Purpose: The present retrospective clinical study aimed to evaluate and compare the clinical and radiographic parameters, complications, and satisfaction in patients who received fixed prostheses supported by narrow-diameter implants (NDIs) in the anterior and posterior jaw.

Methods: Patients aged ≥30 years who had NDI-supported fixed prostheses in the anterior or posterior region of either jaw for at least 2 years were included. Complications such as chipping of the crown; loosening or fracture of the screw, crown abutment, or implant; and loss of retention were recorded. Clinical peri-implant outcomes and crestal bone loss (CBL) were measured. A questionnaire was used to record responses regarding the aesthetics and function of the fixed restorations. Analysis of variance was used to assess the significance of between-group mean comparisons. The log-rank test was performed to analyze the influence of location and prosthesis type on technical complications.

Results: Seventy-one patients (mean age: 39.6 years) provided informed consent with a mean follow-up duration of 53 months. Only bleeding on probing showed a statistically significant difference between NDIs in the anterior and posterior regions. The complication rate for NDIs in the posterior region was significantly higher than that for NDIs in the anterior region (P=0.041). For NDIs, CBL was significantly higher around splinted crowns than single crowns (P=0.022). Overall mean patient satisfaction was 10.34±3.65 on a visual analogue scale.

Conclusions: NDIs in the anterior and posterior jaws functioned equally well in terms of peri-implant soft and hard tissue health and offered acceptable patient satisfaction and reasonable complication rates.

Keywords: Alveolar bone loss; Dental implants; Patient satisfaction; Questionnaires

INTRODUCTION

Dental implants are devices used to secure artificial teeth and are widely used to restore missing teeth, a practice that has existed worldwide for several decades. In some clinical
scenarios, such as cases of inadequate bone volume, treatment with regular-diameter implants (RDIs) is often hampered, leading to relatively unfavorable clinical outcomes [1]. For this purpose, advanced and complex surgical techniques including bone splitting, guided bone regeneration, and distraction osteogenesis are often required to increase the horizontal bone dimension [2–4]. However, these surgical interventions are unrealistic for some patients, because they may involve extended treatment time, can have unforeseen complications, and can be costly [5].

Extensive research has led to the development of multiple types of dental implants that vary in shape and size according to the patient’s needs [6]. Among these dental implants, the short- and long-term survival of artificial narrow-diameter implants (NDIs) has been extensively researched in patients with reduced horizontal bone height in edentulous jaws [7–10]. According to Al-Johany et al. [11], NDIs are defined as dental implants with diameters ranging from 3.0 mm to 3.75 mm. NDIs are designed to work well in edentulous areas where there is limited mesiodistal space, such as the maxillary lateral and mandibular lower incisors [12,13]. Using a RDI in such limited spaces may damage the adjacent natural dentition. Furthermore, several reports on the survival rates, aesthetic outcomes, and technical complications of NDIs have been published. Although results regarding clinical and radiographic peri-implant parameters of NDIs in the esthetic zone are widely documented, few clinicians have studied the clinical success rate of NDIs in the posterior jaws [14,15]. In their short-term clinical study, Tolentino et al. [16] observed 100% implant survival and success rates for NDIs in the molar region of the mandible. A long-term retrospective study with up to 11 years of follow-up reported an overall survival rate of 95.1% for NDIs in the posterior region [17]. A recent meta-analysis reported a mean implant survival rate of 97.7% for NDIs that was reflective of clinical success in all regions, including posterior single-tooth restorations [18].

Nevertheless, there are still several limitations that should be taken into account when considering the introduction of NDIs in the posterior jaws. These include the risk of fracture of the screw and implant fixture due to the thin fixture wall of the NDI, as well as the risk of overload stemming from the reduced ratio of the diameter of the implant to the occlusal surface area, which can produce cantilever effects [19]. These factors may contribute to the complication rate and thereby reduce the overall clinical success of NDIs placed in the posterior region. Therefore, the present retrospective clinical study aimed to evaluate and compare the clinical and radiographic parameters, complication rates, and patient satisfaction levels of fixed prostheses supported by NDIs placed in the anterior and posterior regions.

