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Afr. J. Biomed. Res. Vol. 28(2s) (February 2025); 37 - 43
Research Article

A Comparative Evaluation of Crestal Bone Loss in Morse Taper and Internal Hexagonal Connections Implant - An In Vivo Study

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ABSTRACT
Oral rehabilitation has become increasingly important in dentistry. Currently dental implants are considered as the best option for treatment of partial or completely edentulous patients.Stability of peri-implant bone is a prerequisite for long-term aesthetic and function of implant-supported restoration. Nevertheless, dental implants are associated with some crestal bone remodelling[1] .The aim of the present study was to do comparative evaluation of the crestal bone loss between the two implant abutment connection designs i.e., the internal hexagonal and the morse taper. This study was undertaken in order to remove the dilemma from the mind of the concerned clinicians as to which is a better proposition in this regards.

Keywords: Crestal Bone, Edentulous, Hexagon, Implants, Morse, Peri -Implant

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Received: 06/01/2025 *Accepted: 12/01/2025*

DOI: https://doi.org/10.53555/AJBR.v28i2S.6690

INTRODUCTION

Various designs have been introduced in the field of implant dentistry. The implantabutment connections more commonly used today are screw-retained and canbe divided into two major groups: external and internal connections. The most widely used external connection is the "external hexagon". However, mechanical problems led to the growth of internal connections. [1,2]

Jokstad *et al*. noted the development of internal connections showing improved results regarding esthetic outcomes and mechanical stability. The common examples of the implant abutment connections are the internal hexagonal and the morse taper.[3,45, 6] . A unique design feature of the Morse taper implant- abutment connection is an internal joint design between two conical structures. This internally tapered design creates significant friction via the high propensity of parallelism between the two structures within the joint space.[5, 6]

The morse taper implant abutment connection is an internal joint designed between two conical structures, as suggested this design aligns the micro gap size to be further separated from the marginal bone.[7] In addition, this internally stable design allows for a narrower abutment platform abutment design that can be additionally combined with platform switching. The platform switching abutment design has shown clinically to reduce marginal bone loss and provide additional space for soft tissue development and maintenance over longer follow-up studies.[4] With the introduction of Morse taper implant which is a cone in cone having a cold welded interface. It has been seen that the crestal bone loss around this implant interface seems to be lesser than the internal hexagonal implant. Moreover, the literature indicates that the periimplant bone strain vary significantly with the type of implant – abutment connection. The conical interface of morse taper connections helps in dissipating the forces to the fixture.[7,8,9]

Since there is still a limited body of knowledge concerning the differences in the crestal bone loss of different implant-abutment assemblies. To the best of our knowledge, there are no randomised controlled trials (RCTs) that evaluated clinical and radiographic parameters related to bone remodelling around implants using internal hexagon and morse taper connection, but equal on all other implant- and patient-related parameters.

The aim of the present study was to do comparative evaluation of the crestal bone loss between the two implant abutment connection designs i.e., the internal hexagonal and the morse taper. This study was undertaken in order to remove the dilemma from the mind of the concerned clinicians as to which is a better proposition in this regards.

MATERIALS AND METHODS

A total of 20 patients were chosen for the study which requires placement of implants in the mandibular posterior missing tooth region requiring one implant supported prosthesis. Radiographic assessment of available bone was done after loading 3 and 9 months based on Intra Oral Periapical Radiographs and evaluated for the crestal bone level relative to the implant platform. Radiographs revealed mesiodistal and apicocoronal dimensions of the available bone at the implant site as well as the trabecular pattern of the bone

Pre-fixture placement Intra-oral peri apical radiographs (IOPA): A screening procedure.**Post fixture placement** A radiographic follow up was conducted during the following periods. 3 months and 9 months

Each radiographic examination included and measurements taken from reference points.

