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Comparative Evaluation of Insertion Torque on Marginal Bone Resorption and Survival Rates of Implants: A Systematic Review and Meta-Analysis

Dr. Ravi Joshi[1] , Dr. Hetangi Patel[2] , Dr. Miloni Bhatt[3] , Dr. Kalpesh Vaishnav[1] , Dr. Ruchi Patel[4] , Dr. Krushangi Pandya[5]

[1]Professor, [2]Private practitioner, [3]Reader, [4]Professor & Head,[5]Post graduate student
Department of Prosthodontics, Karnavati School of Dentistry,Karnavati University, Gujarat, India

***Corresponding Author:**
Dr. Krushangi Pandya
Department of Prosthodontics, Karnavati School of Dentistry,Karnavati University, Gujarat, India

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Abstract

Aim:

The aim of this systematic review and meta-analysis is to assess the clinical outcomes of dental implants placed at high insertion torque (≥50 Ncm) compared to regular or low torque (<50 Ncm).

Methodology:

This study protocol was registered in PROSPERO and conducted according to the PICOTS framework. Electronic searches were performed in PubMed, EBSCO, Google Scholar, and the Cochrane Library for studies published between January 2010 and December 2024. Two reviewers independently performed study selection, data extraction, and risk-of-bias assessment using RoB 2 and ROBINS-I tools. Meta-analysis was conducted in RevMan 5.4, with outcomes reported as mean differences (MD) and risk ratios (RR) with 95% confidence intervals.

Result:

Meta-analysis showed no statistically significant difference in marginal bone loss between high- and low-torque implants at 3 months, 6 months, or 1 year.). Although not statistically significant, there was a tendency toward lower torque at six months, with a mean difference of 0.37 mm (95% CI: -0.10 to 0.83). After one year, high-torque implants had a mean difference of 0.22 mm (95% CI: -0.05 to 0.48), which was also not statistically significant but slightly favoured low torque. Implant survival rates were comparable between the two groups, with no significant difference detected.

Conclusion:

The use of high insertion torque (>50 Ncm) showed no significant impact on marginal bone resorption or implant survival rates compared to conventional torque levels (35–45 Ncm).

Keywords: Bone loss, bone resorption, dental implant, high torque, insertion torque, low torque, marginal loss, marginal bone resorption, regular torque.

Introduction

Dental implants have become a predictable and widely accepted treatment modality in modern restorative dentistry, with long-term survival rates reported to be approximately 90% after 10 years.[1] Despite these favorable outcomes, peri-implant marginal bone loss remains a significant biological complication that may compromise implant esthetics, function, and long-term success. Therefore, identifying factors that influence peri-implant bone stability is of considerable clinical importance.

Primary stability, defined as the mechanical engagement between the implant and surrounding bone at the time of placement, is considered a critical factor for successful osseointegration. Insertion torque, the rotational force applied during implant placement, is commonly used to evaluate primary stability.[2] Adequate insertion torque minimizes implant micromovement and promotes osseointegration, thereby supporting immediate or early loading protocols.[3] Conversely, insufficient torque may indicate poor bone-implant contact and increase the risk of fibrous encapsulation and early implant failure.

However, concerns have been raised regarding excessively high insertion torque. Experimental and clinical studies suggest that excessive compressive forces may induce microfractures, compression necrosis, and increased stress in peri-implant bone, potentially resulting in early crestal bone loss and impaired osseointegration. Some clinical investigations have reported greater marginal bone loss in implants placed with very high torque values compared to those placed with moderate torque.

The literature remains controversial. While several studies have shown no significant relationship between high insertion torque and peri-implant bone loss, others have reported either beneficial effects on implant stability and survival or adverse effects on marginal bone preservation. This inconsistency creates uncertainty regarding the optimal insertion torque for balancing primary stability and peri-implant bone health.

Therefore, the present systematic review and meta-analysis aim to evaluate the effect of insertion torque on peri-implant marginal bone loss and implant survival by comparing implants placed with high insertion torque to those placed with regular or lower torque values in partially or completely edentulous patients.

Material and methods

Protocol And Registration

The present systematic review registered in the International Prospective Register of Systematic Reviews (PROSPERO) under **CRD42024576346.**

Search Strategy

Three electronic databases was conducted for articles published from January 2010 to December 2024. The databases consulted were MEDLINE via PubMed, EBSCO, Google Scholar, Cochrane library. The following MeSH term were used along with Boolean operators 'AND' and 'OR'.**[MeSH]** term used were "Insertion torque 'OR' High torque" 'OR' "Low torque" 'OR' "Regular torque" 'AND' "Dental implant" 'OR' "Bone loss" 'OR' "Bone resorption" 'OR' "Marginal loss". Two independent investigators performed the study selection. For cross-references, all reference lists of the selected studies were checked. Along with it, the journals were hand-searched from the years January 2010 to December 2024.

