

Primary Implant Stability in the Atrophic Maxillary Sinus Floor

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Objectives:

Simultaneous implant placement in conjunction with lateral or transcresal maxillary sinus floor augmentation gives the benefit of reduction in healing times and surgical interventions. Primary implant stability, however, may be significantly reduced in resorbed residual ridges. Aim of the present study was to investigate the impact of residual bone height, bone density and implant diameter on primary stability of implants in the atrophic sinus floor.

Material and Methods:

A total of 66 NobelActive™ implants were inserted in the sinus floor of fresh human cadaver maxillae: 22 narrow (3.5 mm), 22 regular (4.3 mm) and 22 wide (5.0 mm) diameter implants in residual ridges of 2 to 6 mm height. Presurgical computed tomographic scans were acquired to assess bone height and density. Primary implant stability was evaluated by insertion torque values (ITV), Periotest values (PTV) and Osstell implant stability quotients (ISQ).

Results:

Correlations within outcomes (ITV, PTV, ISQ) were highly significant ($p < 0.001$). Radiographic bone density was found to significantly impact all 3 outcome measures ($p < 0.001$), while no influence of residual bone height and implant diameter could be revealed by multifactorial analysis. Consistent results were seen in all subgroups (including residual ridges of 5 to 6 mm height).

Conclusions

Bone density seems to represent the major determinant of primary stability in maxillary sinus augmentation with simultaneous implant placement (as well as 5 to 6 mm short implants in the maxillary sinus floor). Preoperative bone density assessment may help to avoid stability-related complications in one-stage implant treatment of the atrophic posterior maxilla.

Suggested Reading

Fenner, M., Vairaktaris, E., Stockmann, P., Schlegel, K.A., Neukam, F.W. & Nkenke, E. (2009) Influence of residual alveolar bone height on implant stability in the maxilla: an experimental animal study. *Clinical Oral Implants Research* 20: 751-755.

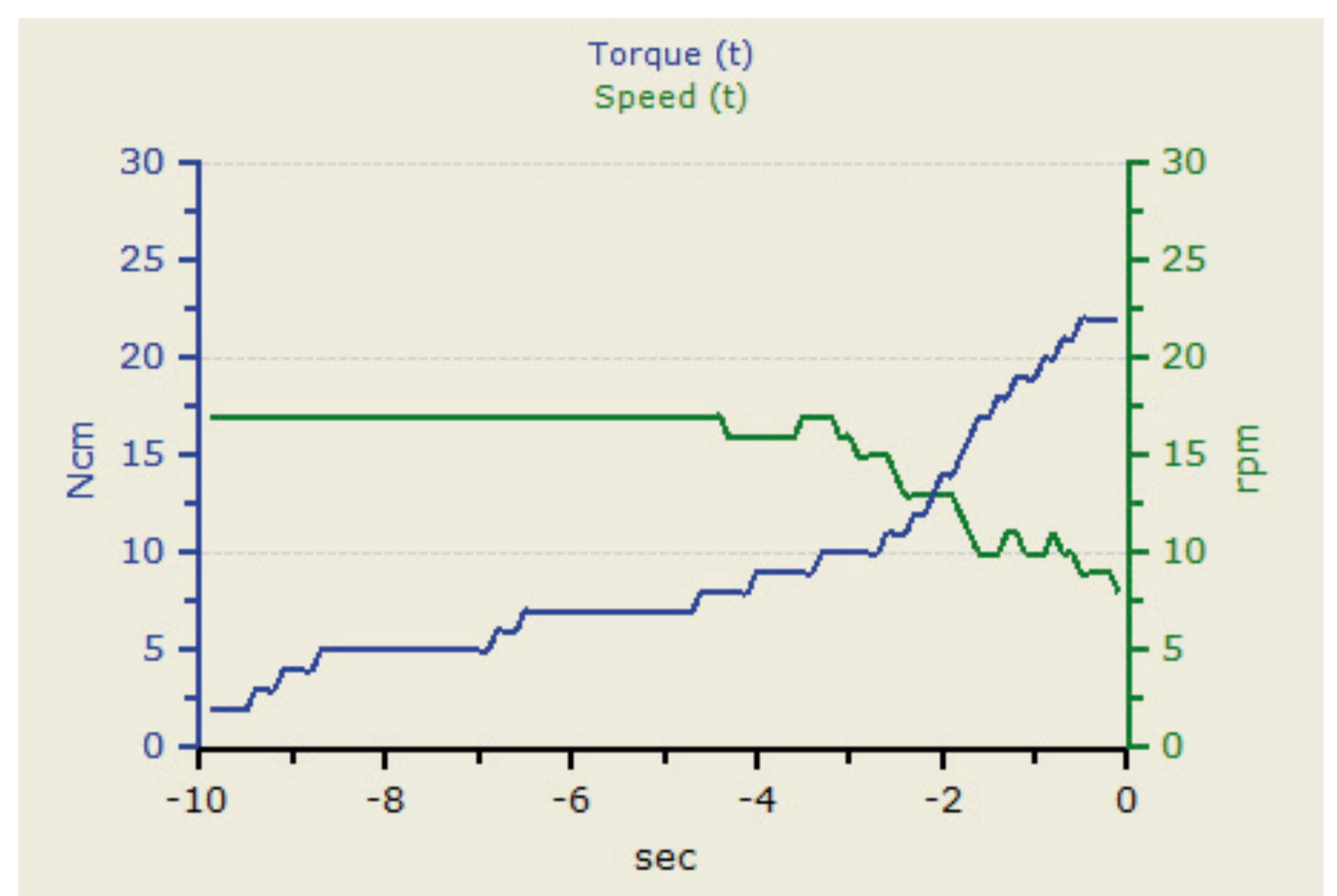
Nkenke, E., Hahn, M., Weinzierl, K., Radespiel-Tröger, M., Neukam, F.W. & Engelke K. (2003) Implant stability and histomorphometry: a correlation study in human cadavers using stepped cylinder implants. *Clinical Oral Implants Research* 14: 601-609.

