INTRODUCTION

The past decade has experienced a significant rise in expectations, both functional and aesthetic, of patients’ from implant-supported restorations. Hence, the previously described standard suprastructure gingival location of the crown margin (microgap/interface) is no longer acceptable from an esthetic point of view. Therefore, implants in esthetically demanding sites are placed deeper into the bone than in areas of less esthetic concern to avoid a visible titanium implant shoulder thus achieving a subgingivally located implant shoulder following healing. To obtain the desired esthetic goals, clinically driven recommendations have been devised to change the standard surgical protocol when using implants in the esthetic area. It has been recommended to create a microgap/interface located 1–2 mm below the gingival margin by moving the rough/smooth implant border of non-submerged implants to slightly below the crest of the alveolar bone. The apical part of the relatively smooth, machined titanium surface is placed subcrestally to accomplish a subgingivally located implant shoulder. However, there is no dearth evidence from a multitude of clinical studies that additional crestal bone loss can be attributed to relatively smooth machined titanium. It has therefore been opined that, in esthetic regions or areas of limited vertical bone height, the placement of the rough/smooth implant border into a subcrestal location is not biologically favorable. Based upon experimental data, the biologic width or the supracrestal attachment is largely affected by the changes in crestal bone height around dental implants. Thus, a submerged implant placement technique might also pose a threat to the health of peri-implant soft tissues leading to recession thereby compromising the esthetics.

Background: Crestal bone level surrounding a dental implant is a dynamic structure due to bone remodeling and possible bone loss after implant loading. The study aims to compare the bone changes around single implants 1.8 mm machined collar soft tissue level versus bone level implant with nonmachined collar all roughed surface placed either in the maxilla or the mandible at 3–6 years. Materials and methods: A randomized controlled clinical trial was conducted among 100 patients needing dental implants. The participants were randomly divided into two study groups; group 1 received bone level implants. Group 2 received soft tissue level implants (1.8 mm machined surface). After three months of the healing period, the implants were loaded with a screw-retained single crown. The initial measurement was done at three years and repeat measurements were recorded after six years. Statistical analysis was performed by paired sample t-test and independent sample t-test. Statistical significance was considered at α = 0.05.

Results: The bone measurements for the soft tissue level implant at three years and six years were 0.556 ± 0.2742 mm and 1.172 ± 0.6128 mm, respectively while those for the bone level implant were 0.668 ± 0.3178 mm and 1.366 ± 0.8163 mm, respectively. The intragroup comparison revealed that there was a statistically significant rise in the measurement at the 6-year evaluation as compared to the three-year evaluation for both the type of implants. However, the intergroup comparison revealed no statistically significant difference in the bone measurement between the two implant types at both three years and 6-year measurements.

Conclusion: There is no difference in the bone changes around single implants placed either at soft tissue level or at the bone level. Clinical significance: The choice of implant should be based on the esthetic requirement of the patient as well as the clinician’s expertise. Keywords: Crestal bone, Microgap, Submerged implant.

ABSTRACT

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Materials and Methods
Patients referred to the King Abdulaziz University hospital for single-implant treatment were considered for the study based on the following criteria:

Inclusion Criteria
Non-smoker with an age range of 18–45 years. The subject should have one missing tooth indicated for replacement by a dental implant and no bone augmentation needed. Adequate oral hygiene and a minimum of 2 mm thickness of gingival tissue present at the implant site.

Exclusion Criteria
Any subject with ASA score III or presence of clinically active periodontal disease as expressed by probing pocket depths and attachment loss. Presence of periapical lesions or any other bone abnormalities. History of radiotherapy to the head and neck region or uncontrolled diabetes.

Study Design
A randomized controlled clinical trial was approved by the Medical Ethical Committee of King Abdulaziz University. Patients were recruited between 2008 and 2014. Written informed consent was obtained from all eligible patients before enrolment. One hundred patients (50 males and 50 females), age ranged between 18 years and 45 years were recruited for the study.

Study Groups
Block randomization with an allocation ratio of 1:1 was used for assigning the patients to the two study groups. Block randomization was used to ensure equal gender distribution amongst the study groups.

• Group 1: 50 patients (25 males and 25 females) received bone level implants.
• Group 2: 50 patients (25 males and 25 females) received soft tissue level implants (1.8 mm machined surface).

Intervention Procedure
The extraction sites were allowed to heal for three months after tooth removal before placing the implants. One day before implant surgery, patients were instructed to start taking antibiotics (amoxicillin 500 mg, three times daily for seven days or clindamycin 300 mg, four times daily for seven days in case of amoxicillin allergy) and use a 0.2% chlorhexidine mouthwash (two times daily for seven days) for oral disinfection. Ibuprofen 600 mg twice daily was given as analgesic for three days. Group 1 received bone level implants. All the implants platform were surgically placed flush with the crestal bone level. After three months of the healing period, the implants were loaded with a screw-retained single crown. Group 2 received soft tissue level implants (1.8 mm machined surface). The border of the machined-rough surface was placed flush with the crestal bone leaving 1.8 mm of the machined collar coronal to the crestal bone. A surgical guide was used with all implants in both groups to be loaded axially. All the soft tissue level implants were loaded with a screw-retained single crown. All surgical procedures were performed by a single periodontist. The prosthetic procedure was accomplished by one prosthodontist, and all the crowns were fabricated by a single dental technician.