PICOT question and eligibility criteria

The question for this systematic review were developed according to patient, intervention, comparison, outcome, time, study design **(PICOTS)** framework:

Patient (P): partially or completely edentulous maxillary or mandibular arch.

Intervention (I): Placement of dental implants at a high torque

Comparison (C): Dental implants placed at moderate or low torque

Outcome (O): Marginal bone loss and Survival rate

Times (T) : from January 2010 to December 2024

Study design (S): In vivo studies, prospective and randomized clinical trials and cross over clinical trials were included.

Study Selection

Inclusion criteria - Only studies which published between January 2010 and December 2024 were accepted, and studies done on human beings were selected. Articles in full-text and written in English were accepted, which had a minimum follow-up time of three months. Acceptable study designs included randomized clinical trials, prospective and retrospective cohort studies, and crossover clinical trials.

Exclusion criteria - Studies lacking primary clinical data or providing unreliable evidence were excluded. Systematic reviews, meta-analyses, case reports, case series, in vitro studies, and animal studies were not included. Studies with follow-up periods shorter than

Volume 9, Issue 4; July-August 2026; Page No 356-365

three months or published in languages other than English were also excluded.

Volume 9, Issue 4; July-August 2026; Page No 356-365

STUDY FLOW CHART

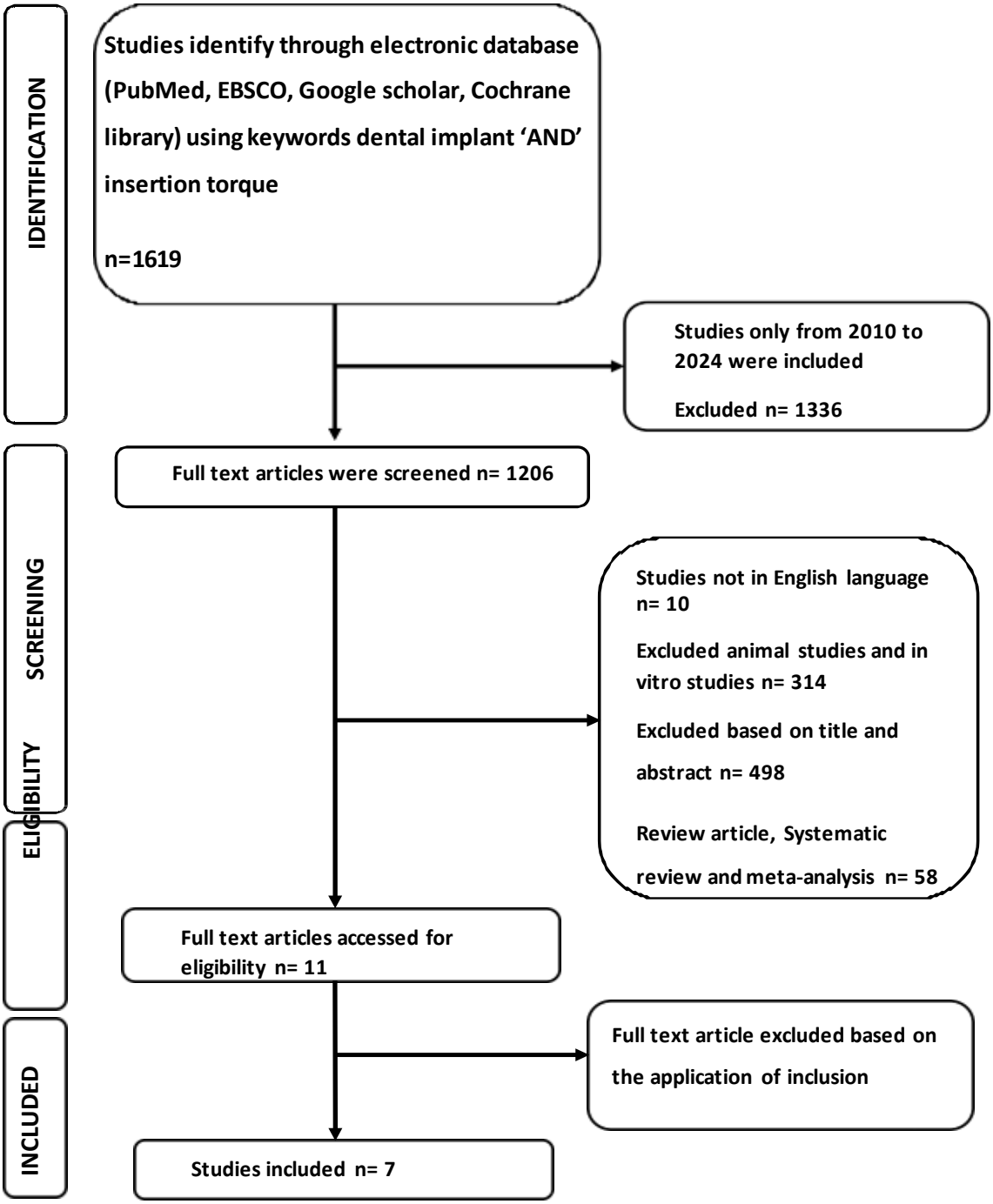


FIGURE 1: Study Flow Chart

Data extraction

Volume 9, Issue 4; July-August 2026; Page No 356-365

A total of 7 studies (2 randomized and 5 non-randomized) were included in the qualitative and quantitative analyses. The studies involved 538 participants (331 women and 207 men; mean age 54.1 years) and 798 dental implants. Among these, 499 implants were placed with high insertion torque (>50 Ncm) and 299 with low-to-moderate torque (<50 Ncm). Implant dimensions ranged from 3.5–5 mm in diameter and 8–16 mm in length, and both maxillary and mandibular arches were evaluated. Implant survival was high across all studies, with only 7 failures (0.87%) reported among the 798 implants.

Table 1 –Summary of characterization of included studies

Author	Study type	Country	No. of participant	Mean Age	Implant Number	Implant dimension	Implant System	Implant site	Insertion torque	Follow up	Marginal bone loss	Survival rate
Daniele De Santis	Prospective July 2007-2008	Italy	62 Male – 27 Female - 35	32-74	144	3.5-5 x 8.5-11.5 mm	Noble Biocare	edentulous maxillary and mandibular region	HT > 50 LT<50 HT – 131 LT - 13	36 months	1.5 ±0.7mm	HT – 130 (99.2%) LT – 12 (92.3%)
