



RESEARCH ARTICLE

PRIMARY STABILITY FOR SHORT DENTAL IMPLANT WITH DEEP THREADED IN POSTERIOR MAXILLA DURING EARLY HEALING PERIOD

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Abstract

Background and aim: Because they provide a dependable way to replace lost teeth and restore both function and appearance, dental implants have completely transformed the profession of restorative dentistry. These artificial tooth roots, which are usually composed of titanium, are placed into the mandible to support crowns, bridges, or dentures. The study's objective was to assess the main stability of a short, deep-threaded dental implant in the posterior maxilla during the early healing phase. It focused on the correlation between the values of the implant stability quotient (ISQ) and insertion torque (IT).

Methodology: A prospective clinical study was conducted on 20 patients requiring posterior maxillary implants. Short implants ($\varnothing 4 \times 7$ mm) were placed using the Megagen Any Ridge system. Primary stability was assessed by measuring IT at insertion and ISQ via resonance frequency analysis (RFA) at baseline and weekly for four weeks. Variables such as bone density, age, gender, and implant site distribution were also recorded.

Results: Implants with moderate IT (26–35 Ncm) maintained stable ISQ values (50–65), suggesting optimal primary stability. Low IT (15–25 Ncm) implants showed gradual improvement in ISQ (from 45 to 64), whereas resulted high IT (36–45 Ncm) gradually decrease in ISQ (from 65–52). Bone density was predominantly D3 (50%) and D4 (40 %). No significant correlation was found between IT and ISQ over time (Spearman's rho: 0.20–0.55, $p > 0.05$).

Conclusion: Short, deep-threaded implants placed with moderate insertion torque provide optimal primary stability in the posterior maxilla. Excessive torque increases the risk of loose the stability. Regular ISQ monitoring is recommended during the healing phase to guide clinical decision-making.

Keywords: Implant stability quotient, insertion torque, posterior maxilla, primary stability, resonance frequency analysis, short dental implants.

INTRODUCTION

Because they provide a dependable way to replace lost teeth and restore both function and appearance, dental implants have completely transformed the profession of restorative dentistry¹. Crowns, bridges, or dentures can be fixed on these implants, which are usually constructed of titanium, and act as artificial tooth roots when placed into the jawbone^{2,3}. The capacity of dental implants to accomplish osseointegration- a process in which the implant fuses with the surrounding bone to provide a solid base for prosthetic restorations is essential to their effectiveness⁴. Primary stability is a critical factor influencing the success of dental implants. It refers to the initial mechanical stability of the implant immediately after insertion, before the onset of biological osseointegration⁵. This stability is

essential for preventing micromovements that can disrupt the healing process and ultimately affect the long-term success of the implant⁵. Several factors contribute to primary stability, including implant design, bone quality, and surgical technique⁶.

The posterior maxilla or the back part of the upper jaw, presents unique challenges for implant placement due to its anatomical characteristics^{7,8,9}. This region often suffers from reduced bone density and volume, a condition exacerbated by the natural resorption of bone over time and the proximity to the maxillary sinus. As a result, placing implants in this area can be more complex compared to the anterior maxilla or mandible¹⁰.

Short dental implants, described as implants with a length typically not more than 8 mm, have emerged as a viable option for addressing these challenges. They

offer a potential solution for patients with insufficient bone height in the posterior maxilla, reducing the need for extensive bone grafting procedures. However, the primary stability of short implants has been a topic of considerable debate, particularly in relation to their design features, such as deep threading^{11,12}.

Deep-threaded implants are designed with threads that extend further down the implant body, which theoretically enhances their mechanical stability by increasing the surface area in contact with the bone. This design modification is intended to improve the primary stability of the implant, particularly in areas with compromised bone quality. Despite this theoretical advantage, the effectiveness of deep threading in short implants during the early healing period in the posterior maxilla remains underexplored^{9,11}.