The clinical examination was done to diagnose oral infections in the form of periodontal or periapical infection. Implant sites were seen for gingival architecture, adjacent tooth morphology and osseous architecture. Pretreatment planning included preparation of study and working cast models to record occlusal relationships as well as for wax up of the proposed prosthesis. Bone width gauge was used for the assessment of buccolingual thickness of bone, this was done to select the diameter and the length of the implant. Subsequently, the diagnostic wax up of the cast was completed

Selection of the implant

The implant size was selected both in width and length according to the bone mapping and with the help of radiographic evaluation after taking into account the magnification error with the help of radiographic template. Having a residual bone height of atleast 10 mm and thickness of atleast 4 .75 mm. The internal hex and morse taper implants were used with platform switching.The implant used in this study was of **DENTSPLY.**

OBSERVATION AND RESULTS

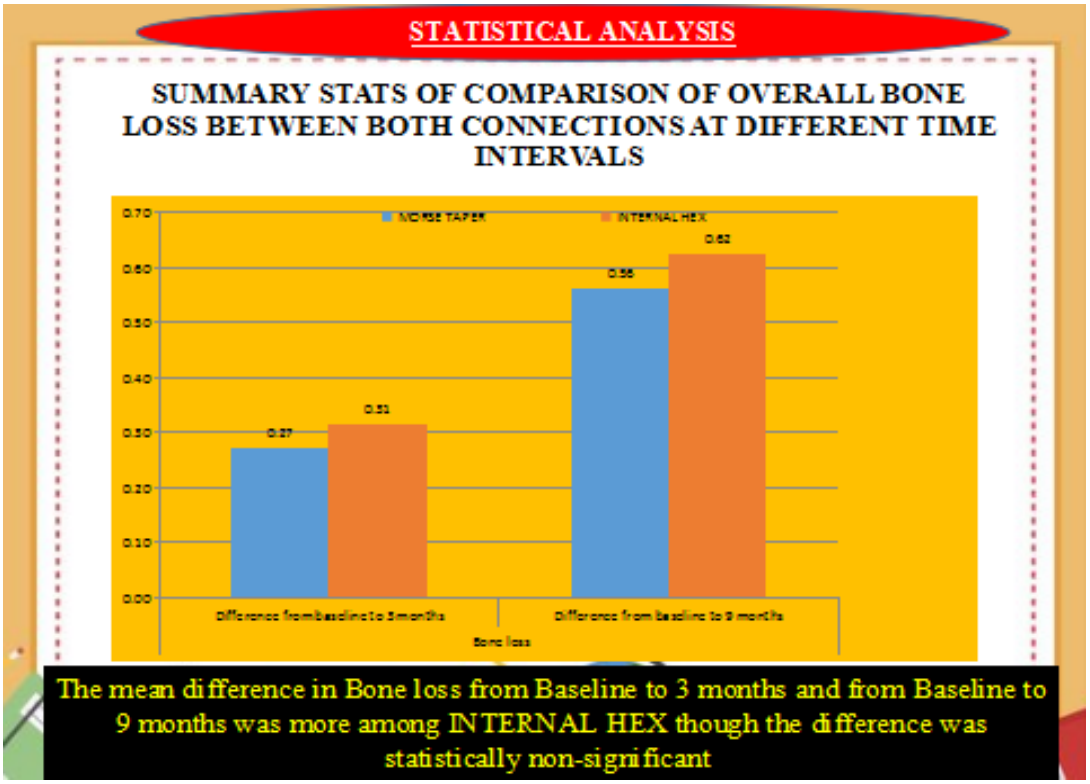
20 patients were consecutively enrolled in the Study, 10 patients in the Morse taper group and 10 patients in the internal hexagonal group. All patients were treated according to the allocated interventions. Patients were recruited and the follow-up focused on the time 3 and 9 months after loading and data was tabulated and analysed statistically. The statistical software namely SPSS 25.0 was used to analysis of the data and Microsoft excel have been used to generate charts, graphs and tables, etc

At implant placement there was no statistically significant difference between the two treatment groups (P = 1.000). Bone levels were 0.00±0.00 mm (95% CI - 0.000.00) for the MORSE TAPER and were 0.00±0.00mm (95% CI -0.00-0.00) for the internal hexagonal group. There was no statistically significant (P = 1.000) difference after loading between the two groups for peri-implant bone levels. Both treatment groups shows statistically significant marginal peri-

implant bone loss at 9 month post-loading: $P = 0.347$. The implants in the morse taper group lost an average of 0.56mm of peri-implant bone while implants in the internal hexagonal group lost about 0.62mm.