**MATERIALS AND METHODS**

**Design and research ethics**

Ethical approval was obtained from the Ethics Research Committee of the Center for Specialist Dental Practice and Clinical Research (UDCRC/004-86). The current clinical study was a retrospective study that followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines [20]. The follow-up duration ranged from 2 to 6 years. Suitable participants were telephoned to invite them to the study and, later, to carry out follow-up assessments. The present clinical study was performed in accordance with the guidelines described in the Declaration of Helsinki. Participants were invited to participate in the clinical study and asked to provide informed consent.
**Subject selection**
Patients aged ≥30 years who had NDI- and RDI-supported fixed prostheses in the anterior or posterior region of either jaw for a minimum duration of 2 years were selected for the study. Participants were excluded if they had undergone advanced surgical procedures such as bone augmentation, were former or current smokers [21], had medically compromised status including uncontrolled diabetes mellitus, had severe periodontal or peri-implant disease, had bone disorders or osteoporosis, exhibited complete edentulism, or were missing baseline radiographs.

**Assessment of NDIs and RDIs and their fixed prostheses**
All details regarding NDIs and RDIs were obtained from the records saved in the database. All NDIs and RDIs were screened to determine the depth of placement, total number of implants, implant loading and duration of implants in service, implant design, and implant length and diameter. The restoration type was also determined at the follow-up assessment. In addition, baseline standardized periapical radiographs were examined for a detailed radiographic analysis.

**Technical complications**
Complications such as chipping of the crown; loosening or fracture of the screw, crown abutment, or implant; and loss of retention were evaluated and recorded.

**Patient satisfaction**
A questionnaire sheet was provided to all eligible participants and consisted of questions regarding the aesthetics and function of the fixed restorations. Responses were made on a Likert scale ranging from “exceptionally dissatisfied” to “exceptionally satisfied.”

**Clinical peri-implant measurements**
All clinical peri-implant assessments were conducted by a single and calibrated examiner (Mohammed Alrabiah). Kappa scores were used to estimate probing depth (PD) before detailed clinical measurements were performed. Two parameters—the plaque score (PS) and bleeding on probing (BOP)—were based on dichotomous measurements, for which the responses were “yes – 1” and “no – 0” [22]. The measurement of PD was based on the recommendations described in the consensus report of the 11th European Workshop on Periodontology in 2015 [23]. All clinical measurements were taken at 6 sites of the NDIs and reported as mean percentages per individual. All clinical parameters were measured using a manual periodontal probe (UNC-15, Hu-Friedy, Chicago, IL, USA).

**Standardized radiographs**
Crestal bone loss (CBL) was assessed by a single and calibrated examiner (Fahim Vohra). Radiographic techniques were performed as explained in our previous reports; these techniques include standardization of a bite registration material and an aluminum step wedge of specific density [24,25]. Digital radiographs were incorporated in a software program (Romexis; images stored at a 1:1 ratio) and studied on an adjusted personal computer screen integrated with an image analyzer (Scion Image Analyzer, Scion Corp., Frederick, MD, USA). The range of pixels for calibration was set at 16 bits in Scion Image and was generated automatically according to a linear density calibration function for original 16-bit pixel values.
Statistical analysis
Normality testing was conducted using the Shapiro-Wilk test before performing any further statistical tests. For all dependent variables, including clinical peri-implant parameters and CBL, analysis of variance was used to assess the significance of between-group comparisons of mean values. The Dunn test was used for multiple comparisons. The log-rank test was performed to analyze the influence of location and prosthesis type on the rate of technical complications. \( P \) values <0.05 were considered to indicate statistical significance.