Mohsen Bidgoli	Retrospective Cohort study Dec 2012-Dec 2013	Iran	136 Male – 58 Female - 78	21-69	136	NA	TBR Implant	edentulous maxillary and mandibular region	HT >45 LT <45 HT – 64 LT- 72	4 months	HT - 0.33 ± 0.41 mm LT – 0.40 ± 0.56	HT – 64 (100%) LT – 72 (100%)
Simone Marconcini	Randomized Control Trial July 2011 to December 2012.	Pisa	116 Male – 39 Female - 77	31.0–68.4	116	NA	CT implant - Blossom implant (BLCT)	edentulous maxillary and mandibular region	HT > 50 LT < 50 HT – 58 LT- 58	36 months	HT – 1.16 ± 0.61 mm / 1.53 ± 0.29mm LT – 0.96 ± 0.46 / 1.03 ±0.12	HT – 55 (94.8%) LT – 57 (98.3%)
T. Grandi	Prospective study Oct 2009 – jan 2011	Italy	102 Male – 38 Female - 64	39-67	156	3.7-4.3 x 8-13 mm	JDental - care	edentulous maxillary and mandibular region	HT > 50 LT < 45 HT – 114 LT - 42	12 months	HT - 0.41 ± 0.18 mm LT- 0.45 ± 0.25	HT – 42 (100%) LT – 114 (100%)
Markus Hof	Randomized control tri 2009-2011	Austria	21 Male – 8 Female - 13	45-86	84	3.5- 5 x 10 – 13mm	NA	Overdenture/ edentulous	HT > 50 LT < 20 HT – 42 LT - 42	12 months	HT – 1mm ± 0.35 LT – 0.75mm ± 0.35	HT - 41 (97.6%) LT – 42 (100%)
Philipee G. Khayat	Prospective	france	38 Male – 15 Female - 23	34 - 84	66	4.5 x 10, 13, 16mm	Zimmer implant	edentulous maxillary and mandibular region	HT > 50 LT < 50 HT/RT – 42 LT - 9	12 months	HT – 1.24 ± 0.75 LT – 1.09 ± 0.62	HT – 42 (100%) LT – 9(100%)
Jörg-Martin Ruppin	Retrospective January 2021 to June 2022	Germany	63 Male – 22 Female - 41	23-84	111	NA	Camlog progressive line	edentulous maxillary and mandibular region	HT > 50 LT < 50 HT/RT – 48 LT - 63	3 months	HT - 0.27±0.30 mm LT - 0.24±0.27 mm	HT – 48 (100%) LT – 63(100%)

Quality assessment

Established guidelines were used to assess the quality of included studies. Randomized clinical trials (RCTs) were assessed by using the Cochrane RoB 2 tool. The risk of bias in RCTs by evaluating five domains, and the ROBINS-I tool was applied for the non-randomized studies by considering seven domains of potential bias. Studies were classified into "Low risk," "High risk," or "Unclear risk," Assessments were conducted by two independent reviewers, and disagreements were resolved through discussion or consultation.[7,8]

After the final set of studies was identified through the eligibility screening, an additional assessment was

Volume 9, Issue 4; July-August 2026; Page No 356-365

carried out to determine which of these could be included in the quantitative synthesis. Only studies that reported comparable outcome measures of interest of marginal bone loss (in millimetres) and implant survival rates with sufficient numerical data were considered eligible for meta-analysis.