The results obtained from our study showed the marginal bone loss in Morse taper and internal hexagonal connection that has taken place mesially and distally from baseline to 3rd month postoperatively were 0.14 and 0.16 mm mesially respectively and 0.14 and 0.15 mm distally respectively, whereas the marginal bone loss that has occurred at mesial and distal sides from baseline

to 9th month was 0.28 and 0.32 mm mesially respectively and 0.28 and 0.30 mm distally respectively. The Mean Marginal bone loss in morse taper connection from baseline to 9th month at Mesial=0.28 mm. The Mean Marginal bone loss in internal hexagonal connection from baseline to 9th month at Distal =0.32 mm.



DISCUSSION

The success of dental implant is based on the presence of good amount and quality of bone around the implants, especially the crestal bone.[1]

This study aimed to compare two implants with different prosthetic interfaces: morse taper v/s internal hexagonal connections. In order to do an evaluation, only the type of connection was different, all other implant characteristics remained the same. At 9 months post loading, no statistically significant differences were observed; the number of complications was low and similar for both types. The implants in the morse taper group lost an average of 0.28 mm of peri-implant bone while implants in the internal hexagonal group lost about 0.32 mm. Due to the relatively small sample size of this study and moreover, the short follow-up (only 9 months after loading), it would be wrong to conclude that there are no differences between the two connection types. However no statistically or clinically significant differences were observed 9 months after loading. For more reliable conclusions longer followups are required. Cannata et al debated that implant-abutment connection designs can induce different degrees of crestal bone remodelling, after being subjected to functional loading. And showed that no statistically significant difference is observed in between conical and internal hexagonal connections but this study hypothesised that conical connection showed less crestal bone loss than internal hexagonal connection like stated in our study.1 Pozzi et al showed that marginal bone changes (loss) were statistically significantly different, with good results for the internal conical connection then external hexagonal connection.[7,9] Conversely Esposito et al comparingtapered titanium screw-shaped implants exhibiting external or internal connection did not observe any significant differences or even trends 5 years after loading. [10] D'Ercole et al showed lower bacterial contamination in cone morse taper than internal hexagonal connection. The lower bacterial infiltration rate favours to lower the inflammatory process thus reduces the crestal bone loss and seems less in morse taper than internal hexagonal connection. [53] Similar findings were observed in our study which also favours the Morse taper connection over internal hexagonal connection. Macedo Jose paulo et al showed Morse taper implant system with platform switching

provides a more effective relationship between the implant and intermediary abutment for prolonged healing and health within the surrounding hard and soft tissues. The studies reviewed that of the implant abutment systems, the Morse taper system with the use of a smaller abutment diameter has the following advantages:conserves more of the peri-implant bone,provide stabilization to the soft tissues, reduces the microgap size found in the abutment-implant connection, and proper geometry for narrower mesio-distal edentulous spaces.[5] .The benefits on Morse taper implants and platform switching abutment are listed as follows:

Morse taper design showed a marked decrease in the microgap size found within the abutment-implant joint, thus reducing biofilm accumulation.

Morse taper implants revealed less peri-implantitis when placed supracrestally. Reduced resorption of crestal bone.

The biological width formation takes place apical and laterally around the abutment and the implant's horizontal platform.

The smaller abutment diameter in proportion to the implant diameter, naturally augments for increased thickness of the connective soft tissue around the abutment.

