STRESS ANALYSIS ON THE BONE AROUND FIVE DIFFERENT DENTAL IMPLANTS

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Abstract- **Implantology has a widespread application in dental cases these days. Although the life of this practice is short, there has been considerable progress in this field and many research laboratories and production sites have been developed in this regard. There are various types of implants in the market, and there is a need to study their features to find out the advantages and disadvantages of them and choose the appropriate implant in each case. One major research is the study of stress distribution on the bone around the implant, which is an effective criterion in osseointegration. In this paper, stress analysis has been conducted on the bone by applying finite element method. A comparison has been performed among different models of dental implant fixtures.**
Keywords- **Dental Implant, Root Form, Cylinder Form, Step Form, Hollow Basket Form**

I. INTRODUCTION

Various types of dental implants are present in the market; each design is based on some widespread research to recognize the criteria, which are important for its success. [1]

Since the bone-implant interface is an important area, in this paper finite element method has been used to compare the stress distribution on bone in case of different implants of Threaded Form, Cylinder Form, Step Form, Hollow Basket Form, and Root Form. The stress distribution has been discussed in each case.

In accordance with the results, the implants with the Root Form fixtures are much better in experiencing the stress. The distribution of stress on the bone is more uniform in this case. [2]

II. METHODOLOGY

In this study five models with Threaded Form, Cylinder Form, Step Form, and Root Form fixtures (Fig. 1) are compared. Since the aim is just the comparison, the dimensions are chosen the same to have better results.

The surrounding bone is considered a block with a width of 15 (millimeter) in BL direction and a length of 30 in ML direction. The implants are inserted in the bone with 0.5 (millimeters) of them standing out. The thickness of cortical bone is considered to be 0.5 (mm) in the upper border and 1 (mm) in the lower border. The fixtures are all with the same dimensions of 4 (mm) in diameter and 10 (mm) height.

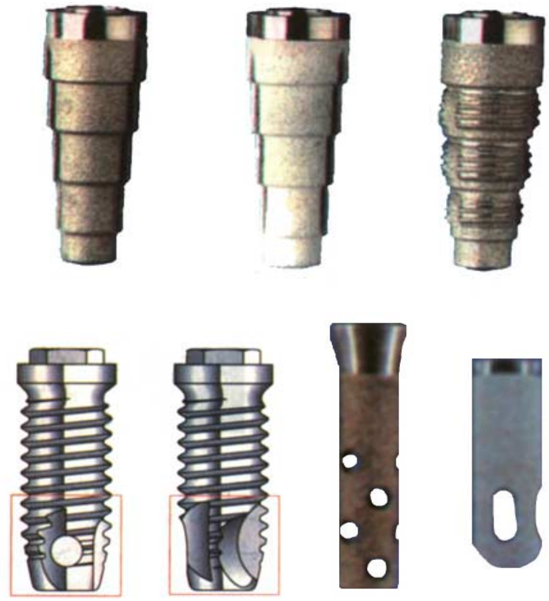

Fig. 1 Five different models of fixtures, upper row Step Form, lower row, 2 Threaded Forms, Cylinder Form, and Hollow Basket Form

Nisa II software has been chosen for the analysis and the models are constructed as two-dimensional models with the plane stress elements. The dimensions of the models are according to Table 1. The load is compressive and has been applied under the angles of 0, 10, 15, 20, 25, and 30 (degrees) with the normal line respectively. The amount of load is considered equal to 160 Newtons. [3,4]

TABLE I
The dimensions of implants

Type	Diameter	Length	Pitch
Cylinder Form	4 mm	10 mm	-
Threaded From	4 mm	10 mm	1.5 mm
Step Form	4 mm	10 mm	-
Hollow Basket	4 mm	10 mm	-
Root Form	4 mm	10 mm	-

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Abstract

Subject Terms

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III. Results

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The FEA output for the Root Form fixture is plotted in Fig. 3. Fig. 2 represents the points, which are selected to perform the stress analysis. Similar plots like Fig. 3 have been obtained for four other forms of fixtures, of course with different stress distribution patterns. The other patterns are not shown to save the space on the paper.

In all models the peak stress happens on the upper corner of bone-implant interface. The amount of this maximum stress has been calculated and the results are represented as the following curves in Fig. 4.

IV. Discussion and Conclusion

According to the values of von mises stress it can be observed that the Root Form fixtures results in a better stress distribution in the surrounding bone.

Fig. 5 compares the maximum stresses in the implants under different angles of loading. It can be observed from the curve that as a result of increasing the angle of load with the normal line, the amount of the transferred stress increases, which is due to the flexural stress caused as a result of bending moment.