Results

Literature search:

Total study identified from keyword search was 1619. From which 7 studies met the all inclusion criteria were included.[9-15] (Figure 1). A total of 7 studies[9-15] have been included in both qualitative and quantitative analyses, which consist of 2 Randomized Studies[11,13] and 5 non-randomized studies.[9,10,12,14,15] The included studies originated from different countries. Studies conducted in Italy (n=2) followed by Iran (n=1)**,** Pisa (n=1), Austria (n=1), Germany (n=1), and France (n=1)**.** Altogether, 538 participants were divided between 331 women and 207 men. Their average age was 54.1 years. In total, 798 dental implants were placed with an average of 499 by high torque and 299 by regular or low torque. There is no definition standard for high, regular, or low torque; however, all of them defined the term high torque as peak insertion torque >50 Ncm (range: 50-176 Ncm) and regular or low torque as <50 Ncm (range: 20-49), except one study[14], which described the mean torque to be 37.1 Ncm in the range of 30-50 Ncm for regular or low torque. Different implant systems were evaluated with different dimensions.

Risk of Bias of Included Studies

For randomized controlled studies, both studies had a low risk of bias for random sequence generation and selective reporting bias[11,13] but a low allocation concealment bias in one study[11] and a high allocation concealment bias in the other.[13] The risk in blinding of participants and personnel and outcome assessment was high in one study[11] but unclear in the other.[13] Incomplete outcome data were not available to show an amount of risk for one study,[13] but unclear in the other one.[11] (Figure 2)

For the non-randomized studies, across all studies, confounding bias and implementation bias was low.[9,10,12,14,15] Selection bias was less in two studies[10,12] and highest in three.[9,14,15] Classifying bias were less in three studies[9,10,15] but high in two.[12,14] Missing data along with reporting biases were less present in four of the studies[9,10,12,15] and high in just one.[14] Measurement Bias was less reported in three[9,12,14] and high reported in two studies.[9,15] (Figure 3).

Volume 9, Issue 4; July-August 2026; Page No 356-365

Figure 2 – Risk of bias summary using Cochrane collaboration tool for randomized studies