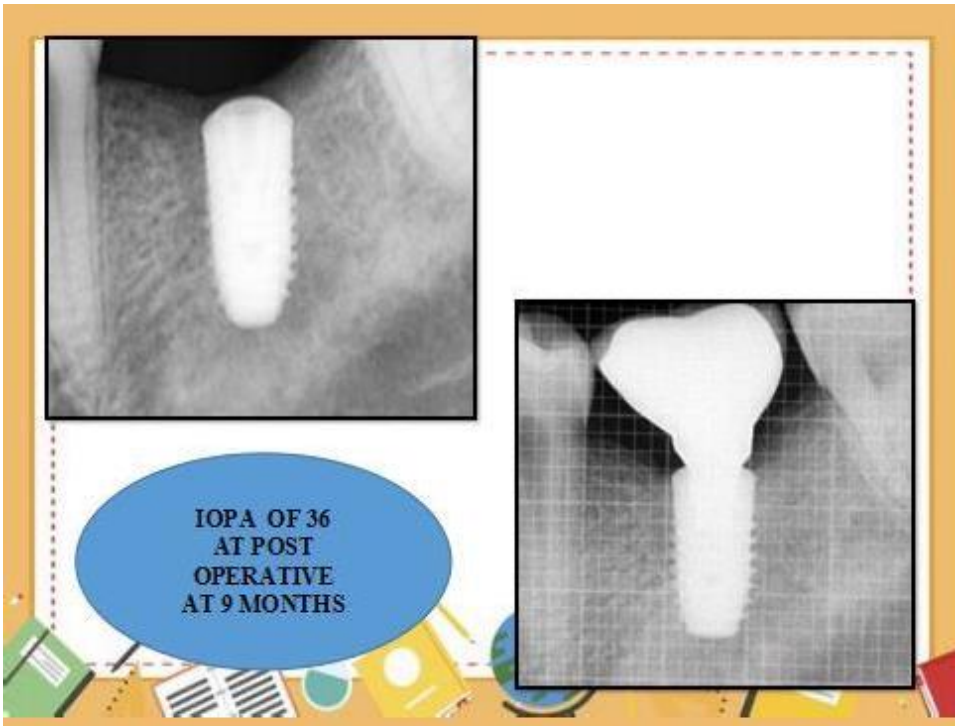
Torque stability and maintenance of the loaded contacting surface is high due to the biconical Morse system established between the implant and the intermediate screw.

The Morse tapered machined connection design was associated with decreased micro-movements during distribution of occlusal forces on the implant.

Morse taper implant-abutment design eliminates the need for additional screw retained connections associated with other implant-abutment designs.

Roberto S Pessoa et al.[9] Mechanical micro movements have been found to be extremely low in Morse tapered Connections than external hexagonal configurationand the taper connection have different mechanical principles of function. Thus lead to less bone loss in morse taper connection. Devaraju et al. [11] concluded that, biomechanically, Morse taper connections showed better results against external and internal connections,because of their geometry, as they were able to redistribute the forces and stresses evenly through the implant body, thereby ensuring reduced deleterious forces to the surrounding bone. When compared between other internal abutment connections, Morse tapered connections distributed stress better at the alveolar bone level and provide better resistance to bacterial leakage. Morse taper connections with platform switching showed reduced inflammation and bone loss. Which is in synchronization with our study. Quaresma *et al*. in 2008 showed that the stress is better distributed at the alveolar bone but more concentrated at the abutment itself in Morse taper implant. Whereas internal hex abutments produce greater stresses on the alveolar bone and the prosthesis but lower stresses onthe abutment system.[54]Which is in synchronization with our study. Shadid et al.[12]concluded that morse taper connection were promising then other connections. Christian M. Schmitt et al.[13] concluded that conical connection (morse taper) showed less bone loss. The results obtained from our study showed the marginal bone loss in Morse taper and internal hexagonal connection that has taken place mesially and distally from baseline to 3rd month postoperatively were 0.14 and 0.16 mm mesially respectively and 0.14 and 0.15 mm distally respectively, whereas the marginal bone loss that has occurred at mesial and distal sides from baseline to 9th month was 0.28 and 0.32 mm mesially respectively and 0.28 and 0.30 mm distally respectively. The Mean Marginal bone loss in morse taper connection from baseline to 9th month at Mesial=0.28 mm. The Mean Marginal bone loss in internal hexagonal connection from baseline to 9th month at Distal =0.32