The early healing period following implant placement is a critical phase where the implant must remain stable to allow for successful osseointegration. During this period, the biological response of the bone to the implant, including bone remodeling and repair, is crucial for long-term implant success. Understanding how different implant designs, particularly short implants with deep threading, affect primary stability and early healing is essential for optimizing implant outcomes and developing evidence-based guidelines for clinical practice^{13,14}.

The management of mandibular angle fracture¹, hardware removal in maxillofacial trauma¹⁵, treatment of comminuted mandibular fracture with closed reduction and mandibular fixation versus open reduction and internal fixation¹⁶, maxillofacial trauma among head trauma patients¹⁷, osteomyelitis of the jaws¹⁸, the impact of 3D printing in reconstructing maxillofacial defects¹⁹, the efficacy of modified occlusal splint in treating temporomandibular dystonia²⁰, the impact of intermaxillary fixation on biochemical and hematological markers²¹, Punt analysis²², and 3D evaluation of the shape of the first cervical vertebra in skeletal class I and III malocclusion²³ are just a few of the previous studies carried out in Yemen. The previous research also covered the following topics: forms of maxillofacial fractures and how they are treated²⁴, implant failure because of extensive oral bacterial colonization²⁵, and the anterior thumb-posterior finger-guided single insertion approach for mandibular anesthetic²⁶. Nevertheless, no research has assessed the deep threaded design implant's primary stability in the posterior maxilla during the initial healing phase. Therefore, by measuring the insertion torque for short dental implants with deep threads and relating it to the implant stability quotient, this study was conducted to assess the primary stability of deep threaded design implants in the posterior maxilla during the early healing period.

MATERIALS AND METHODS

Study design: This study was a prospective clinical series evaluating primary stability in short dental

implants with deep threads placed in the posterior maxilla during the early healing phase.

Study population: Participants were patients in need of one or more dental implants and met the inclusion criteria for the study. Recruitment was conducted from the clinic population, ensuring all ethical approvals and informed consent processes were met in accordance with university guidelines.

Inclusion criteria: Individuals aged 18 years or older, regardless of gender, who do not have any conditions likely to impair bone healing, who have partial edentulousness in the posterior maxilla, a residual bone height of 7 mm and a margin width of at least 6 mm, and who have healed edentulous sites suitable for implant placement.

Exclusion criteria: Exclusion criteria included individuals with systemic diseases or habits known to affect bone healing or implant success, as well as individuals with a history of bisphosphonate-associated osteonecrosis of the jaw (BRONJ) or drug-associated osteonecrosis of the jaw (MRONJ). Patients also received radiation therapy to the head or neck, which could affect the implant site. Patients who smoked more than 20 cigarettes per day within the past year or used medications known to interfere with healing (such as corticosteroids or chemotherapeutic agents) were also excluded. Patients who were immunocompromised due to illness or treatment, as well as those lacking sufficient bone volume for implant placement, were also excluded.

Implant: MegagenAnyRidge short implants, Ø4 × 7 mm were used to accommodate the reduced bone height in the posterior maxilla.

Stability measurement device: Implant stability quotient (ISQ) values were measured using the Megagen ISQ device for (RFA), providing an objective assessment of implant stability. The Megagen ISQ system includes:

- **ISQ Measurement Unit:** A handheld, digital device that records ISQ values based on resonance frequency.
- **Probe Arm:** The sensor that directs the frequency waves to the SmartPeg and captures the response, which is then translated into an ISQ value.
- **SmartPeg:** A metallic peg specifically designed to attach to the implant fixture. It vibrates in response to the resonance frequency analysis (RFA) device, allowing measurement of the implant's stability.
- **Megagen any ridge implant kit:** a new megagen any ridge kit specific for dental implant was used for preparation the socket of implant.
- **Micro motor device:** a wood packer dental implant micro motor was used for the implant procedure.

Pre-implantation phase:

Patient assessment and planning: A comprehensive clinical examination was performed to assess oral health, soft tissue condition, occlusion, and the patient's suitability for implant treatment. Strict inclusion and

exclusion criteria were applied to determine eligibility for participation. A panoramic radiograph was taken for each patient to assess bone height and anatomical landmarks, such as the sinus floor.

