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# EFFECT OF ABUTMENT CONNECTION TYPE ON CRESTAL BONE RESORPTION AROUND IMPLANTS

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## ABSTRACT

**Purpose:** To test the hypothesis that the type of implant abutment connection configurations may influence the stresses and strains induced in the peri-implant area and affect crestal bone resorption around implants.

**Materials and Methods:** Sixty implants were inserted in forty two male patients (mean age 44 years old) and randomly divided into two groups according to internal hexagon (**Legacy™ 2, Implant Direct, USA)** and conical hybrid connection (**AnyRidge; MEGAGEN, Seoul, Korea**). Abutments were connected and restoration delivered four months after implants placement. Each case was evaluated radiographically and linear measurements of bone resorption were made from the implant's platform to the first point of bone-to-implant contact at baseline (time of restoration delivery), 6,12, 24 and 36 months later. Data were collected, tabulated and statistically analyzed with repeated measures two way ANOVA test.

**Results:** No statistical significant differences were found between the tested groups ($P \geq 0.05$). Peri-implant bone changes demonstrated mean bone loss of ($1.17 \pm 0.58$) for Group (1) and ($1.12 \pm 0.53$) for Group (2) after three years of insertion.

**Conclusions**: Despite the limitations of this controlled clinical trial and although no statistical significant differences were found, conical hybrid implant abutment connection showed less crestal bone resorption around implants than internal hexagon implant in short term evaluation.


**KEYWORDS**: Implant abutment, internal connection, conical hybrid, crestal bone resorption.

This study was conducted at faculty of dentistry, Tanta University, Egypt after the approval of the Ethics committee of the faculty.

## INTRODUCTION

While dental implants have made a significant impact on the dental profession all over the world; implant prosthodontics still present a challenge to the restorative clinicians. One of the features that have been for a long time the object of debate among implant systems is the configuration of the connecting part that allows the abutment to be attached to the implants. From the beginning, the

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Branemark system was characterized by an external hexagon[1]; this external hexagon design has served well over the years and it has been incorporated in a number of competing systems.

However, it has some drawbacks; as the external hexagon allows the existence of a micro gap in the implant abutment interface. Besides, this system is less favorable for stress distribution and has lower stability which increases the stress over the abutment screw and micro-movements during loading when compared to internal connection[2,3].

Internal connections have been introduced to lower or eliminate mechanical complications and reduce stresses transferred to the crestal bone [4,5]. When analyzing the implant-abutment coupling of internal connecting systems, many differences have been described[6-9]. A primary question aroused: What is the impact of implant abutment configuration on crestal bone level changes? Since, unlike the external hexagon connection, the internal connection configurations adopted by different companies are not alike[10,11] .

In previous stress analysis study; the authors found that the stress distribution at the level of the implant abutment connection is strongly associated with the design characteristics of the interface, which may vary according to the manufacturer; Which in turn affect the magnitude of stress distribution in the bone surrounding the dental implants[12], while clinical follow up studies reveals conflicting results[11].

The philosophy of decreasing crestal bone loss around implants; particularly regarding the decision-making criteria for the abutment-implant connection configurations is still a topic of argument, so; the aim of this study was to test the hypothesis that implant-abutment configuration has no effect on crestal bone resorption around implants after three years of loading.

## MATERIALS AND METHODS

This study was carried out on forty two partially edentulous male patients, with a mean age of 44 years old. Patient's general health was evaluated by taking full medical history. Laboratory investigations included the Glycosylated Hemoglobin Test (HbA1c Test) to ensure that all selected patients were controlled with levels up to 7.0% and free from any other systemic diseases that might have an effect on implants osseointegration. Patients whose HbA1c level was above 8%, alcoholic, drug abuse, poor oral hygiene were excluded from this study.

