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Influence of Thread Design for Primary Stability

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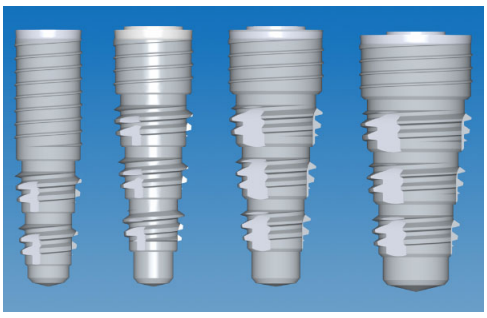
Introduction

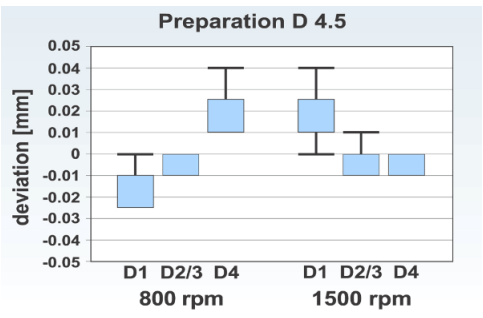
Immediate loading has become one of the most interesting topics in clinical research, since it can result in increased patient acceptance and reduce treatment time and management problems. Favourable results with different clinical procedures are only shown in case presentations. All authors claim to gain a maximum of primary stability with the surgical and prosthetic procedures applied.
The aim of this in vitro study was to evaluate the precision of osteotomies by using the same drills in various bone qualities and at different speeds. In addition, the insertion torque as a factor for primary stability was determined by various thread designs.

Material and Methods

For the evaluation of the precision of the receptor site each cavity was checked with a special set of calibrated pins. Placing the smallest diameter followed by the next larger diameter was determined, when the according pin was placed with a light friction. Each measurement was performed ten times.
The primary stability was determined by the measurement of the insertion torque. After each half turn the value was documented by utilizing the torque instrument (15 BTG-N; Tohnichi, Japan). Measurements were performed with the stepped cylinder FRIALIT®-2 Stepped Screw Synchro and the cylindrical stepped prototype Phoenix-Implant. The thread profile was modified between 0.1 and 0.5 mm with the same pitch.

Implant Site Preparation





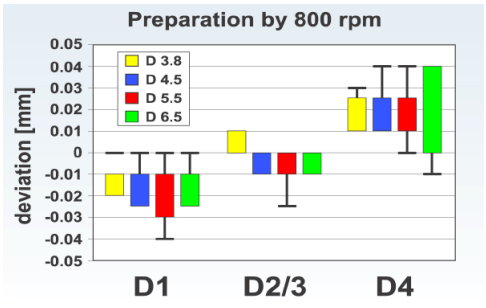


Fig. 1a-c: Preparing the receptor site with stepped burs for the diameters D3.8, D4.5, D5.5 and D6.5 in various bone qualities (D1 Bone type 1, D2/3 Bone type 2 & 3, D4 Bone type 4) and different speed of 800 and 1,500 rpm to determine the precision of the prepared implant site at the crestal level.

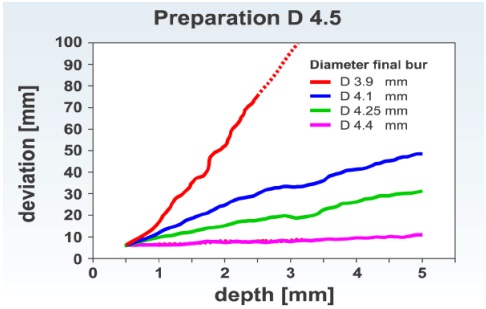
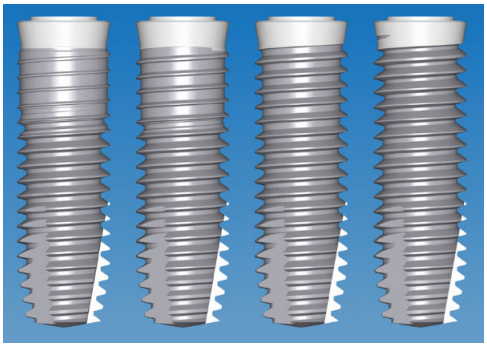
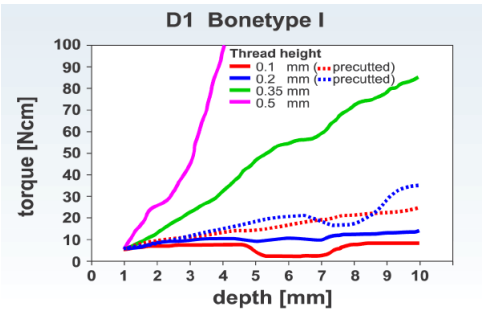


Fig. 1d: Insertion torque of self tapping implants with thread height 0.35 mm with various diameters of receptor site

Various Thread Designs





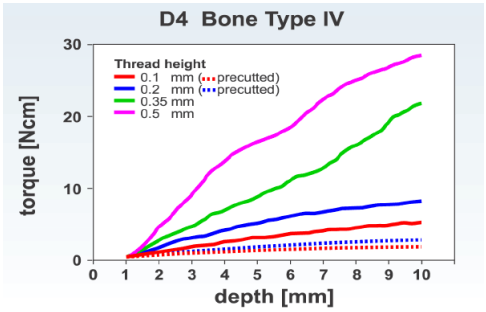
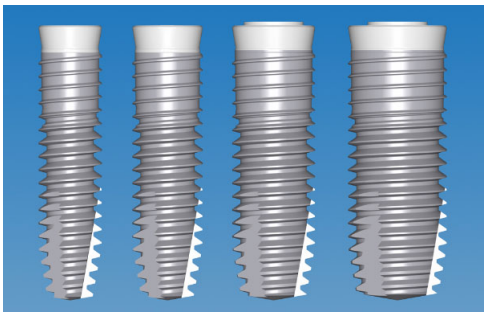


Fig. 2a-c: Insertion torque of self tapping implants with various thread heights between 0.1 and 0.5 mm in bone type 1 and type IV. The receptor sites for thread height 0.1 and 0.2 mm were also precutted by a thread former.