In addition, CBCT scans were recommended for all patients, to provide a more accurate assessment of bucco-palatal bone width, trabecular pattern, and bone density. Bone quality was evaluated and recorded using the Lekholm and Zarb classification system based on radiographic density. Finally, suitable implant sites in the posterior maxilla were selected and documented using clinical measurements.

Pre-surgical preparation: Patients were provided with both verbal and written preoperative instructions, which emphasized the importance of maintaining good oral hygiene and advised discontinuing smoking or qat chewing at least 48 hours prior to surgery.

A thorough review of medical history and current medications was conducted to rule out any contraindications, such as uncontrolled diabetes or the use of bisphosphonates. Patients were instructed to use 0.12% chlorhexidine mouthwash twice daily, beginning 24 hours before the procedure. On the day of surgery, patients rinsed with chlorhexidine for one minute, and the surgical field was disinfected using povidone-iodine. Local anesthesia, typically articaine with epinephrine (1:100,000), was administered at the surgical site. Informed consent was obtained prior to the procedure, and the surgical setup was prepared under sterile conditions.

Implant selection

Short implants measuring 7 mm in length and 4 mm in diameter from the MegagenAnyRidge system were selected for placement. The implants featured a deep-threaded design, which was specifically chosen to enhance primary stability, particularly in the low-density bone commonly found in the posterior maxilla. The final implant dimensions were determined based on the available bone height and width measured during the planning phase

Implant placement procedure

- A mid-crestal incision with minimal full thickness flap elevation was performed to preserve blood supply.
- Site preparation was done using a sequential drilling protocol provided by the manufacturer, customized to bone density.
- Copious irrigation with sterile saline was used during drilling to avoid overheating.
- Implants were inserted using a manual torque wrench, and insertion torque (IT) was recorded at final seating.

Resonance Frequency Analysis (RFA) and ISQ Measurements

- A SmartPeg (specific to the implant system) was hand-tightened to the implant.
- The Megagen ISQ device was calibrated according to the manufacturer's instructions.
- The probe was positioned at a right angle (90°) to the SmartPeg in two directions: bucco-lingual and mesio-distal.

- The mean of two readings was recorded as the ISQ value.
- The SmartPeg was removed and replaced with a healing abutment (tightened to 5 Ncm).
- Radiographs and Healing Abutment Placement: Periapical radiographs were taken immediately after implant placement using a customized X-ray holder to ensure repeatable positioning at each follow-up.
- Postoperative instructions were provided including soft diet, no smoking or qat, and maintaining hygiene.

Follow-up schedule

Follow-up visits were scheduled weekly to monitor implant stability:

- Baseline (Surgery Day): Record IT and ISQ, take periodical radiograph.
- Week 1: ISQ reading and soft tissue inspection.
- Week 2: ISQ reading and radiograph.
- Week 3: ISQ reading, radiograph, evaluate for any signs of failure.
- Week 4: Final ISQ for early healing period analysis.

Maintenance program

1. After the 4-weeks follow-up:

- a. Patients entered a long-term maintenance program.
- b. Each visit included:
 - i. Oral hygiene reinforcement.
 - ii. Clinical evaluation of peri-implant tissue.
 - iii. Radiographic assessment using standardized technique
 - iv. Removal of plaque and calculus as needed.

Interpretation of ISQ values

1. $ISQ \leq 55$: Low stability, delayed loading advised.
2. $ISQ 56-65$: Moderate stability, regular healing monitoring.
3. $ISQ \geq 66$: High stability, favorable for early loading.

Independent variables:

1. Implant insertion torque (IT) measured at the time of placement.
2. Bone density at the implant site, classified by Hounsfield units.

Dependent variables:

1. ISQ measurements at baseline and at weekly intervals over four weeks.
2. Implant stability as inferred from ISQ changes over time.
3. Implant failure rate over the four-week observation period.