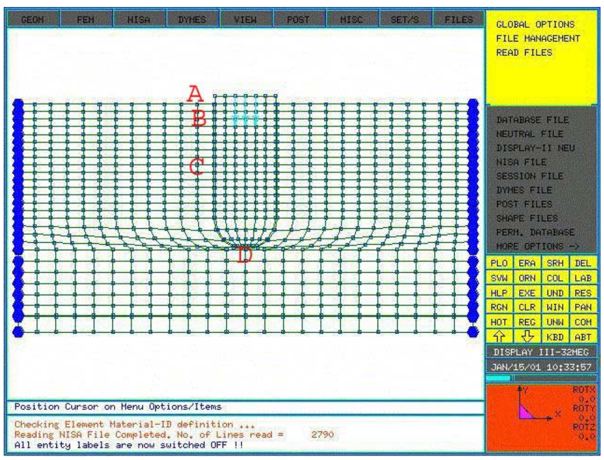

Fig. 2 Stress distribution in the Threaded Form fixture

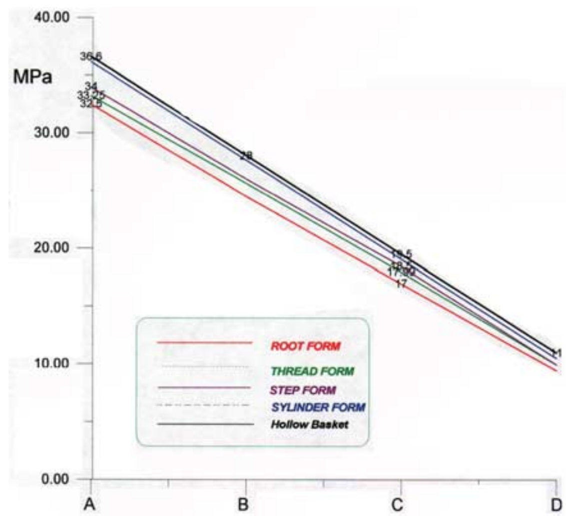

Fig.4 Comparison of stresses for different models

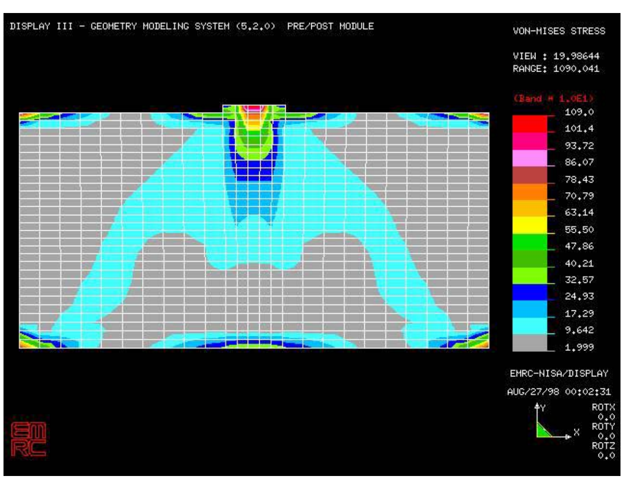

Fig. 3 Stress distribution in the Root Form fixture

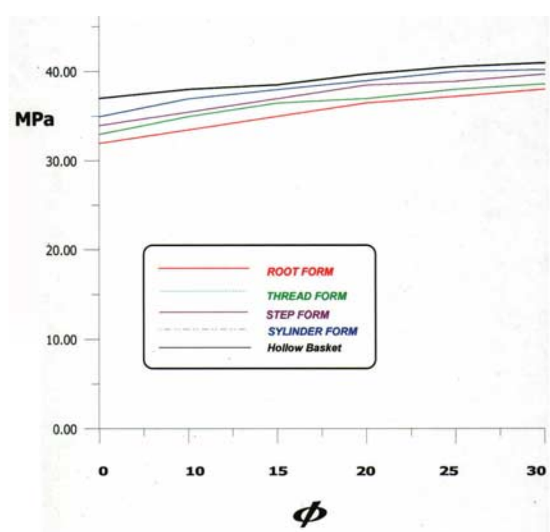

Fig. 5 Comparison of peak stresses versus the angle of load with the normal line

In this curve still the Root Form fixture has a better performance than the other form.

The Threaded Form fixture also results in a very good stress distribution, hence as a result of the thread sharp edge; some stress concentration exists at its origin. This implant, still transfer less stress to the bone than the two other models, because of the large interface surface with bone.

The two other models come after the Threaded Form.

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