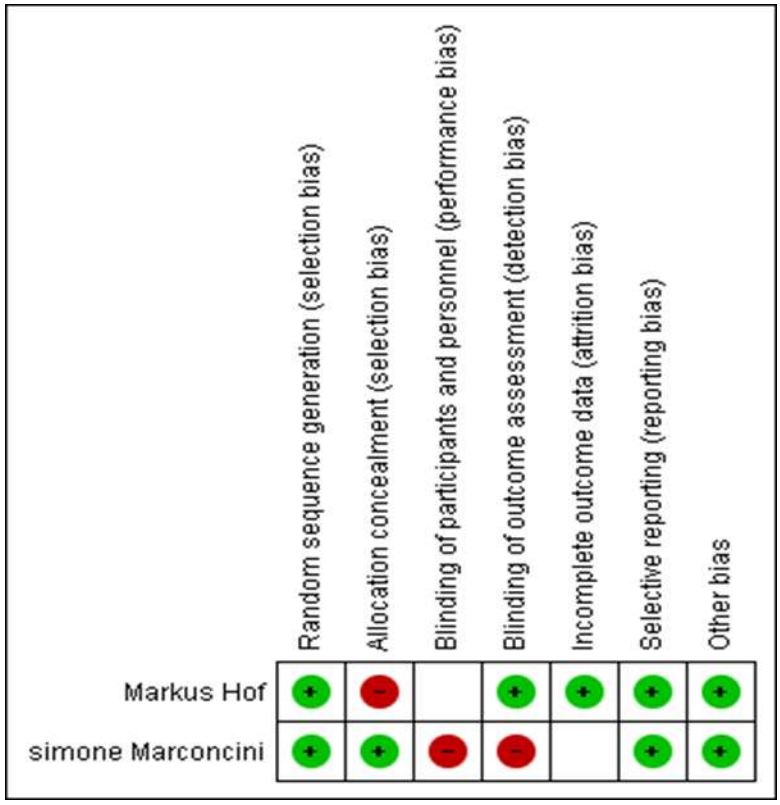
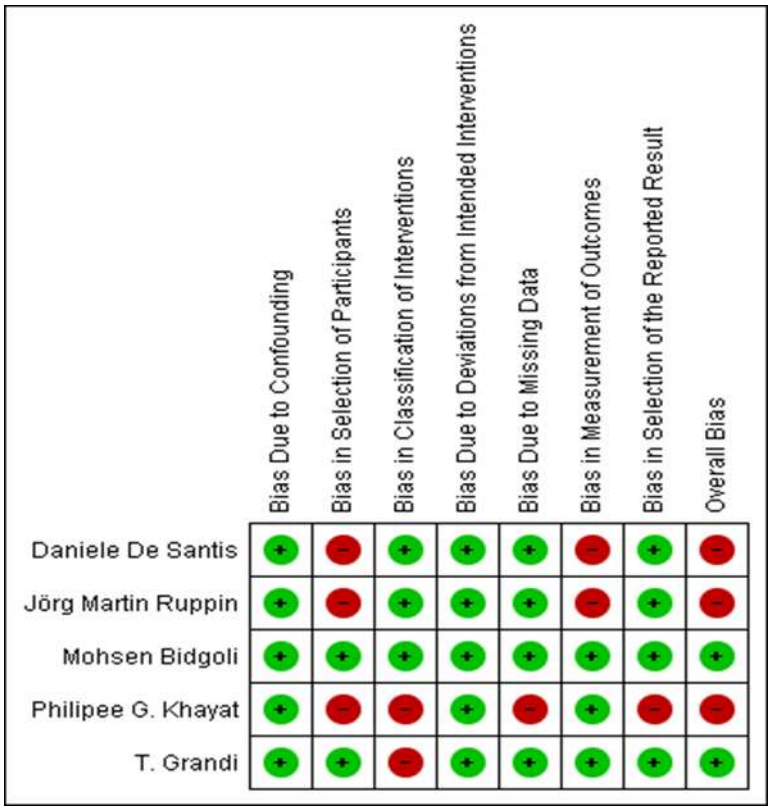