Statistical Analysis

The statistical package for the social sciences, or SPSS, was used to analyse the data, and a significance level of $p < 0.05$ was established. The distribution of bone density, implant stability measures, and baseline patient data were compiled using descriptive statistics. To investigate connections between the main stability indicators, correlations between insertion torque and ISQ values were examined.

Ethical Considerations

This study received approval from the Ethical Committee of the Faculty of Medicine and Health Sciences at Sana'a University. All participants provided informed consent, and procedures adhered to ethical standards for patient care and clinical research.

RESULTS

Age Distribution: Table 1 provides an overview of the age distribution among the 20 patients included in the study. The age groups are categorized into four periods: 20–30 years, 31–40 years, 41–50 years, and those over 50 years. The largest proportion of cases, representing 35%, falls within the 20–30 age group, with 7 patients represented in this category. This indicates a relatively younger population in the study sample. The next two age groups, 31–40 years and 41–50 years, contribute 25% of the total cases, with 5 patients in each group. These results indicate that the study includes a significant representation of individuals in early to mid-adulthood. The smallest percentage, 15%, is observed in the >50 age group, which includes 3 patients.

Table 1: Age distribution.

Age Group (Years)	Number of cases (%)
20–30	7 (35)
31–40	5 (25)
41–50	5 (25)
> 50	3 (15)
Total	20 (100)

Gender Distribution: Of the total cases, 14 were female, representing 70% of the sample, while 6 were male, making up 30%. This shows a marked gender disparity, with females being significantly more represented in the study than males.

Bone Density and Implant Site Distribution: Table 2 provides a classification of the bone density observed in the 20 patients included in the study.

Table 2: Bone Density Distribution.

Bone Density	Classification	Number of Cases (%)
D2	Dense Bone	2 (10)
D3	Medium Density	10 (50)
D4	Low Density	8 (40.0)
Total		20 (100)

Bone density is categorized into three primary groups: D2, D3, and D4, where D2 represents good bone density, D3 indicates medium density, and D4 is categorized as low density. The majority of cases, 50%, fall under the D3 classification, which corresponds to medium bone density. This indicates that a significant portion of the study population exhibited average bone density, which may have implications for the choice of treatment strategies, particularly in procedures such as implant placement. The second most common category is D4, or low bone density, which includes 8 patients, making up 40% of the total sample. Finally, only 2 cases (10%) were classified as D2, indicating good bone density.

Implant site distribution: Table 3 outlines the distribution of implant sites among the 20 patients included in the study. The implant sites are categorized based on the upper left and upper right quadrants of the mouth, further subdivided by the specific tooth numbers involved. The most frequently used implant site is the Left Upper 6, which accounts for 8 cases, or 40% of the total. The next most common site is the Upper 7, with 4 cases in the left side, representing 20% of the total, and 3 cases in the right side representing 15% of the total. The Right Upper 5 was the site of 5 implants, which corresponds to 25% of the cases.

Table 3: Implant site distribution.

Implant Site	Number of cases (%)
Left Upper 7	4 (20)
Right Upper 7	3 (15)
Left Upper 6	8 (40)
Right Upper 5	5 (25)
Total	20 (100)

Distribution of Insertion Torque (IT) Groups: Table 4 presents the distribution of insertion torque (IT) values across three groups for the 20 patients in the study. Insertion torque is an important factor in implant placement, influencing the primary stability of the implant and the likelihood of successful osseointegration. The majority of patients, 50%, fall into the 26–35 Ncm IT group, with a mean insertion torque of 30 ± 4 Ncm. This group represents the optimal range for implant stability, suggesting that a significant portion of the implants in this study achieved moderate to high primary stability, which is often associated with favorable outcomes.

Table 4: Distribution of Insertion Torque (IT) Groups.

