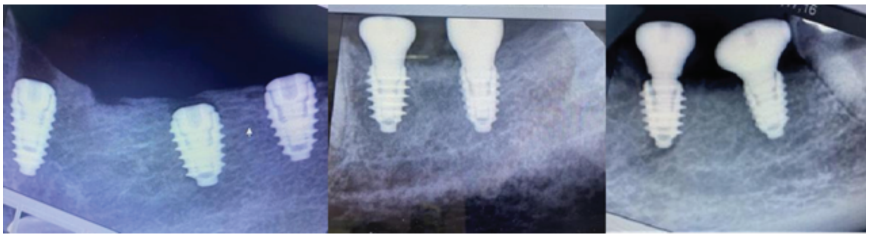

***Figure 6.*** *Post-operative periapical x ray*

## Immediate Post-Implant Procedure and Follow-Up

Immediately following implant placement, an Osstell Smart Peg was secured to the fixture with a torque of 5 Ncm. Initial implant stability quotient (ISQ) measurements were obtained using a Mega ISQ meter (Figure 4). With the Smart Peg in place, a Mega ISQ Osstell probe, positioned perpendicular to the Smart Peg, was employed to assess implant stability in four directions. A continuous audible signal indicated successful measurement, and the ISQ value was displayed on the device screen. ISQ values were recorded for mesio-distal, disto-mesial, bucco- lingual, and lingo-buccal directions. Calibration of the Mega ISQ Osstell meter was performed at each patient visit using a reference implant embedded in an epoxy block. Subsequently, the Smart Peg was removed, and a gingiva former was positioned to protrude slightly through the gingiva without contacting occlusion. Healing abutments were installed using an electric handpiece at 5 Ncm to facilitate controlled placement and removal during follow-up visits (Figure 5). The surgical flap was closed with 3/0 Vicryl or silk sutures (Figure 5), and periapical radiographs were captured (Figure 6). Patients were prescribed analgesics and antibiotics for seven days post-surgery, along with chlorhexidine gluconate mouthwash to be used twice daily. Cold compresses were recommended for the first day, and a soft diet was advised for one week. Sutures were removed, and a follow-up evaluation was conducted one week post-surgery. Additional follow-up appointments were scheduled at weeks two, three, four, and five, with ISQ measurements repeated using the previously described protocol (Figure 4) at each visit.

## Outcome Measures

The study evaluated the following outcome measures:

- Insertion Torque (IT): Measured during implant placement.
- Implant Stability Quotient (ISQ): Recorded immediately post-implantation and at weeks 2, 3, 4, and 5.

## Statistical analysis

Data were analyzed using SPSS software version 28. Descriptive and comparative analyses were conducted. The Mann-Whitney U test was employed to compare IT and ISQ values between groups. For repeated measures of ISQ over time, the Greenhouse-Geisser correction was applied.

# Results

## Study Design and Patient Population

A prospective study was conducted on sixty dental implants placed in the posterior mandible of patients aged 21 to 65 years (mean age: 48.2 years) between August 2021 and September 2022. Twenty implants were selected for further analysis: ten short implants (7 mm) comprised the test group, and ten standard implants (11.5 mm) served as the control group. All implants had a diameter of 4.0 mm.

## Insertion Torque (IT)

All implants achieved an insertion torque (IT) within the range of 35-60 Ncm. The mean IT for short implants was 47.5 ± 6.8 Ncm, and for standard implants, it was 47.0 ± 4.8 Ncm. A Mann-Whitney U test revealed no significant difference in IT between the two implant lengths ($Z = -0.125$, $p = 0.9$).

## Implant Stability Quotient (ISQ)

ISQ values ranged from 69.5 to 80 for all implants. Mann-Whitney U tests were performed to compare ISQ values between short and standard implants at baseline and at weeks 2, 3, 4, and 5. No significant differences in ISQ were found at any time point ($p > 0.05$ for all comparisons).

Table 1 summarizes the demographics of the 20 patients included in the study. | | The mean age is 48.2 years, and the age range is from 21 to 65 years old.

***Table 1.*** *Patient Demographics (Hypothetical).*

| Characteristic | Value |
|---|---|
| Number of patients | 20 |
| Mean age (years) | 48.2 |
| Age range (years) | 21-65 |

***Table 2.*** *Implant Characteristics.*

| Implant Type | Length (mm) | Diameter (mm) | Thread Design |
|---|---|---|---|
| Short | 7 | 4 | Deep |
| Standard | 11.5 | 4 | Deep |

***Table 3.*** *Insertion Torque Values (Ncm).*

| Implant Type | Mean | SD |
|---|---|---|
| Short | 47.5 | 6.8 |
| Standard | 47.0 | 4.8 |