Cone Beam CTs were taken for all patients to show the height and width of bone in the edentulous areas, the position of the mental foramen, maxillary sinuses, and inferior alveolar canal and to check for any clinically undetectable pathology or bone abnormality. An informed consent approved by the ethics committee was signed by each patient after discussing the treatment plan with them and prior to initiation of treatment.

Patients were randomly and equally distributed into two groups according to internal hexagon and conical hybrid connection: Group (1): were patients receiving internal hexagon implants **(Legacy™ 2, Implant Direct, USA),** while Group (2): were patients receiving conical hybrid connection implants **(AnyRidge; MEGAGEN, Seoul, Korea)** were placed surgically, left for three to six months, then re-exposed and impressions were taken using pick up impression copings then corresponding abutments were screwed into implants using digital torque gauge. Patients were recalled and the restorations were delivered. All patients were then scheduled for clinical and radiographic follow-up visits (**Figure 1and Figure 2**).

Patients were evaluated radiographically at baseline (restoration delivery) and at 6, 12, 24 and 36 months after restoration delivery as follows:

Periapical X-ray films were used to measure the marginal bone loss around the implants. The long cone paralleling technique using the Rinn XCP instrument **(Rinn Co. Dentsply division, York, PA, USA)** was used. It included the use of standardized periapical radiographs to detect changes in alveolar bone surrounding the implants during the follow-up period. The standardized periapical radiographs were taken by the Xerograph Coping Process holder with a personalized bite registration record, made from putty rubber base impression material for extension cone (35 cm) paralleling technique. Every X-ray film was inserted into a slot in the bite-block. To ensure accurate repositioning of the film every time the radiograph was taken, the putty rubber base impression material **(Express XT VPS, 3M ESPE AG, Germany)** was folded around the bite-block, then a bite registration was obtained for each film in closed mouth position, the putty bite-block with the occlusal registration was kept aside for the follow-up recall visits. Repeatable standardized periapical radiographs were made for each implant to measure the mesial and distal bone heights. The measurements were made from the base of the implant to the most coronal point of bone adjacent to the implant surface.

All radiographs were exposed using ultra speed periapical film **(Kodak, Paris, France)** with X-ray grid and X- ray unit set at 70 KV and 10 mA. With similar exposure times, the radiographs were developed under standardized condition using automatic process. The digital image was then saved in an uncompressed format on the patient file. The stored images of each patient were then interpreted at the end of the follow-up period.

The marginal bone loss measurements were made from the reference point to the lowest observed point of contact of the marginal bone with the fixture. The reference point for the fixture was the fixture–abutment interface. The distance was measured to the nearest 0.01 mm. These measurements were done using an analysis software program **(Adobe Photoshop, Adobe Systems Incorporated, San Jose, CA, USA)**. The actual implant length served as a standard to calculate the bone height, calculations were made according to the following formula:

**CBL = IL*BR/MIL**

Where **CBL** is the calculated bone resorption, **IL**: Actual implant length, **BR**: measured bone resorption (mean mesial and distal) and **MIL**: measured implant length.

**Data analysis:**

Radiographic data were tabulated for each individual and group. Summary statistics (mean, standard deviation) were calculated and also tabulated, data were statistically analyzed using repeated-measures ANOVA test at 0.05 significance level.