RESULTS

Subjects and implants
Table 1 describes the details of subject selection and implant-related characteristics. Of 194 patients, 71 patients (mean age: 39.6 years) with NDIs and 65 patients (mean age: 41.4 years) with RDIs provided informed consent. The mean follow-up duration was 53 months. A total of 114 NDIs (36 in the maxilla and 78 in the mandible) and 121 RDIs (48 in the maxilla and 73 in the mandible) were examined, of which 61 NDIs and 74 RDIs were implanted in the anterior jaw, while 53 NDIs and 47 RDIs were implanted in the posterior region. All implants were bone-level platform-switched implants with moderately rough surfaces that were either 10 mm or 12 mm in length and that had diameters of 3.3 mm (for the NDIs) or 4.0 mm (for the RDIs). The NDIs and RDIs had mean loading periods of 3.8 and 3.9 months, respectively. The implant-supported fixed restorations included a total of 85 screw-retained and 29 cement-retained restorations for NDIs and 72 screw-retained and 49 cement-retained restorations for RDIs, while 46 NDIs and 52 RDIs supported single crowns and 68 NDIs and 69 RDIs supported splinted restorations.

Clinical parameters
The follow-up peri-implant conditions are reported in Table 2. Around anterior NDIs, the mean percentages of sites for which “yes” was recorded in the assessments of PS and BOP were 18.2% and 23.8%, respectively, while these values around posterior NDIs were 26.5% and 35.1%, respectively. At follow-up, the overall mean PD values around anterior and posterior NDIs were 3.1 mm and 3.3 mm, respectively. The overall mean CBL was found to be 1.3 mm around anterior NDIs and 1.4 mm around posterior NDIs. None of the

Table 1. Descriptions of patients and implants

| Description                  | Narrow-diameter implants | Regular-diameter implants |
|------------------------------|--------------------------|--------------------------|
| Implant diameter (mm)        | 3.3                      | 4.0                      |
| No. of patients              | 71                       | 65                       |
| Mean age of patients         | 39.6 (31–49)             | 41.4 (34–48)             |
| Male:female                  | 48:23                    | 39:26                    |
| Mean follow-up duration (mon)| 53 (35–69)               | 52 (34–70)               |
| Total No. of implants        | 114                      | 121                      |
| Anterior region              | 61                       | 74                       |
| Posterior region             | 53                       | 47                       |
| Maxilla:mandible             | 36:78                    | 48:73                    |
| Implant length (10 mm:12 mm) | 73:41                    | 82:39                    |
| Depth of placement           | Bone level               | Bone level               |
| Implant design               | Platform-switched with moderately rough surfaces | Platform-switched with moderately rough surfaces |
| Implant loading after placement (mon) | 3.8±0.2 | 3.9±0.4 |
| Type of restoration (screw:cement) | 85:29        | 72:49        |
| Single crown:splinted crown  | 46:68                    | 52:69                    |

Values are presented as median (interquartile range) or mean±standard deviation.
clinical parameters displayed statistically significant differences between NDIs and RDIs or between the anterior and posterior regions ($P > 0.05$), with the exception of BOP, for which a statistically significant difference was observed between the anterior and posterior regions for NDIs.

**Influence of implant location and type of prosthesis on technical complications and CBL**

The rate of technical complications for NDIs in the posterior region was statistically significantly higher than that for NDIs in the anterior region ($P=0.041$). In general, NDIs were associated with a significantly higher number of technical complications than RDIs ($P=0.001$). In addition, splinted crowns were also associated with a higher rate of technical complications than single crowns ($P=0.039$), with increased risk for NDIs compared to RDIs ($P=0.01$). The log-rank test showed that the CBL of NDIs was statistically significantly higher around splinted crowns than around single crowns ($P=0.022$) (Table 3).

**Complication rates and patient satisfaction**

Common complications described by the patients were chipping and loosening of crowns. Of 71 patients with NDIs and 65 patients with RDIs, 65 (91.5%) and 63 (96.9%) patients, respectively, were extremely satisfied with the aesthetics of the restorations, while 61 (85.9%) and 58 (89.2%) patients, respectively, were highly satisfied with the restoration function (Table 4). Only 6 and 10 patients with NDIs and 2 and 7 patients with RDIs reported reservations regarding aesthetics and function, respectively. The main reason for reported dissatisfaction was food impaction. The mean patient satisfaction levels were 10.34±3.65 and 13.62±2.94 on a visual analogue scale for NDIs and RDIs, respectively.