***Table 4.*** *Patient Demographics (Hypothetical).*

| Timepoint (weeks) | Short Implant Mean | Short Implant SD | Standard Implant Mean | Standard Implant SD |
|---|---|---|---|---|
| Baseline | 76.1 | 3.3 | 74.47 | 3.5 |
| 2 | 73.4 | 4.5 | 70.9 | 4.7 |
| 3 | 72.32 | 6.9 | 71.3 | 4.3 |
| 4 | 66.22 | 23.9 | 74.67 | 3.1 |
| 5 | 67.1 | 23.9 | 75.97 | 3.164 |

***Table 5.*** *Patient Demographics (Hypothetical).*

| Comparison | Statistic | Value | p-value |
|---|---|---|---|
| IT (Short vs. Standard) | Mann-Whitney U | -0.125 | 0.9 |
| ISQ Baseline (Short vs. Standard) | Mann-Whitney U | -1.024 | 0.3 |
| ISQ Week 2 (Short vs. Standard) | Mann-Whitney U | -0.947 | 0.3 |
| ISQ Week 3 (Short vs. Standard) | Mann-Whitney U | -0.644 | 0.5 |
| ISQ Week 4 (Short vs. Standard) | Mann-Whitney U | -0.494 | 0.6 |
| ISQ Week 5 (Short vs. Standard) | Mann-Whitney U | -0.719 | 0.5 |

***Table 6.*** *Patient Demographics (Hypothetical).*

| Source | df | F | p-value |
|---|---|---|---|
| Time | 4 | 1.17 | >0.05 |

Table 2 describes the characteristics of the two implant types used in the study: short and standard. It includes information on the length, diameter, and thread design of each implant.

Table 3 shows the mean and standard deviation (SD) of insertion torque values (Ncm) for both short and standard implants. The mean insertion torque for short implants is slightly higher than for standard implants, but there is some variability within each group.

Table 4 presents the mean and standard deviation (SD) of ISQ values at baseline and several follow-up time points (weeks 2, 3, 4, and 5) for both short and standard implants. ISQ generally appears to decrease over time for both implant types, although there is some variability.

Table 5 summarizes the results of statistical comparisons between short and standard implants for insertion torque (IT) and ISQ at baseline and several follow-up time points. The Mann-Whitney U test is used for non-parametric comparisons. The p-values for all comparisons are greater than 0.05, indicating no statistically significant differences between the two implant types in terms of IT or ISQ.

Table 6 shows the results of a repeated measures ANOVA to assess changes in ISQ over time for the short implants. The F-statistic and p-value indicate that there is no statistically significant difference in ISQ between the different time points (weeks 0, 2, 3, 4, and 5) for the short implants.

## Discussion

### Summary of Findings

The present study aimed to evaluate the initial stability of short, deep-threaded dental implants in the posterior mandible and to assess the influence of deep-thread design on implant stability during early healing. The results indicate that short, deep-threaded implants exhibited comparable primary stability to standard implants, as evidenced by similar insertion torque values (ITVs) and implant stability quotient (ISQ) measurements throughout the evaluation period.

### Interpretation of Results

The finding that short, deep-threaded implants achieved comparable primary stability to standard implants is encouraging. This suggests that these implants may be a viable treatment option for patients with limited bone volume in the posterior mandible, potentially reducing the need for extensive bone augmentation procedures. The consistent ISQ values over time suggest that these implants integrate well into the surrounding bone tissue.

### Comparison with Existing Literature

The results of this study align with previous research that has demonstrated the potential of short implants in atrophic maxillae and mandible. However, further long-term studies are necessary to assess the overall success rate and survival of short, deep-threaded implants in comparison to standard implants.

### Study Limitations

It is important to acknowledge the limitations of this study. The sample size was relatively small, and the follow- up period was limited to five weeks. Additionally, the study focused solely on implant stability and did not assess other important parameters such as osseointegration, loading protocols, and clinical outcomes.

### Clinical Implications

The findings of this study suggest that short, deep-threaded implants can be considered as a treatment option for patients with limited bone volume in the posterior mandible. However, careful patient selection and treatment planning are essential. Further research is needed to evaluate the long-term performance of these implants and to optimize treatment protocols.

### Future Research

Future studies should focus on:

- Increasing the sample size to enhance statistical power.
- Extending the follow-up period to assess long-term implant stability and success.
- Evaluating the influence of different implant designs and surface treatments on implant stability and osseointegration.
- Investigating the impact of loading protocols on implant survival and clinical outcomes.

## Conclusion

In conclusion, this study provides preliminary evidence supporting the use of short, deep-threaded implants in the posterior mandible. However, further research is warranted to fully elucidate the clinical implications of these findings.

### Financial support and sponsorship

Nil.

### Conflicts of Interest

There are no conflicts of interest.

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