mm. These were statistically found to be highly significant and were in accordance to the study conducted by **Cannata et al. (2017)**. Actually, according to the findings of our study, operators can choose the internal connection type according to their preferences. It could be also hypothesised that morse taper connections are more user-friendly for single implants or 2-unit implant supported prostheses. On the contrary, it may be that in the presence of multiple implants, the internal hex connection, going less deeply into the implant, could be more indicated to avoid the risk of impression distortion. However, these are simply hypotheses that need to be verified in further studies. There are no other published studies comparing morse taper versus internal hex connections comparing crestal bone loss, so meaningful comparisons with other similar studies cannot be made at the present stage. The major limitations of this study were the small sample size. Both implant types were tested under real clinical conditions and the patient inclusion criteria were rather broad, therefore the results of the present trial can be specified to patients having similar features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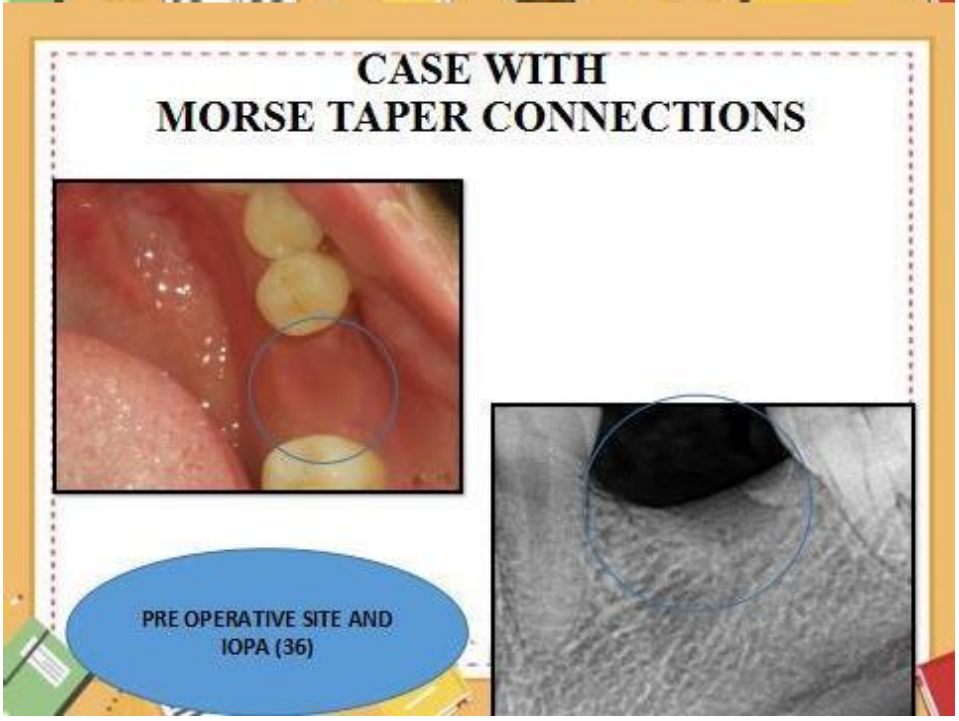
CASE WITH
MORSE TAPER CONNECTIONS
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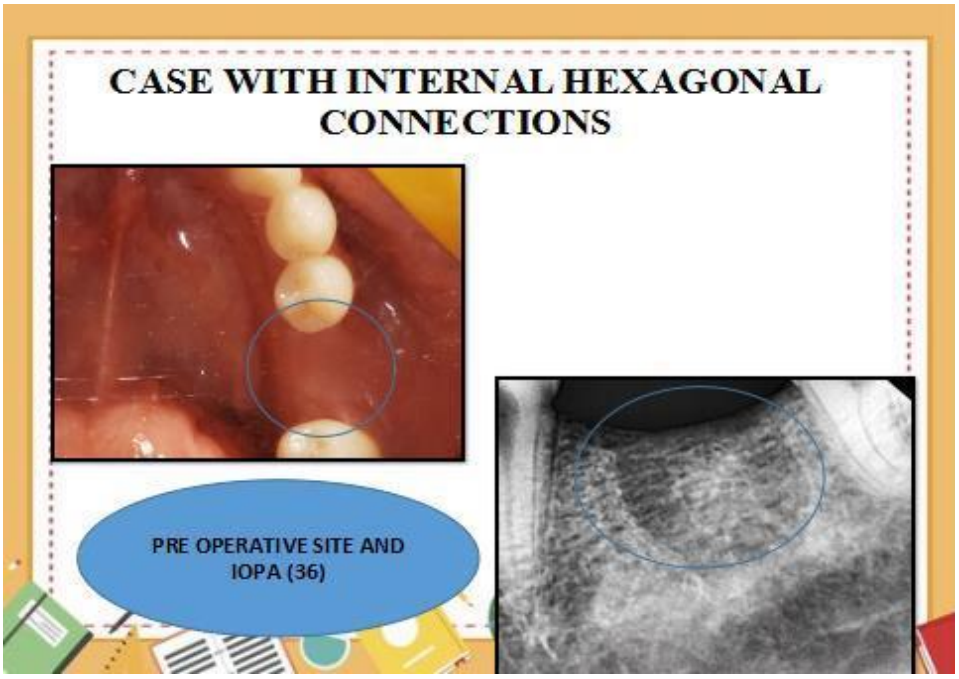

