The evolution of the Neoss implant system: A retrospective follow-up of three patient cohorts treated with three types of Neoss implants

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This article reports on three patient cohorts with three types of Neoss implants. The retrospective analysis shows excellent long-term results with the Neoss implant system. The results also indicate that the introduction of the ProActive implant surface led to improved clinical outcomes in difficult cases.

INTRODUCTION
The effect of dental implant design changes on the clinical outcome is usually difficult to study in a structured way. When comparing study data from different studies, several factors change together with the change of implant design.

Here we have a clinical material where the same surgical protocol has been used by the same surgeon at the same clinic but with three generations of Neoss implants. That gives us a unique opportunity to study the effect of implant design changes in a more controlled manner.

For each new generation of Neoss implants - i.e. Bi-modal Straight, ProActive Straight and ProActive Tapered - the clinical outcome of the first 50 consecutive patients treated in one private office has been retrospectively analyzed. Data on the Bimodal and the ProActive Straight patient groups have been published earlier.¹,²

MATERIALS AND METHODS
Patients
This retrospective study analyzes three patient cohorts consisting of the first 50 consecutive patients treated with three types of Neoss dental implants (Neoss Ltd, Harrogate, UK):

- Bimodal Straight implants
- ProActive Straight implants
- ProActive Tapered implants

The Bimodal implant had a straight implant body with a blasted surface. The ProActive Straight implant has exactly the same implant geometries as the Bimodal implant, but with the blasted and etched hydrophilic ProActive implant surface. The ProActive Tapered implant has the same ProActive surface, the same prosthetic connection and cutting features as the ProActive Straight implants but with a tapered implant body.

The patients were examined clinically and radiographically before treatment. They were thoroughly informed of the surgical and follow-up procedures and gave their written consent before treatment. All treatment steps were part of the routine procedures at the clinic, and no extra measures were taken for the cause of the study. The study was conducted in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki.

Surgical protocol
Patients were given antibiotics (Dalacin, 300 mg, Pfizer AG, Zurich, Switzerland) prior to the procedure, and the implant surgery was performed under local anesthesia (Ultracain D-S Forte, Sanofi-Aventis, Geneva, Switzerland).

In cases of localized horizontal and vertical defects, a guided bone regeneration (GBR) procedure using BioOss
and a resorbable BioGide membrane (Geistlich, Switzerland) was performed simultaneously with implant placement. Larger defects were treated using a staged GBR procedure. First, either an autologous bone block and a resorbable membrane (BioGide) or a bone substitute material (BioOss) and a non-resorbable ePTFE membrane (Gore-Tex Regenerative Membrane, Gore Medical, Flagstaff, AZ, USA) were used. Implants were placed after a healing period of 6 months. ePTFE membranes were removed in the same operation. In some cases, sinus floor augmentations were made simultaneous with implant placement either by the use of a series of osteotomes or by using a lateral window technique.

Flapped surgery was used. Implant sites were prepared and implants were placed in accordance with the manufacturer’s guidelines.

Implant placement depth varied between the different treatment groups: In the Bimodal treatment cohort 59% of the implants were placed with the implant platform at bone level and 41% were placed supracrestal with half of the collar above bone level. In the two ProActive cohorts, all implants were placed with the implant-abutment connection at bone level.

Healing protocol
Three different healing protocols were utilized: Two-stage healing, one-stage healing with delayed loading and immediate loading.

Prosthetics
Implants were restored with single crowns, partial bridges, fixed full bridges, or overdentures (Figure 1). All restorations were fabricated using conventional prosthetic techniques on NeoLink abutments (Neoss Ltd). Frameworks were made of titanium or gold, and both porcelain and acrylic were used as veneering materials.

Follow-up
The patients were scheduled for annual check-ups with clinical and radiographic examination. Follow-up data was collected from the 1-, 3-, 5-, and 10-year visits.

Survival analysis was performed, and marginal bone levels were measured from periapical radiographs. Mesial and distal bone levels were measured and an average was calculated. Baseline measurements were taken at time of implant placement for the ProActive groups and at time of prosthesis delivery for the Bimodal group.

RESULTS
Baseline data, treatment schedule and follow-up status for each treatment group is presented in Figure 1.

Figure 1: Overview of studies
In the Bimodal group, all followed patients have attended the 10 year check-up. In the ProActive Straight group, the patients have completed the 5 year follow-up, and in the ProActive Tapered group, the 3 year follow-up is completed (Figure 1).

Implant survival is shown in Figure 2. In the Bimodal group, the cumulative survival rate after 10 years was 93.2% for augmented sites (8 implant failures) and 98.2% for non-augmented sites (1 failure). In the ProActive Straight group, the cumulative survival rate after 5 years was 98.5% for augmented sites (1 failure) and 98.9% for non-augmented sites (1 failure). In the ProActive Tapered group, no failures occurred, resulting in cumulative survival rates after 3 years of 100% for augmented sites as well as non-augmented sites.

Marginal bone levels over time are shown in Figure 3. In the Bimodal group, the bone resorption from prosthesis delivery to 10 years was 0.4 ± 1.2 mm. In the ProActive Straight group, the bone resorption from implant placement to 5 years was 0.7 ± 0.6 mm. In the ProActive Tapered group, the bone resorption from implant placement to 3 years was 0.5 ± 0.6 mm.

All groups showed stable bone levels after the first year. None of the patients in any of the study groups showed any signs of peri-implantitis.

**DISCUSSION**

The three patient cohorts were treated according to the same clinical protocol. Hence, the groups were similar in gender distribution and percentage of sites requiring bone grafting. However, as clearly seen in Figure 1, the number of implants decreased for each new group. This most likely reflects a shift in the general implant population over time where the percentage of full arch restorations has decreased and the percentage of single crown restoration has increased over the last 10-15 years.

The results indicate excellent long-term clinical results with the Neoss implant system. The bone levels are maintained on a stable level after one year in all groups with an average long-term bone level change in the Bimodal group between 5 and 10 years is less than 0.1 mm.

The Bimodal implant showed lower survival rate in augmented sites (93.2% vs. 98.2%). No difference in implant survival rates over time for the three study groups. The Bimodal GBR group showed lower survival rate than the other groups.

A Neoss 4.0 mm straight implant is outlined to show the bone levels in reference to the implant collar.
plant survival between augmented and non-augmented sites were seen for the ProActive implants. This indicates that implants with the ProActive surface experience less complications than implants with the Bimodal surface. This finding is in line with earlier studies showing that ProActive implants performed better than Bimodal implants when placed directly after total extraction of remaining teeth and loaded with a fixed bridge within 3 days.³

No case of peri-implantitis was recorded in the studied patient population during the 3-10 years of follow-up. This is an interesting and encouraging finding. However, additional studies and larger patient populations are needed to establish whether this is due to the studied patient population, the surgical and prosthetic protocol, the meticulous follow-up schedule or the implant properties.

In conclusion, the studies show excellent long-term results with the Neoss implant system. The results also indicate that the introduction of the ProActive implant surface led to improved clinical outcomes in difficult cases.

REFERENCES