### Table 2. Clinical and radiographic peri-implant status

| Peri-implant parameters          | Narrow-diameter implants | Regular-diameter implants |
|----------------------------------|--------------------------|----------------------------|
| Peri-implant parameters          | Anterior | Posterior | Anterior | Posterior |
| Plaque index (% of sites)        | 18.2±6.9 | 26.5±9.2 | 21.7±5.4 | 26.4±6.3 |
| Bleeding on probing (% of sites) | 23.8±7.7 | 35.1±6.4 | 28.4±7.5 | 31.6±8.8 |
| Probing depth (mm)               | 3.1±0.4  | 3.3±0.6  | 3.0±0.8  | 3.2±1.8  |
| Mean crestal bone loss (mm)      | 1.3±0.1  | 1.4±0.2  | 1.6±0.3  | 1.7±0.5  |
| Distal                           | 1.1±0.1  | 1.2±0.1  | 1.3±0.2  | 1.5±0.1  |
| Mesial                           | 1.4±0.2  | 1.5±0.3  | 1.7±0.3  | 1.7±0.2  |

Data are shown as mean±standard deviation.

*Statistically significant difference compared to the anterior group at $P<0.05$.

### Table 3. Influence of implant location and type of prosthesis on technical complications and CBL in NDIs and RDIs

| Variable          | Technical complication rate | $P$ value | CBL (mm) | $P$ value |
|-------------------|-----------------------------|-----------|----------|-----------|
| **NDI**           |                             |           |          |           |
| Anterior region   | 8.1 (5/61)$^{a}$           | 0.047$^{a}$| 1.01±0.77 (n=61) | 0.768 |
| Posterior region  | 16.9 (9/53)$^{a}$          |           | 1.26±0.31 (n=53)  |          |
| **RDI**           |                             |           |          |           |
| Anterior region   | 1.35 (1/74)                | 0.824     | 1.25±0.12 (n=74) | 0.446 |
| Posterior region  | 6.3 (3/47)                 |           | 1.31±0.22 (n=47)  |          |
| **NDI**           |                             |           |          |           |
| Single crown      | 6.5 (3/46)                 | 0.039$^{a}$| 1.03±0.14 (n=46) | 0.022$^{c}$|
| Splinted crown    | 13.2 (9/68)$^{a}$         |           | 1.5±0.33 (n=68)  |          |
| **RDI**           |                             |           |          |           |
| Single crown      | 2.4 (1/39)                 | 0.714     | 1.19±0.12 (n=39) | 0.946 |
| Splinted crown    | 2.4 (2/82)                 |           | 1.67±0.25 (n=82)  |          |

Data are shown as mean±standard deviation or number (%). CBL: crestal bone loss, NDI: narrow-diameter implant, RDI: regular-diameter implant.

*Statistically significant difference at $P<0.05$; *$^a$Statistically significant difference in subgroups between NDIs and RDIs at $P<0.05$.  

https://doi.org/10.5051/jpis.2020.50.2.97
DISCUSSION

This study focused on the comparative analysis of NDIs placed in the anterior and posterior regions. Their clinical peri-implant parameters, including plaque levels, bleeding scores, PD, and radiographic evidence of bone loss, were recorded. In addition, technical complication rates and patient satisfaction were evaluated. The results of the present retrospective study suggest that clinical and radiographic parameters showed statistically similar outcomes during the follow-up period. In addition, NDIs placed in both the anterior and posterior regions offered acceptable patient satisfaction and reasonable complication rates.