IT Group (Ncm)	Number of Patients (%)	Mean IT $\pm$ SD (Ncm)
15–25	5 (25)	20 ± 3
26–35	10 (50)	30 ± 4
36–45	5 (25)	40 ± 2
Total	20 (100)	30 ± 7

The second most common group is the 36–45 Ncm IT group, which includes 5 patients (25%) and has a mean IT of 40 ± 2 Ncm. Implants within this range of torque are considered to be highly stable, indicating that these cases may have benefited from stronger bone quality or more precise placement techniques. The remaining 5 patients (25%) fall into the 15–25 Ncm IT group, with a mean insertion torque of 20 ± 3 Ncm. This lower range of torque is generally seen in patients with poorer bone quality or less favorable conditions for implant placement, which may require additional care or different treatment strategies to ensure success.

ISQ stability: Table 5, presents the ISQ measurements across different IT levels at baseline and during weekly follow-ups. In the IT group of 15–25 Ncm, the ISQ values showed a consistent increase from baseline (45 ± 2) to Week 4 (64 ± 1). The p -value (< 0.05) indicates that this increase was statistically significant, suggesting that implants with lower insertion torque experience a significant improvement in stability over

time. On the other hand. The IT group of 26-35 Ncm displayed relatively stable ISQ values, starting at 50 ± 1 at baseline and rising to 65 ± 1 by Week 4. The p -value (>0.05) indicates that these changes were not statistically significant, implying that the stability of implants in this group remained consistent throughout the follow-up period. In contrast, the IT group of 36-45

Ncm showed a gradual decrease in ISQ values, starting at 65 ± 1 at baseline and decreasing to 51 ± 1 by Week 4. The p -value (<0.05) suggests that this decrease was statistically significant, highlighting a potential reduction in implant stability over time for implants with higher initial insertion torque.

Table 5: ISQ Measurements by IT levels at baseline and weekly follow-ups.

IT Group (Ncm)	Baseline	Week 1	Week 2	Week 3	Week 4	P-value
15-25	45 ± 2	50 ± 3	60 ± 2	63 ± 2	64 ± 1	< 0.05
26-35	50 ± 1	63 ± 2	64 ± 1	64 ± 2	65 ± 1	> 0.05
36-45	65 ± 1	58 ± 2	53 ± 2	51 ± 1	51 ± 1	< 0.05

Table 6: Spearman's correlation between IT and ISQ values.

Time Point	Spearman's rho	p-value	Significance
Baseline	0.45	> 0.05	Not Significant
Week 1	0.50	> 0.05	Not Significant
Week 2	0.55	> 0.05	Not Significant
Week 3	0.30	> 0.05	Not Significant
Week 4	0.20	> 0.05	Not Significant

Correlation between IT and ISQ: Table 6 presents the results of Spearman's correlation between insertion torque (IT) and Implant Stability Quotient (ISQ) values at each time point, from baseline through to Week 4. This statistical test was performed to assess the relationship between these two variables over time and determine if a higher insertion torque leads to better implant stability. At all-time points, including baseline, week 1, week 2, week 3, and week 4, the Spearman's rho values were relatively low, ranging from 0.20 to 0.55. These correlation coefficients indicate weak positive relationships between IT and ISQ at each stage of follow-up. However, the p -values for all time points were greater than 0.05, suggesting that none of these correlations were statistically significant. In practical terms, this means that, despite a positive correlation between insertion torque and ISQ values at each time point, there was no statistically meaningful relationship between these two variables over the course of the study. Thus, while implants with higher initial insertion torque may show slight improvements in stability over time, the correlation between IT and ISQ does not reach statistical significance at any stage, implying that other factors may be influencing implant stability more strongly than IT alone.

Implant failure analysis: Table 7 presents the implant failure rates observed during weekly follow-ups after implant placement.

Table 7: Implant failure at weekly follow-ups.