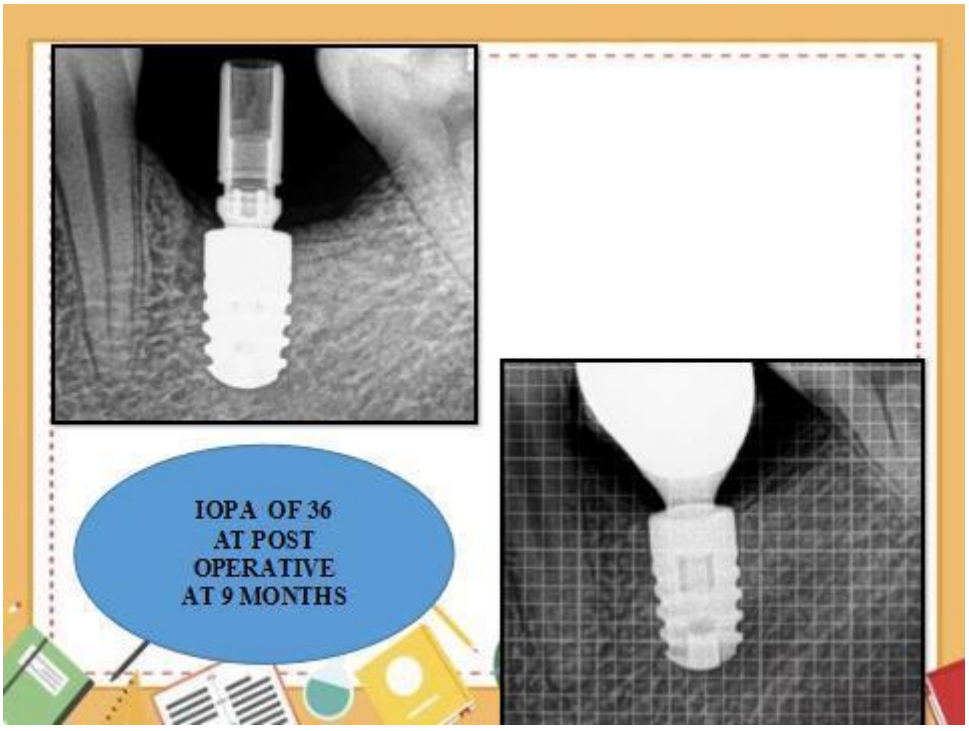

SUMMARY AND CONCLUSION

The Morse taper system has the following advantages: Preserves more of the peri implant bone, stabilizes more of the soft tissues, reduces the microgap size found in the abutment-implant connection, and proper geometry for narrower mesiodistal edentulous spaces.

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