Clinical peri-implant parameters reflective of health were observed at various follow-up intervals. These were indicative of the meticulous oral hygiene maintenance practiced by all of the patients during follow-up. This relates to the importance of oral hygiene care and implies that dental implants could survive longer if plaque levels were kept low [26,27]. It should be noted that PSs around NDIs placed in the posterior region (26.5%) were higher than those associated with anterior NDIs (18.2%). However, this difference was not statistically significant. Nevertheless, a possible reason for this difference could be that the posterior region is considered to be a difficult-to-maintain area and is a region where effective oral hygiene may not be practiced optimally. In addition, BOP was the only parameter that showed statistical significance—in particular, a statistically significant difference between the posterior and anterior NDIs. This may be related to known inflammatory signs in the posterior region, which in turn may be due to the plaque levels around NDIs placed in the posterior jaw.

None of the NDIs placed in the anterior or posterior region were associated with serious complications, including implant fracture. A previous meta-analysis found 5-year dental implant fracture rates of only 0.08% and 0.5% for single crown restorations and splinted restorations, respectively [28]. This may demonstrate that these implants with a 3.3-mm diameter yield predictable outcomes in the posterior jaw. The technical complications associated with single crowns were also higher than those associated with splinted crowns (6.5% vs. 13.2%, respectively). All 12 fixed restorations either became loosened or had some level of chipping observed in the splinted group. This might explain the significantly higher supra-structure complication rates in splinted restorations compared to single crown restorations.

Statistically significant differences with regard to CBL were observed between splinted and single restorations (P<0.22). These outcomes contradict the results presented in the long- and short-term studies conducted by Shi et al. [28] and Al-Aali et al. [29], respectively. The study by Shi et al. [28] showed that the CBL was 1.2 mm in splinted restorations and 1.3 mm in single restorations at an 8-year follow-up assessment and that the difference between splinted and single restorations was not considered clinically meaningful. This lack of a

| Variable | No. of satisfied patients | No. of unsatisfied patients | Overall satisfaction |
|----------|--------------------------|-----------------------------|---------------------|
| Aesthetics | 65 (91.5) | 6 (8.5) | 10.34±3.65 |
| Function | 61 (85.9) | 10 (14.1) |
| Aesthetics | 63 (96.9) | 2 (3.1) | 13.62±2.94 |
| Function | 58 (89.2) | 7 (10.8) |

Data are shown as mean±standard deviation of visual analog scale or number (%).
clinically meaningful difference may indicate that both NDI-supported single and splinted crowns could maintain the CBL.

It is noteworthy that the average CBL around splinted crowns was statistically significantly higher than the average CBL around single crowns (1.51 mm vs. 1.03 mm, respectively; \( P=0.022 \)). This difference might be explained by the higher occlusal force and more persistent inflammation around splinted restorations compared to single restorations [29,30]. The impact on oral cleanliness around splinted restorations is another important factor, as more debris can be retained around splinted crowns, requiring more care.

Some noticeable limitations are present in this study. First, survival analysis using advanced statistical methods such as Kaplan-Meier analysis was not performed. Additionally, with the strict eligibility criteria imposed, the outcomes may not translate to other cohorts, including tobacco smokers and individuals with systemic disorders such as uncontrolled diabetes mellitus. Finally, a limited number of NDIs were studied in the maxillary jaw, even though the maxilla and mandible differ in their bone mineral density, suggesting a potentially different outcome in mandibular NDIs. Therefore, future studies should be undertaken to confirm the clinical efficacy of NDIs in maxillary jaws compared to mandibular jaws.

NDIs placed in the anterior and posterior regions of the jaws function equally well in terms of peri-implant soft and hard tissue health, although NDIs demonstrated an increased risk of prosthetic complications. NDIs placed in both regions offered acceptable patient satisfaction and reasonable complication rates. NDI-supported prostheses in either the anterior or the posterior region could be a promising treatment option, especially in areas where advanced surgical interventions such as bone augmentation should be avoided.