	Number of Failed Implants (%)
Baseline	0 (0)
Week 1	0 (0)
Week 2	0 (0)
Week 3	1 (5)
Week 4	0 (0)

The data shows that, at baseline, no implants had failed, with a failure rate of 0%. Similarly, Weeks 1 and 2 saw no implant failures, maintaining a 0% failure rate. However, by week 3, there was one implant failure,

resulting in a failure rate of 5% at that specific time point. This indicates a small but notable increase in failure compared to the previous weeks. By Week 4, the failure rate returned to 0%, as no further failures were reported.

DISCUSSION

Age and gender distribution

This study distributes the age with 35% of patients in the 20–30 contrasts with conventional implant demographics, which typically emphasize older adults (50+ years) due to age-related edentulism²⁷. However, regional epidemiological trends may explain the younger cohort. For instance, in populations with high rates of untreated caries or trauma (e.g., due to limited access to preventive care), younger adults often present with advanced tooth loss requiring early implant intervention²⁸. This aligns with findings from a Middle Eastern cohort study, where 28% of implant patients were under 40 due to cultural dietary habits and delayed dental care²⁹.

The female predominance in this study (70%) contrasts with global trends where males typically make up 55–60% of implant recipients³⁰. The predominance of female participants in this study may be attributed to the fact that they were more likely to meet the inclusion criteria, particularly regarding the absence of habits such as smoking and qat chewing, which were more prevalent among males in Yemen. Other explanations of this divergence may be attributed to factors such as females' greater emphasis on aesthetic restoration, even though the study focused on posterior sites³¹, the higher prevalence of osteoporosis-related tooth loss among postmenopausal women³².

Bone Density

The posterior maxilla is anatomically complex, characterized by thin cortical plates, trabecular bone of varying density, and proximity to the maxillary sinus³³. The predominance of D3 (50%) and D4 (40%) bone densities in this study aligns with classifications by

Norton and Gamble³⁴, who identified D3/D4 as the most common types in the posterior maxilla.

The Role of thread design in low-density bone

Deep-threaded implants were selected to enhance primary stability in soft bone. Comparative studies demonstrate that aggressive thread designs increase surface area contact, improving mechanical interlock in low-density bone³⁵. For example, a meta-analysis by Esposito *et al.*³⁶, found that implants with triangular threads and pitch depths >0.5 mm achieved 15% higher ISQ values in D4 bone compared to conventional designs. Similarly, previous study³⁷ reported that deep threads reduced micro-motion by 22% under functional loading in cadaveric models of osteoporotic bone.

Site of dental implant selection

The left maxillary first molar (40%) was the most frequent implant site, contrasting with symmetrical distributions in larger studies³⁸. This Unilateral Tooth Loss Patterns may be due to Asymmetric occlusal forces or para-functional habits as bruxism or qat chewing) could predispose to unilateral posterior loss²⁷.

Insertion Torque (IT) and stability dynamics

Moderate insertion torque values between 26–35 Ncm demonstrated stable ISQ readings (62–65) over a four-week period, suggesting an optimal mechanical “sweet spot” that balances compression with biological viability. This range aligns with findings by Javed *et al.*⁴, who suggested that IT values greater than 25 Ncm but less than 35 Ncm minimize the risk of bone microfractures while providing sufficient primary stability. Supporting this, Garcez-Filho *et al.*³⁹, reported that a 30 Ncm torque preserved osteocyte viability within 200 µm of the implant surface in a cadaveric model. In contrast, implants with lower IT values (15–25 Ncm) showed a gradual increase in ISQ (from 55 to 64), reflecting a reliance on secondary stability achieved through bone remodeling. This delayed stabilization is consistent with observations by Sennerby *et al.*⁴⁰, particularly in low-density bone, where woven bone forms more slowly around the implant interface. However, lower ISQ values early on may pose a risk; Huang *et al.*⁴¹, reported that ISQ <60 within the first two weeks increases the risk of implant failure by 30% under functional loading. On the other end of the spectrum, high IT values above 35 Ncm were associated with biomechanical overload lead gradually decrease in ISQ. Clinically, this trend is supported by Alshehri M., Alshehri⁴² which found a low failure rate at 12 weeks for implants placed with IT >40 Ncm, compared to few cases failure for those inserted at 25–35 Ncm.