Figure 3 - Risk of bias summary using ROBINS – I tool for non-randomized studies

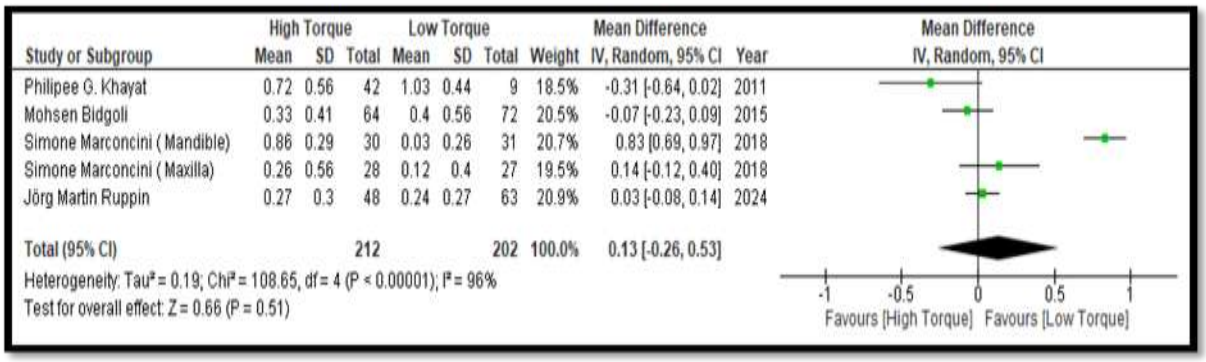


Volume 9, Issue 4; July-August 2026; Page No 356-365

Meta-Analysis

Separate meta-analyses were performed to analyses the mean differences in MBL values depending on the insertion torque group at different points in time (3, 6 and 12 months). Comparison of Mean Marginal Bone Loss at 3-Month Interval is shown in (Figure 4), which illustrates a mean difference in Marginal Bone Loss between the high torque group (n = 212) and the low-to-moderate torque group (n = 202) at 3 months after implant placement of 0.13 mm, with P > 0.05 (95% CI, −0.26 to 0.53; I^2 = 96.%; P < 0.00001) The p-value was 0.51, and the z-score was 0.66, and the position of the diamond in the forest plot, which represents the pooled estimate, slightly favors the low torque group, indicates the effect is minimal and not statistically significant. Comparison of Mean Marginal Bone Loss at 6-Month Interval is shown in (Figure 5), which illustrates a mean difference in Marginal Bone Loss between the high Torque group (n = 172) and the low-to-moderate torque group (n = 100) at 6 months after implant placement of 0.37 mm, with P > 0.05 (95% CI, −0.10 to 0.83; I^2 = 97%; P < 0.00001). The p-value was 0.13, and the z-score was 1.53, indicating that the difference between the two groups was not statistically significant, although it trended toward favoring low torque. Comparison of Mean Marginal Bone Loss at 12-Month Interval is shown in (figure 6), which illustrates a mean difference in MBL between the high Torque group (n = 256) and the low-to-moderate IT group (n = 151) at 12 months after implant placement of 0.22 mm, with P > 0.05 (95% CI, −0.05 to 0.43; I^2 = 97%; P < 0.00001) The p-value of 0.11 and the z-score of 1.59 indicate that the difference between the two groups is not statistically significant, as the confidence interval does not cross zero, suggesting a non-significant trend favouring the low torque approach over the 12-month interval. Comparison of survival rate is shown in (figure 7), which evaluates the impact of high torque vs. low torque on survival rate. The data across all 7 studies show a total of 5 implant failures in the high torque group and 2 in the low torque group. The overall risk ratio (RR) is 0.97 with a 95% confidence interval of [0.10, 9.51], suggesting no statistically significant difference in implant survival rates between the high torque and low torque groups. The p-value of 0.98 and the z-score of 0.02 further indicate no significant effect of torque type on implant survival.

Figure 4 - Analysis 1 – Comparison of Mean Marginal Bone Loss at 3 months interval



Volume 9, Issue 4; July-August 2026; Page No 356-365

Figure 5 - Analysis 2 – Comparison of Mean Marginal Bone Loss at 6 months interval

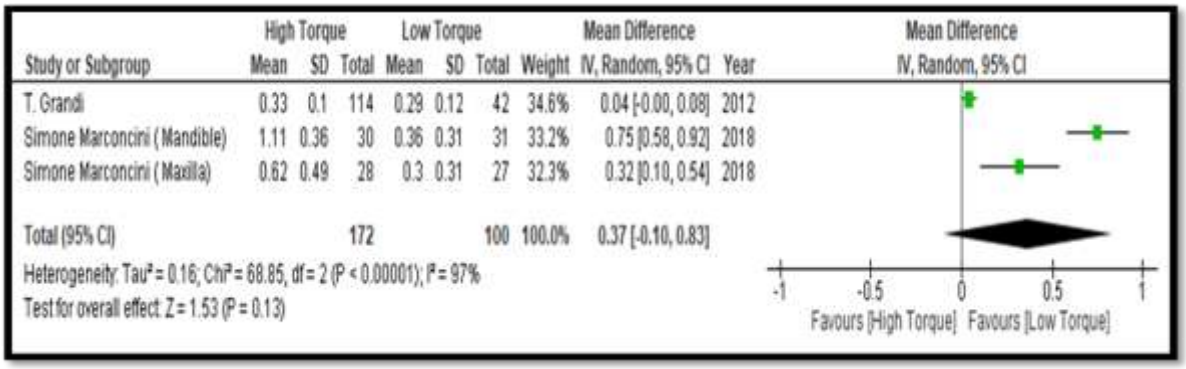


Figure 6 - Analysis 3 – Comparison of Mean Marginal Bone Loss at 12 months interval