ACKNOWLEDGEMENTS

The authors are grateful to the Deanship of Scientific Research at King Saud University for its funding through the Vice Deanship of Scientific Research Chairs, Research Chair for Biological Research in Dental Health.

REFERENCES

1. Nisand D, Renouard F. Short implant in limited bone volume. Periodontol 2000 2014;66:72-96.
2. Bozkaya S, Durmuşlar MC, Çakır M, Erkmen E. Use of alveolar distraction osteogenesis for implant placement: a case report with eight-year follow-up. Aust Dent J 2016;61:252-6.
3. Jung RE, Herzog M, Wolleb K, Ramel CF, Thoma DS, Hämmerle CH. A randomized controlled clinical trial comparing small buccal dehiscence defects around dental implants treated with guided bone regeneration or left for spontaneous healing. Clin Oral Implants Res 2017;28:348-54.
4. Gehrke SA, Maté Sánchez de Val JE, Ramírez Fernández MP, Shibli PH, Calvo Guirado JL. Stability and crestal bone behavior following simultaneous placement of multiple dental implants (two or more) with the bone splitting technique: a clinical and radiographic evaluation. Clin Implant Dent Relat Res 2017;19:123-30.
5. Chiapasco M, Zaniboni M. Clinical outcomes of GBR procedures to correct peri-implant dehiscences and fenestrations: a systematic review. Clin Oral Implants Res 2009;20 Suppl 4:113-23.

6. Zhang G, Yuan H, Chen X, Wang W, Chen J, et al. A three-dimensional finite element study on the biomechanical simulation of various structured dental implants and their surrounding bone tissues. Int J Dent 2016;2016:4867402.

7. Iegami CM, Uehara PN, Sesma N, Pannuti CM, Tortamano Neto P, Mukai MK. Survival rate of titanium-zirconium narrow diameter dental implants versus commercially pure titanium narrow diameter dental implants: a systematic review. Clin Implant Dent Relat Res 2017;19:1015-22.

8. Alsahhaf A, Alshiddi IF, Alshagroud RS, Al-Aali KA, Vohra F, Abduljabbar T. Clinical and radiographic indices around narrow diameter implants placed in different glycemic-level patients. Clin Implant Dent Relat Res 2019;21:621-6.

9. Alshiddi IF, Alsahhaf A, Alshagroud RS, Al-Aali KA, Vohra F, Abduljabbar T. Clinical, radiographic, and restorative peri-implant measurements of narrow and standard diameter implants in obese and nonobese patients: a 3-year retrospective follow-up study. Clin Implant Dent Relat Res 2019;21:656-61.

10. Alasqah MN, Alfawaz YF, Aldahiyan N, Vohra F, Alotaibi BM, Abduljabbar T. Longitudinal assessment of clinical and radiographic periimplant status around narrow and regular diameter implants placed in cigarette-smokers and nonsmokers. Clin Implant Dent Relat Res 2019;21:910-5.

11. Al-Johany SS, Al Amri MD, Alsaeed S, Alalola B. Dental implant length and diameter: a proposed classification scheme. J Prosthodont 2017;26:252-60.

12. Trbakovic A, Bongenhielm U, Thor A. A clinical and radiological long-term follow-up study of narrow diameter implants in the aesthetic area. Clin Implant Dent Relat Res 2018;20:598-605.

13. Galindo-Moreno P, Nilsson P, King P, Worsaae N, Schramm A, Padial-Molina M, et al. Clinical and radiographic evaluation of early loaded narrow-diameter implants: 5-year follow-up of a multicenter prospective clinical study. Clin Oral Implants Res 2017;28:1584-91.

14. de Souza AB, Sukekava F, Tolentino L, César-Neto JB, Garcez-Filho J, Araújo MG. Narrow- and regular-diameter implants in the posterior region of the jaws to support single crowns: a 3-year split-mouth randomized clinical trial. Clin Oral Implants Res 2018;29:100-7.