IT-ISQ Correlation

The observed weak and statistically non-significant correlation between insertion torque (IT) and implant stability quotient (ISQ) over time ($\rho = 0.20\text{--}0.55$, $p > 0.05$) suggests that mechanical anchorage and biological integration are fundamentally distinct processes. ISQ, derived from resonance frequency analysis (RFA), measures the stiffness of the implant-bone interface but cannot differentiate between mechanical compression and actual osseointegration, as noted by Nedir *et al.*⁴³. Additionally, the temporal dynamics of bone healing play a role: early ISQ values

primarily reflect fibrin clot stabilization, while later measurements are influenced by the maturation of woven bone⁴⁴. Bone quality also modulates this relationship low-density bone (D3/D4) may show gradual increases in ISQ as new trabeculae fill the implant threads, whereas high-density bone (D1/D2) typically presents with high initial ISQ but slower remodeling, as reported by Turkyilmaz *et al.*⁴⁵.

Implant Failure

The single implant failure (5%) observed at Week 3 in the high insertion torque group supports the “critical window” hypothesis, which identifies weeks 2 to 4 as a period of heightened vulnerability due to inflammatory bone remodeling²⁷. Several mechanisms may contribute to failure during this phase. Excessive compression can cause microfractures that propagate under functional loading³⁹, while ischemic necrosis may result from compromised blood supply in overly compressed bone, hindering osteoblast activity⁴⁴. Additionally, micromotion exceeding 150 µm can disrupt the soft tissue seal around the implant, allowing bacterial colonization and jeopardizing osseointegration²⁴. Nonetheless, systematic reviews suggest that short implant failure rates below 10% within 12 weeks are acceptable, particularly in cases involving low-density bone²⁷.

Limitations of the study

The limitations of this study were primarily financial. Due to the difficult economic situation in Yemen, the researcher had to bear the costs of treatment, implant materials, and follow-up care for most participants. This limited the possibility of enrolling a larger number of cases. Furthermore, it was difficult to find suitable cases, as it was difficult to recruit patients who fully met the inclusion criteria, particularly with regard to the availability of sufficient bone in the posterior maxilla. Finally, there was the high number of exclusions due to harmful habits: Many potential participants were excluded from the study due to their inability to stop chewing qat or smoking during the early healing period, which could negatively impact implant stability and healing.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the results of a study of the primary stability of short-threaded, deep-threaded dental implants in the posterior maxilla during the early healing period were analyzed by incorporating data on age, sex, insertion torque (IT), implant stability index (ISQ), and failure rates. The results were critically analyzed based on a wide range of studies. The discussion focused on biomechanical principles, biological responses, and clinical implications, supported by comparative studies to contextualize the novelty and significance of the findings. Short-threaded, deep-threaded implants implanted in the posterior maxilla demonstrated positive primary stability during the early healing period, particularly with a moderate insertion torque (26–35 N/cm). The implant stability index values remained stable and improved over time.

We recommend monitoring implants for a longer period of time after loading to better understand their long-term stability and success. Further studies are needed on insertion torque (IT) and stability. Further research is needed to explore the relationship between insertion torque (IT) and implant stability, particularly across various bone characteristics. Caution should also be exercised when using high insertion torques. Dentists should avoid using excessively high insertion torques during implant placement, as this can damage bone and increase the risk of early implant failure. The ISQ should also be used to monitor healing. Regularly measuring the ISQ during healing can help detect any problems early and support better clinical decisions regarding when to load the implant.

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AUTHOR'S CONTRIBUTIONS

Ahmed MAQ: research, methods, and original draft writing. **Alrubaidi YAS:** design and supervision. **Alhadi YAA:** design and supervision. **Al-Kabsi TA:** formal analysis, data processing. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The accompanying author can provide the empirical data that supported the study's findings upon request.

CONFLICT OF INTEREST

There are no conflicts of interest with regard to this project.

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