Different Diameters



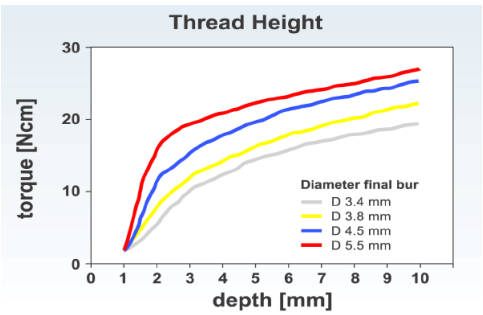


Fig. 3a-b: Insertion torque of self tapping implants with various diameters between 3.4 and 5.5 mm. Torque only measured for the thread area with a height of 0.35 mm.

Combination of Thread Design

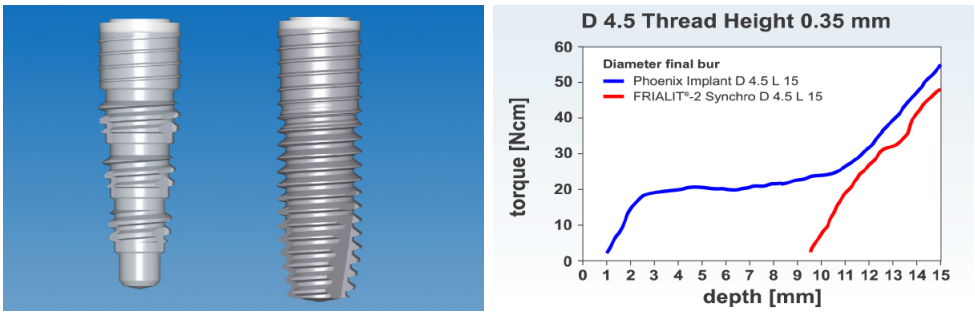


Fig. 4a-b: Insertion torque according to depth of implant placement by a cylindrical and a stepped designed implant with a combination of threads with a thread height of 0.1 and 0.35 mm.

Summary

In cortical bone type I, the highest primary stability was achieved with a precut thread and a low thread height of 0.1 or 0.2 mm. In bone type III or I, 0.3 mm to 0.5 mm self-tapping threads provided the best results. Due to the difficult evaluation of the exact bone quality between type II and type III bone, a combination of the two thread heights seems to be optimal to ensure sufficient primary stability. Stepped designed implants have the advantage of a long intial insertion depth without the need for tapping. Cylindrical implants achieve primary stability only after several insertion turns.

Discussion

Self tapping threads require sufficient space for the prepared bone. Consequently, the thread design determines the size of the final osteotomy. The precision of the implant sites varies according to bone quality and the drilling speed. While better results are achieved by preparing bone of density type I with 800 rpm, the best results were obtained by preparing bone of density type IV with a higher speed of 1,500 rpm.
The cutting depth of the thread determines the friction of the implant in the bone. In hard bone the friction may result in a very high torque which can damage the bone by heat or high compression. In soft bone low thread heights show less stabilization due to limited gearing.
A precut thread in soft bone shows no stability due to the small mechanical friction and the risk of damaging and re-cutting the thread. The space between the threads must be large enough for a mechanically stable bone situation.
In dense bone especially with wide body implants the torque becomes very high due to the larger friction of the increased surface and the precision of the prepared receptor site. The natural elasticity shows a compression of the cavity. For an appropriate insertion torque the additional use of cortical burs is necessary.

Literature

- Brunski J.B. Biomechanical factors affecting the bone-dental implant interface: Review paper. Clin Mater 1992; 10:153-201
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This Poster was submitted by Dr. Jörg Neugebauer.

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Poster Faksimile:

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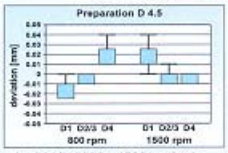

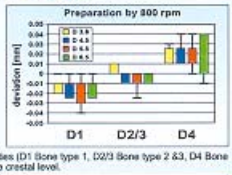

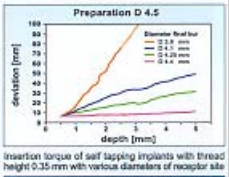

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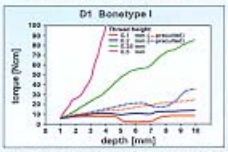

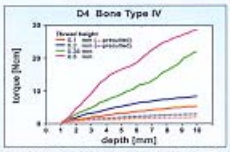

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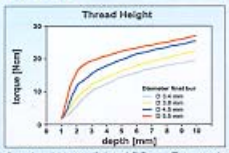

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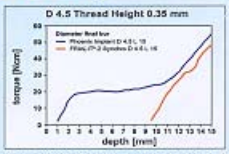

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