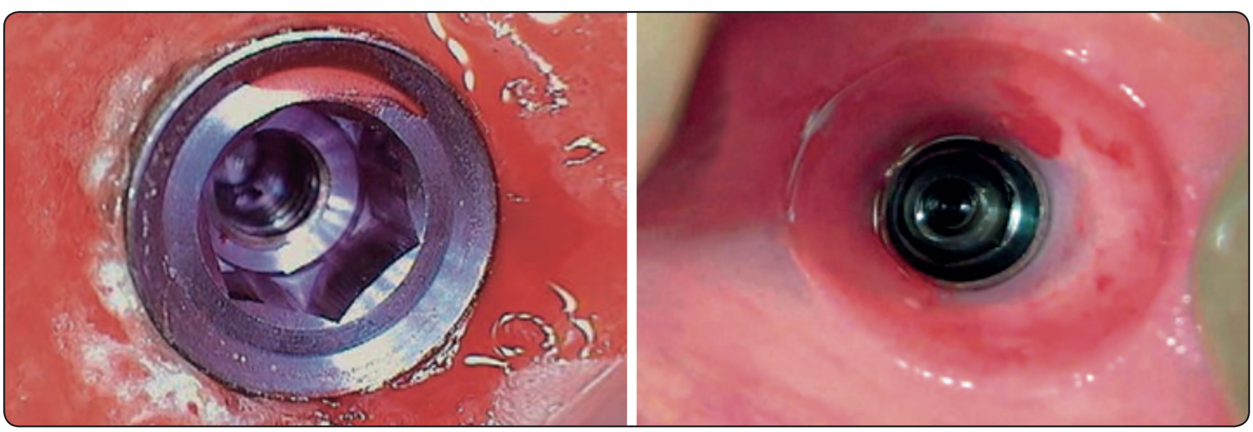
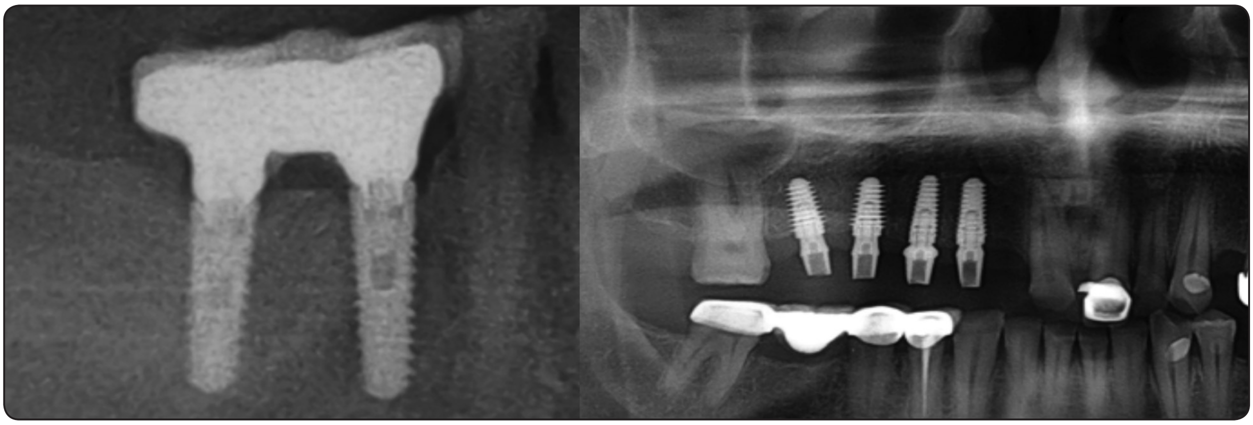


Fig. (1): Showing (A) Internal hex connection and (B) Conical Hybrid connection.



(A) Internal hex connection (B) Conical Hybrid connection.

Fig. (2): Showing Implants of both types at the loading stage

## RESULTS

Forty two patients were enrolled in this investigation. During the observation period, no implants were lost nor did fractures occur. Figure (3) shows the mean of the marginal bone loss measurement values at different periods of follow-up and Table (1) lists the results of the repeated-measures ANOVA analysis for marginal bone loss over time. On the initial examination after prosthesis insertion, mean ± standard deviation (SD) of marginal bone loss scores of group I patients was (0.81±0.24), while mean±standard deviation (SD) of marginal bone loss scores of group II patients was (0.79±0.22). During the follow-up period there was a non-significant statistical increase of the marginal bone loss scores (P 0.05 >) between the two groups.