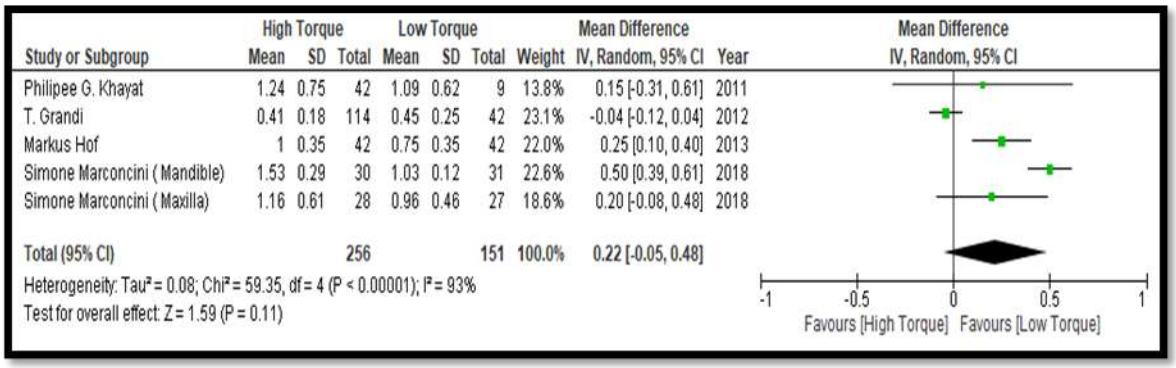
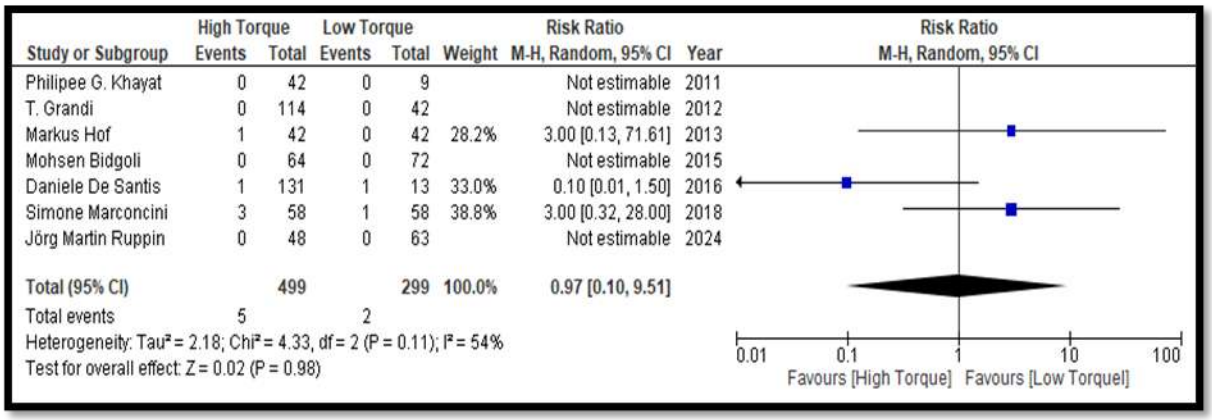


Figure 7 – Analysis 4 - Comparison of Implant survival rate



Discussion

This systematic review was conducted to solve a clinical dilemma about the contribution of insertion torque to the long-term success of dental implants. Although primary stability is recognized by all as key to osseointegration, there is still much controversy about whether increased insertion torque provides benefit or, leads to peri-implant marginal bone loss. Single studies up to now have yielded conflicting and frequently contradictory results: some indicate that greater torque enhances implant survival and stability, while others show that too much torque can cause crestal bone remodeling and jeopardize results. By integrating evidence from different clinical designs, this review offers a more balanced and evidence-led view that can inform clinicians in setting optimal torque values during implant placement.

The null hypothesis that dental implants placed with a high insertion torque had similar implant survival rates to the implants placed at a regular or low insertion

Volume 9, Issue 4; July-August 2026; Page No 356-365

torque was accepted, since the meta-analysis found that there was no difference in the survival rate between the 2 treatment groups. All the studies included reported that high survival rates were irrespective of the insertion torque evaluated. Four studies[10,12,14 ,15] reported 100% survival rates, two studies performed evaluation for 3 months[10,15] and two studies performed evaluation for a period of 1 year.[12,14] The loss of an implant can be caused by different primary or secondary factors.[16] Typically primary factors are implants that never osseointegrated. Secondary factors may be related to surgical, local, systemic, and prosthetic factors. In many cases, it is quite challenging to determine the actual reason for the failure of implants, but these failures tend to be lower, which pinpoints other clinical factors such as marginal bone resorption.[16] The theory that high insertion torque can promote excessive bone compression, generating dangerous micro cracks, or pressure necrosis,[11] which disturb microcirculation and lead to bone resorption[12,14] was not confirmed because the meta-analysis indicated no significant differences in terms of marginal bone level between high and regular or low insertion torque of the implant, thereby leading to acceptance of the null hypothesis. In a study by Matalon et al. (2021), the researchers investigated the impact of high and low insertion torque on implant stability and bone resorption. Their findings suggested that high insertion torque (greater than 40 Ncm) had no significant adverse effects on bone resorption when compared to lower torque values. However, implants placed with very high insertion torque exhibited higher rates of initial stability, which was crucial for promoting osseointegration during the early healing phase. On contrary, Galindo-Moreno et al. (2019) in their study they suggested that the bone-to-implant interface, more than the insertion torque, is a crucial determinant of long-term implant stability.[17]

Limitations and Future scopes

There are low number of included studies and high heterogeneity in study design. Studies with more years of follow up are required. Future Research: Further randomized clinical trials with larger sample sizes and more detailed subgroups (including differentiation between maxilla and mandible) are needed. Future research should focus on improving study quality and reducing bias to provide stronger evidence on the relationship between IT and MBL.

Conclusion

Within the limitations of this study. To conclude for this systematic review,

1. It was found that Marginal bone resorption around implants placed with high insertion torque (> 50 Ncm) is not significantly different from that with conventional insertion torque (35 to 45 Ncm).