15. Pieri F, Forlivesi C, Caselli E, Corinaldesi G. Narrow- (3.0 mm) versus standard-diameter (4.0 and 4.5 mm) implants for splinted partial fixed restoration of posterior mandibular and maxillary jaws: a 5-year retrospective cohort study. J Periodontol 2017;88:338-47.

16. Tolentino L, Sukekava F, Garcez-Filho J, Tormena M, Lima LA, Araújo MG. One-year follow-up of titanium/zirconium alloy X commercially pure titanium narrow-diameter implants placed in the molar region of the mandible: a randomized controlled trial. Clin Oral Implants Res 2016;27:393-8.

17. Maló P, de Araújo Nobre M. Implants (3.3 mm diameter) for the rehabilitation of edentulous posterior regions: a retrospective clinical study with up to 11 years of follow-up. Clin Implant Dent Relat Res 2011;13:95-103.

18. Schiegnitz E, Al-Nawas B. Narrow-diameter implants: a systematic review and meta-analysis. Clin Oral Implants Res 2018;29 Suppl 16:21-40.

19. Lee JS, Kim HM, Kim CS, Choi SH, Chai IK, Jung UW. Long-term retrospective study of narrow implants for fixed dental prostheses. Clin Oral Implants Res 2013;24:847-52.

20. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Int J Surg 2014;12:1495-9.
21. Akram Z, Vohra F, Bukhari IA, Sheikh SA, Javed F. Clinical and radiographic peri-implant parameters and proinflammatory cytokine levels among cigarette smokers, smokeless tobacco users, and nontobacco users. Clin Implant Dent Relat Res 2018;20:76-81.
PUBMED | CROSSREF

22. Galgut P. A comparison of different indices used in the clinical assessment of plaque and gingival bleeding. Clin Oral Investig 1999;3:96-9.
PUBMED | CROSSREF

23. Tonetti MS, Chapple IL, Jepsen S, Sanz M. Primary and secondary prevention of periodontal and peri-implant diseases: introduction to, and objectives of the 11th European Workshop on Periodontology consensus conference. J Clin Periodontol 2015;42 Suppl 16:S1-4.
PUBMED | CROSSREF

24. Alkhudhairy F, Vohra F, Al-Kheraif AA, Akram Z. Comparison of clinical and radiographic peri-implant parameters among obese and non-obese patients: a 5-year study. Clin Implant Dent Relat Res 2018;20:756-62.
PUBMED | CROSSREF

25. Alasqah MN, Al-Shibani N, Al-Aali KA, Qutub OA, Abduljabbar T, Akram Z. Clinical indices and local levels of inflammatory biomarkers in per-implant health of obese and nonobese individuals. Clin Implant Dent Relat Res 2019;21:80-4.
PUBMED

26. Tecco S, Grusovin MG, Sciara S, Bova F, Pantaleo G, Capparè P. The association between three attitude-related indexes of oral hygiene and secondary implant failures: a retrospective longitudinal study. Int J Dent Hyg 2018;16:372-9.
PUBMED | CROSSREF

27. Lin CY, Chen Z, Pan WL, Wang HL. The effect of supportive care in preventing peri-implant diseases and implant loss: a systematic review and meta-analysis. Clin Oral Implants Res 2019;30:714-24.
PUBMED | CROSSREF

28. Shi JY, Xu FY, Zhuang LF, Gu YX, Qiao SC, Lai HC. Long-term outcomes of narrow diameter implants in posterior jaws: a retrospective study with at least 8-year follow-up. Clin Oral Implants Res 2018;29:76-81.
PUBMED | CROSSREF

29. Al-Aali KA, Al-Rejaie AS, Alrahlah A, Alfawaz YF, Abduljabbar T, Vohra F. Clinical and radiographic peri-implant health status around narrow diameter implant-supported single and splinted crowns. Clin Implant Dent Relat Res 2019;21:386-90.
PUBMED | CROSSREF

30. Isidor F. Influence of forces on peri-implant bone. Clin Oral Implants Res 2006;17 Suppl 2:8-18.
PUBMED | CROSSREF