

## Insertion Torque Measurements During Placement of Neoss Implants

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Luca Pagliani<sup>1</sup>, Lars Sennerby<sup>2</sup>, Peter Andersson<sup>3</sup>, Damiano Verrocchi<sup>3</sup>, Neil Meredith<sup>4</sup>

<sup>1</sup>Private Practice, Milano and Legnano, Italy

<sup>2</sup>Dept Biomaterials, Inst Clinical Sciences, Sahlgrenska Academy, Gothenburg University, Sweden

<sup>3</sup>Private Practice, Fiera di Primiero and Feltre, Italy

<sup>4</sup>Bristol Dental Hospital and University, Bristol, UK

*This clinical study demonstrates that the Neoss implant design develops continuously increasing insertion torque (IT) during placement; as expected for a tapered implant design. This indicates that the total implant length laterally compresses the adjacent bone, providing firm primary stability of the implant. Moreover, the study demonstrates a correlation between insertion torque and resonance frequency analysis measurements.*

### INTRODUCTION

Primary stability is considered a key factor for the clinical success of dental implants. It is determined by the density of the bone at the site, the surgical technique and the design of the implant (Sennerby & Meredith 1998). Historically, increased failure rates have been reported in sites of low bone density (Jaffin & Berman 1991, Friberg et al 1991). Modified drilling protocols have been proposed with the final drill diameter reduced in an attempt to increase compression and thereby the stability of the implant during insertion (Friberg et al 1999).

Tapered implant designs have been introduced on the market in order to improve primary stability. Experimental and clinical studies with insertion torque (IT) measurements and/or resonance frequency analysis (RFA) have demonstrated higher primary stability for tapered implants compared with parallel-walled implants (O'Sullivan et al 2000, O'Sullivan et al 2004a, 2004b). Parallel-sided implants may show a high peak insertion torque which indicates a high degree of stability. However, this is mainly due to the clamping effect when the implant head reaches the marginal bone, whilst the threaded part of the implant shows little resistance during insertion. Tapered implants demonstrate continuously increasing insertion torque due to lateral compression of the bone from the whole implant length during insertion (O'Sullivan et al (2000)). Then stresses would be distributed along the tapered implant surface and not concentrated to a few spots.

According to the manufacturer, the Neoss implant has a positive tolerance, meaning that it is slightly conical in the coronal direction, like a tapered implant. However, the insertion torque characteristics of that implant design are not known at present. The objective of this clinical study was to evaluate the primary stability of the Neoss implant using IT and RFA measurements. The aim was also to look for correlations between IT and factors such as bone quality and RFA.

### MATERIALS AND METHODS

A total of 118 implants (Neoss Ltd, Harrogate, UK) of different lengths and diameters (Table 1) placed in both jaws (59 mandibular, 59 maxillary) of 38 patients were evaluated at placement surgery. Insertion torque in Ncm was measured at 20 rpm and 8 Hz to a maximum of 50 Ncm using a drilling unit specially designed for implant surgery (Elcomed, W&H, Milano, Italy) (Figure 1). A torque/time curve was obtained, saved and extracted. The final drill diameter and the degree of countersinking were noted. After final seating, the stability of each implant was measured with resonance frequency analysis in ISQ units (Mentor, Osstell AB, Gothenburg, Sweden). Bone density and quantity were assessed by the Lekholm & Zarb index.

The torque/time curves were examined for mean insertion torque over the total curve and for the apical (E1), mid (E2) and coronal thirds (E3). The E1 and E3 parts always included 40 measurements (corresponding to 5 seconds). The registration time for the E2 part varied due to the different implant lengths accounted for.



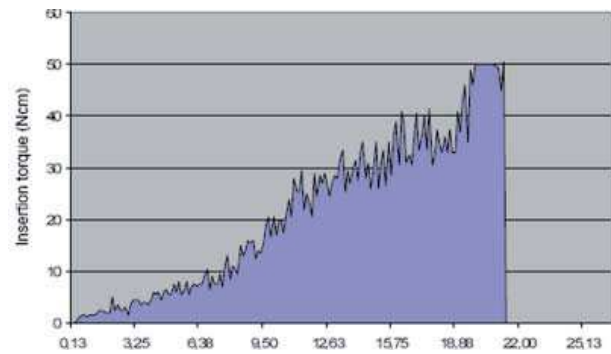
Figure 1. The Elcomed drilling unit used in the study. The handpiece was calibrated before each use (right).

Spearman's rho test was used to test for possible correlations. A statistically significant correlation was considered if  $p < 0.05$ .

## RESULTS

The torque/time curves displayed continuously increasing torque during insertion (Figure 2). Thus, the implants behaved as expected for a tapered implant design as previously described by O'Sullivan et al (2000). The total mean insertion torque was 15.1 Ncm (SD 7.2) and for regions was 4.8 Ncm (SD 6.5) in the E1, 13.3 Ncm (SD 6.5) during E2 and 26.9 Ncm (SD 11.9) in E3 (Figure 3). Except for the E1 region, these torques are higher than those previously reported by Friberg et al (1999a) in 523 self-tapping parallel-sided implants; used in both jaws of 105 patients. The data indicate higher primary stability for the present implant design as described by IT measurements. This accords with previous experimental research which showed higher stability for tapered implants than for parallel-sided ones, without jeopardizing the integration process (O'Sullivan et al 2000, O'Sullivan et al 2004a, 2004b).

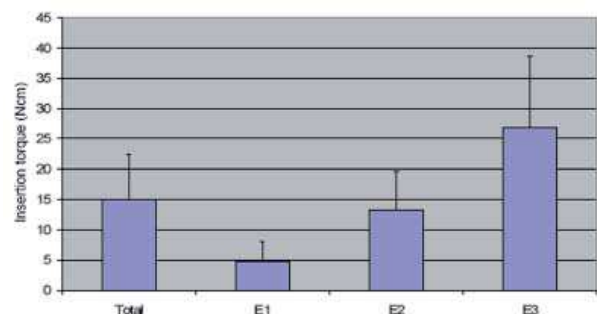
A statistically significant correlation between IT and RFA was demonstrated for the total implant lengths as well as for the E1-E3 regions individually (Table 2). The same correlation was reported by Friberg et al (1999b) in measurements of 47 parallel-sided implants placed in maxillary bone of nine patients. Since RFA measures stability as a function of stiffness, the results indicate that the insertion torque technique can be used to measure bone density and to predict primary stability as measured with RFA. There was no correlation between total mean IT and bone density as assessed



2. Showing a typical torque/time curve for a 4 x 13 mm implant placed in the second premolar region in the maxilla. This implant showed an ISQ value of 76.

using the Lekholm and Zarb index (1985). This may reflect the subjective nature of the latter method which is purely based on the surgeon's perception of bone density during drilling of the implant site.

It is concluded that the Neoss implant design develops a continuously increasing insertion torque during placement as expected for a tapered implant design. This indicates that the total implant length is involved in lateral compression, providing firm primary stability for the implant. Moreover, there is a correlation between IT and RFA measurements.



3. Graphic presentation of the total mean insertion torque and for E1-E3 regions

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