Pommer, B., Frantal, S., Willer, J., Posch, M., Watzek, G. & Tepper, G. (2011) Impact of dental implant length on early failure rates: a meta-analysis of observational studies. *Journal of Clinical Periodontology* 38: 856-863.

Fermergård, R. & Astrand, P. (2008) Osteotome sinus floor elevation and simultaneous placement of implants - a 1-year retrospective study with Astra Tech implants. *Clinical Implant Dentistry & Related Research* 10: 62-69.

		2.0-2.9 mm	3.0-3.9 mm	4.0-4.9 mm	5.0-6.0 mm
ITV	3.5 mm	19 ± 12 Ncm	16 ± 8 Ncm	16 ± 7 Ncm	20 ± 9 Ncm
	4.3 mm	19 ± 5 Ncm	14 ± 10 Ncm	16 ± 6 Ncm	14 ± 8 Ncm
	5.0 mm	16 ± 9 Ncm	17 ± 6 Ncm	19 ± 13 Ncm	16 ± 7 Ncm
PTV	3.5 mm	8 ± 6	8 ± 8	6 ± 6	2 ± 3
	4.3 mm	7 ± 6	11 ± 12	12 ± 9	5 ± 4
	5.0 mm	14 ± 16	7 ± 5	8 ± 7	9 ± 6
ISQ	3.5 mm	45 ± 19	45 ± 22	50 ± 11	61 ± 8
	4.3 mm	34 ± 7	37 ± 12	42 ± 6	46 ± 5
	5.0 mm	42 ± 4	45 ± 9	37 ± 16	46 ± 3

Primary implant stability measurements: insertion torque (ITV), Periotest (PTV) and Osstell implant stability quotient (ISQ) values of 3.5, 4.3 and 5.0 mm diameter implants.