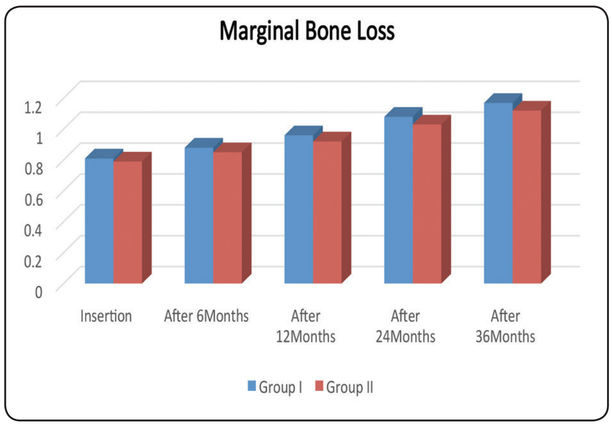



Fig. (3): Mean values of the marginal bone loss at different periods of follow up.

TABLE (1): Results of the repeated-measures ANOVA for marginal bone loss at different follow up periods.

| Marginal bone loss | Group I | | | Group II | | | RANOVA | |
|---|---|---|---|---|---|---|---|---|
| | Mean | ± | SD | Mean | ± | SD | F | P-value |
| Insertion | 0.81 | ± | 0.24 | 0.79 | ± | 0.22 | 1.54 | 0.452 |
| After 6 Months | 0.88 | ± | 0.31 | 0.85 | ± | 0.28 | | |
| After 12 Months | 0.96 | ± | 0.44 | 0.92 | ± | 0.35 | | |
| After 24 Months | 1.08 | ± | 0.53 | 1.03 | ± | 0.49 | | |
| After 36 Months | 1.17 | ± | 0.58 | 1.12 | ± | 0.53 | | |

***(*Significance: P < 0.05)***

## DISCUSSION

Dental implants have been widely accepted as a predictable and reliable tool for missing teeth replacement, but it is still necessary to ensure that the height of the peri-implant crestal bone is maintained[13].

**Albrektsson et al**[14], proposed that a dental implant can be considered successful if peri-implant crestal bone loss is less than 1.5 mm during the first year after implant placement and less than 0.2 mm annually thereafter and according to **Almeida et al**[15], once the osseointegration has been achieved, the stability between the implant and the connection system is responsible for the success of the prosthetic rehabilitation.

In the current study, commercially available implant systems with two types of implant abutment connections (internal hex and internal conical hybrid) was studied for their effects on the peri-implant crestal bone change during three years after implantation and prosthetic loading. Internal connection was selected because of previous recommendations that crestal bone level maintenance is more important around internal connections than external connections. Additionally, this connection type can be successfully indicated for fixed partial prostheses and overdenture planning, since it exhibits high mechanical stability[16].

Bone level measurements were calculated at the loading phase in this study to exclude factors that could hypothetically induced changes in crestal bone during healing period, including surgical trauma of the two surgical phases and peri-implantitis[17].

In this study there was no statistical significant difference between both groups, this matches the conclusions of previous studies[18,19] that the level of peri-implant crestal bone does not differ significantly through the study period among different implant–abutment connection designs and despite that the articles' authors stated that the number of samples and the follow-up period were insufficient (only 6 months after occlusal loading) and require further longer study periods.

On the other hand the study results are opposite to suggestions that the implant-abutment connection appears to have a significant factor on peri-implant crestal bone levels[12,20,21].

The non- significant differences between the study groups can be explained by previous conclusions that the internal hexagon reduced probability of micro-movement during loading similar to Morse taper design[22]. Also the conical design has high stability and tends to dissipate less stress to the abutment screw when compared with external and internal hexagon[3].

## CONCLUSIONS

Based on this study results and limitations and although no statistical significant differences were found, conical hybrid implant abutment connection showed less crestal bone resorption around implants than internal hexagon implant in short term evaluation.

### Conflict of interest:

The Authors declare that they have no conflict of interest, have full control of all primary data.

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