2. The cumulative success rates for implants placed with high insertion torque are comaparble to those for implants placed with conventional insertion torque.

3. There is no statistically significant relationship between insertion torque and marginal bone loss (MBL), suggesting that high insertion torque does not provide a superior outcome compared to conventional torque levels.

Clinical Significance

The study provides insights in deciding optimal insertion torque for dental implants and aims to minimize marginal bone loss and increase implant survival rates. Understanding this can help clinicians minimize peri-implant bone loss, enhance osseointegration, and improve the long-term success of dental implants.

References

1. Levin L, Nitzan D, Schwartz-Arad D. Success of dental implants placed in intraoral block bone grafts. J Periodontol. 2007;78(1):18-21. doi:10.1902/jop.2007.060238

2. Gehrke SA, Pereira GMA, Gehrke AF, Junior NB, Dedavid BA. Effects of insertion torque on the structure of dental implants with different connections: experimental pilot study in vitro. PLoS One. 2021;16(5):e0251904. doi:10.1371/journal.pone.0251904

3. Do Vale Souza JP, de Moraes Melo Neto CL, Piacenza LT, et al. Relation between insertion torque and implant stability quotient: a clinical study. Eur J Dent. 2021;15(4):618-23. doi:10.1055/s-0041-1725575

4. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097. doi:10.1371/journal.pmed.1000097

Volume 9, Issue 4; July-August 2026; Page No 356-365

5. Duyck J, Corpas L, Vermeiren S, et al. Histological, histomorphometrical, and radiological evaluation of an experimental implant design with a high insertion torque. Clin Oral Implants Res. 2010;21(8):877-84. doi:10.1111/j.1600-0501.2010.01895.x
6. Sotto-Maior BS, Rocha EP, de Almeida EO, Freitas-Júnior AC, Anchieta RB, Del Bel Cury AA. Influence of high insertion torque on implant placement: an anisotropic bone stress analysis. Braz Dent J. 2010;21(6):508-14. doi:10.1590/s0103-64402010000600005
7. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898. doi:10.1136/bmj.l4898
8. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016;355:i4919. doi:10.1136/bmj.i4919
9. De Santis D, Cucchi A, Rigoni G, Longhi C, Nocini PF. Relationship between primary stability and crestal bone loss of implants placed with high insertion torque: a 3-year prospective study. Int J Oral Maxillofac Implants. 2016;31:1126-34. doi:10.11607/jomi.4594
10. Bidgoli M, Soheilifar S, Faradmal J, Soheilifar S. High insertion torque and peri-implant bone loss: is there a relationship? J Long Term Eff Med Implants. 2015;25(1-2):63-9. doi:10.1615/jlongtermeffmedimplants.2015012034
11. Marconcini S, Giammarinaro E, Toti P, Alfonsi F, Covani U, Barone A. Longitudinal analysis on the effect of insertion torque on delayed single implants: a 3-year randomized clinical study. Clin Implant Dent Relat Res. 2018;20:322-32. doi:10.1111/cid.12586
12. Grandi T, Guazzi P, Samarani R, Grandi G. Clinical outcome and bone healing of implants placed with high insertion torque: 12-month results from a multicenter controlled cohort study. Int J Oral Maxillofac Surg. 2013;42:516-20. doi:10.1016/j.ijom.2012.10.013
13. Hof M, Pommer B, Strbac GD, Vasak C, Agis H, Zechner W. Impact of insertion torque and implant neck design on peri-implant bone level: a randomized split-mouth trial. Clin Implant Dent Relat Res. 2014;16:668-74. doi:10.1111/cid.12042
14. Khayat PG, Arnal HM, Tourbah BI, et al. Clinical outcome of dental implants placed with high insertion torques (up to 176 Ncm). Clin Implant Dent Relat Res. 2013;15:227-33. doi:10.1111/j.1708-8208.2011.00351.x
15. Ruppin JM, Stimmelmayr M. High insertion torque versus regular insertion torque: early crestal bone changes on dental implants in relation to primary stability: a retrospective clinical study. Int J Implant Dent. 2024;10(1):22. doi:10.1186/s40729-024-00540-3
16. Chrcanovic BR, Albrektsson T, Wennerberg A. Reasons for failures of oral implants. J Oral Rehabil. 2014;41(6):443-76. doi:10.1111/joor.12157
17. Galindo-Moreno P, León-Cano A, Ortega-Oller I, et al. Prosthetic abutment height is a key factor in peri-implant marginal bone loss. J Dent Res. 2014;93(7 Suppl):80S-5S. doi:10.1177/0022034513519800

Volume 9, Issue 4; July-August 2026; Page No 356-365