Outcome Measure
The primary outcome of this study was to measure the crestal bone level proximal to the implant 3 years and 6 years after implant loading by appropriate radiographic images using XP holders to standardize the exposure.

Statistical Analysis
The data was entered in Microsoft Office, Excel worksheets and analyzed using software IBM statistical package for the social sciences (SPSS) version 20.0 (IBM Statistics, SPSS, Chicago, USA). The normality of the data was assessed using the Shapiro–Wilks test while Levene’s test for equality of error variances was used to analyze the homogeneity of error variances. Descriptive statistics were calculated. Independent sample t-test was used for comparison of crestal bone level measurements proximal to the implant 3 years and 6 years after implant placement and loading with a single screw-retained crown. Paired-sample t-tests were employed to evaluate intragroup differences. Statistical significance was determined at α = 0.05.

Results
The current randomized controlled trial was conducted to compare the bone changes around single implants 1.8 mm machined collar soft tissue level versus bone level implant with non-machined collar roughened surface among hundred participants with mean age 29.35 ± 7.11 years.

The bone measurements for the soft tissue level implant at 3 years and 6 years was 0.556 ± 0.2742 mm and 1.172 ± 0.6128 mm, respectively. The bone measurements for the bone level implant at 3 years and 6 years was 0.668 ± 0.3178 mm and 1.366 ± 0.8163 mm, respectively.

Intragroup comparison crestal bone level measurements proximal to the implant revealed that there was a statistically significant rise in the measurement at the 6-year evaluation as compared to the three-year evaluation for both the type of implants (Table 1). However, the intergroup comparison revealed no statistically significant difference in the bone measurement between the two implant types both at 3-year and 6-year measurements (Table 2).

Discussion
The study was conducted to evaluate the effect of having the microgap at the same level with the crestal bone or placing it 1.8 mm coronally by using soft tissue level implant, which has 1.8 mm of machined surface at the platform. However, there was no difference observed in the bone changes around single implants placed either

Table 1: Intragroup comparison crestal bone level measurements proximal to the implant 3 years and 6 years after implant placement

| Implant type       | Group  | N   | Mean ± SD  | t value | p value |
|--------------------|--------|-----|------------|---------|---------|
| Soft tissue level  | 3 years| 50  | 0.556 ± 0.2742 | −6.497  | 0.000   |
|                    | 6 years| 50  | 1.172 ± 0.6128 |         |         |
| Implant bone level | 3 years| 50  | 0.668 ± 0.3178 | −6.139  | 0.000   |
|                    | 6 years| 50  | 1.366 ± 0.8163 |         |         |
The amount of bone loss is determined supra to the crestal bone in a study by Cochran et al.21,22 Hermann et al. compared the one-piece implant system placed in canine with 2.8 mm machined collar to implant roughened with a nonmachined collar placed at the different level of alveolar ridges under unloaded conditions for six months. The result was less bone loss of 0.4 mm of the roughened collar, while 0.69 mm in 2.8 mm machined collar when both implants were placed at the same level.20 The further study analyzed histologically by Hermann et al. to support Alomrani compared machined collar and nonmachined collar implant placed on different levels in relation to the crestal bone. It concluded that crestal bone loss could be significantly reduced when placing a completely roughened nonmachined collar implant 1 mm above the crestal bone, while the machined collar implant exhibited more bone loss when placed at the same level as a nonmachined collar.24

The results of this study indicate that there is no additional crestal bone loss when placing implants with their rough/smooth implant border at the bone crest level when compared to a bone level implant 6 years postimplant placement and loading. This may be of importance in areas of esthetic concern along with the tissue health of the patients while choosing multiple implants connected with rigid connector and bone loss measurement with cone beam computed tomography CBCT.

**CONCLUSION**

It can be concluded that there is no difference in the bone changes around single implants for both design soft tissue level or bone level after 6 years of loading if the rough surface was placed flush with the crestal bone.

**CLINICAL SIGNIFICANCE**

Both designs have almost the same effect on the crestal bone level if strict implant placement and loading protocol is followed. Therefore, the clinician must take into consideration the esthetic concern along with the tissue health of the patients while choosing the implant systems for restoration.

**Future Study Design**

Axial loading with straight abutments was selected in our study. We would like to investigate the effect of nonaxial loading on crestal bone loss by placing an angulated abutment and compare it to the axial loading.

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