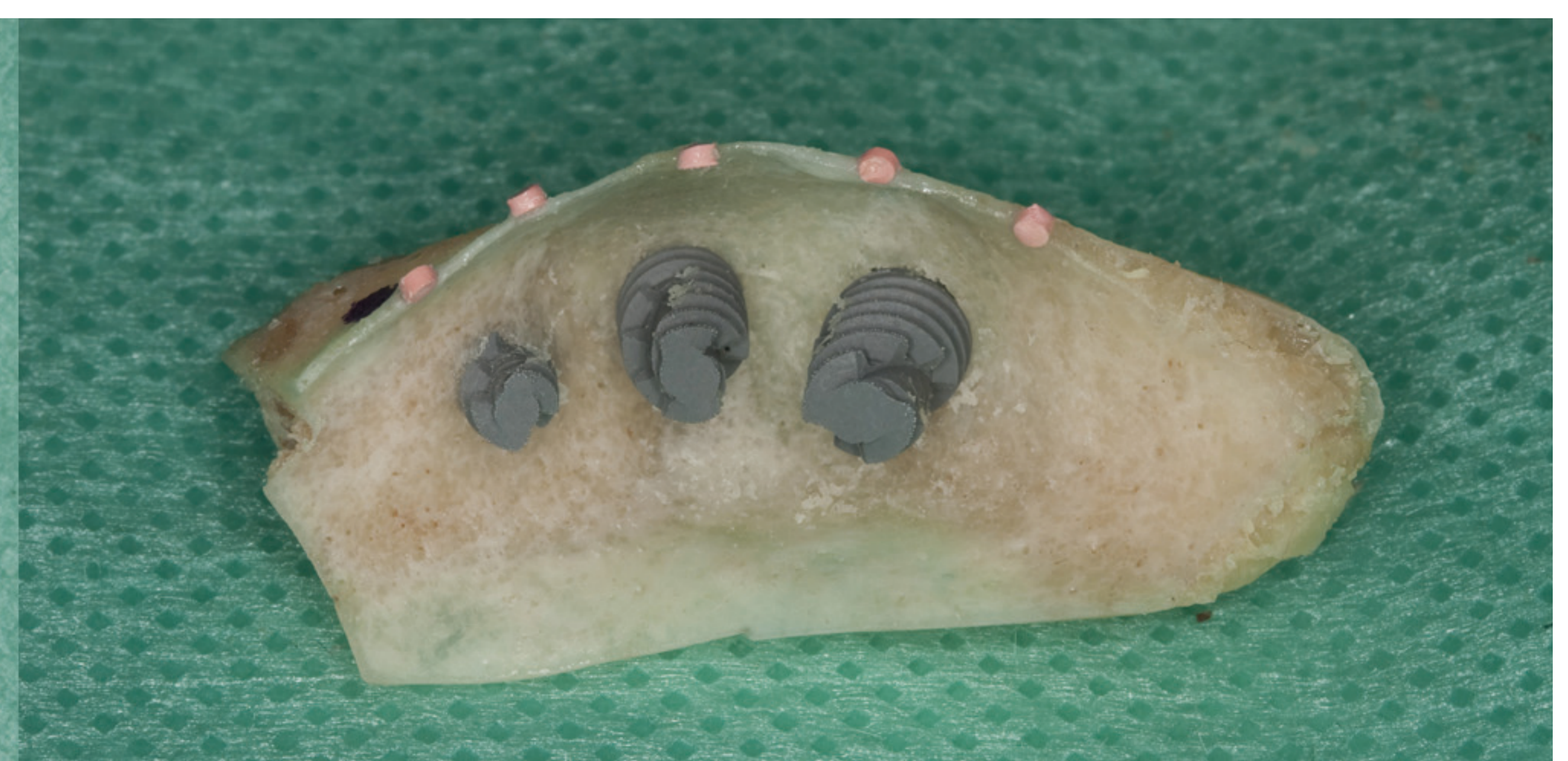
Increasing insertion torque (ITV, blue curve) and decreasing insertion speed (green curve) recorded during implant placement using a KaVo INTRASurg 1000 surgical unit.

bone height	bone density	implant diameter
2.0-2.9 mm	0.81 ($p=0.005$)*	0.07 ($p=0.844$)
3.0-3.9 mm	0.71 ($p=0.001$)*	0.13 ($p=0.597$)
4.0-4.9 mm	0.51 ($p=0.018$)*	-0.19 ($p=0.409$)
5.0-6.0 mm	0.58 ($p=0.014$)*	-0.11 ($p=0.686$)

Significant (*) impact of bone density on primary implant stability (ITV) was consistently observed in residual alveolar bone of 2 to 6 mm height, while no correlation (rs) regarding implant diameter could be found.



Three implants of 3.5 mm, 4.3 mm and 5.0 mm diameter were placed in each maxillary sinus floor (residual bone height 2-6 mm): crestal (a) and apical (b) view of harvested specimen.



The present study was accepted for publication on October 1st 2012 in the journal *Clinical Oral Implants Research* (impact factor 2.514, rank 13 of 81 in Dentistry, Oral Surgery & Medicine).