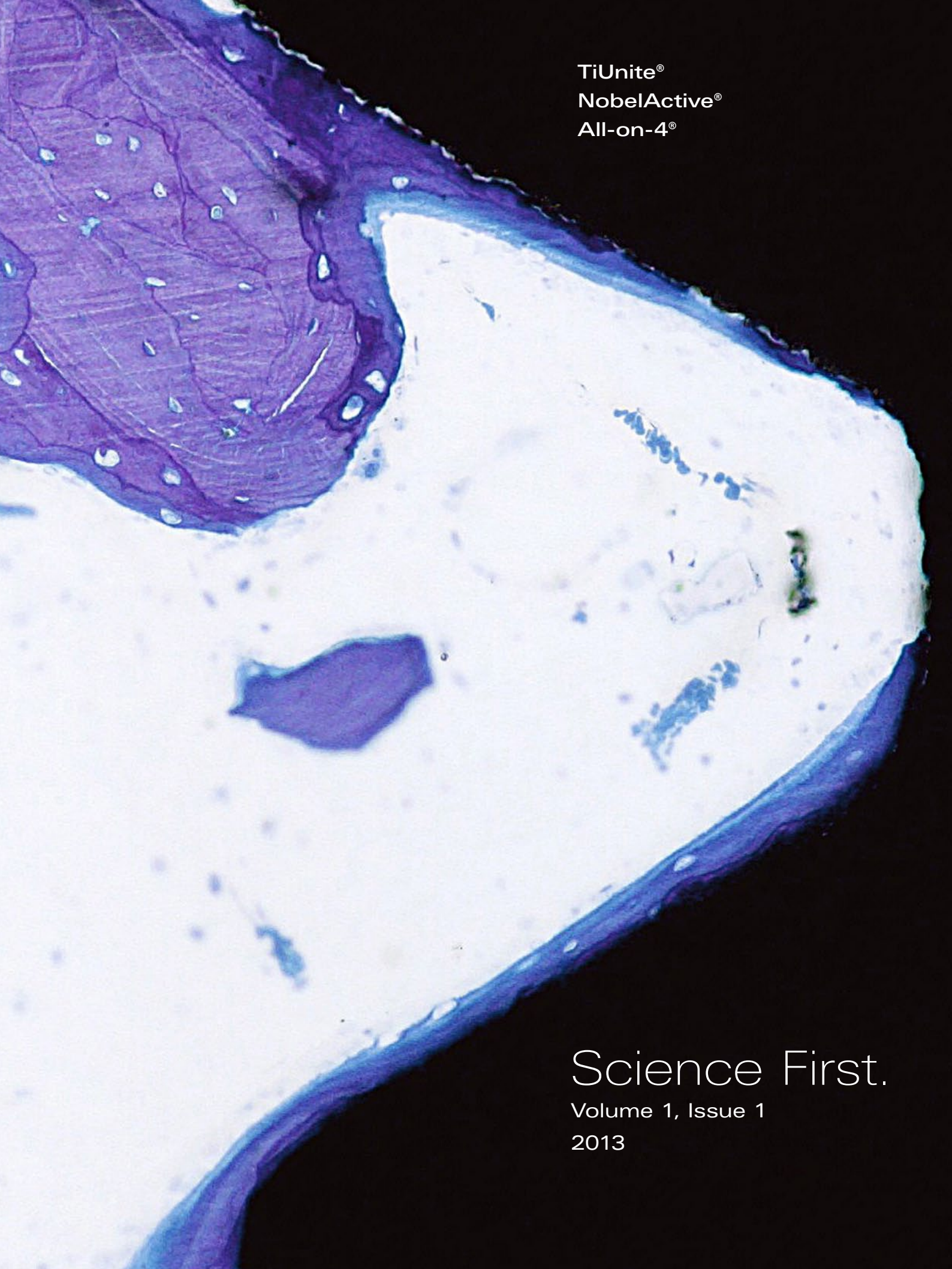


TiUnite®
NobelActive®
All-on-4®

Science First.

Volume 1, Issue 1
2013

Cover picture: Light microscopic image showing the bone formation pattern along the TiUnite surface after three weeks of healing. The bone grows in direct contact with the implant surface along the contours of the threads, indicating that TiUnite is osseoconductive (courtesy of Dr. Peter Schüpbach, Switzerland).

Contents.

Introduction	A heritage of scientific leadership	4
	High reporting standards	5
TiUnite®	Enhanced osseointegration and stable bone levels	6
	Scientific evidence	7
	Pivotal study	10
	References	11
	Summary of key studies	12
NobelActive®	High initial stability allows for immediate loading	27
	Scientific evidence	28
	Pivotal study	30
	References	31
	Summary of key studies	32
All-on-4®	Efficient and reliable full-arch restoration	34
	Scientific evidence	35
	Pivotal study	37
	References	38
	Summary of key studies	39

A heritage of scientific leadership.

Looking back to that point in time when Professor Per-Ingvar Brånemark treated his first edentulous patient Gösta Larsson in 1965, we return to the beginning of Nobel Biocare's leadership in scientific and evidence-based implant dentistry.

Gösta Larsson was the first patient in a clinical study that eventually included 211 patients, 235 jaws and 1618 titanium implants. At that time, implant treatment was neither well known nor accepted. It required scientific evidence to convince the medical community that implant treatments were safe, reliable and enduring. P.I. Brånemark published this evidence in 1977 in his book called "Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period", together with his colleagues B.O. Hansson, R. Adell, U. Breine, J. Lindström, O. Hallén and A. Öhman. It took another five years until this scientific evidence was presented convincingly at the landmark Toronto Conference in 1982, when a broader community of clinicians accepted implants as a viable treatment option.

Since 1982, implant based oral rehabilitation has progressed rapidly as the standard of care in the field. Millions of patients worldwide have benefitted from this pioneering scientific work. Unfortunately, the notion that this is now a "mature" treatment and scientific evidence is less relevant is emerging from implant providers. Worse yet is the lowering of standards for marketing purposes we observe among certain competitors.

Nobel Biocare is recommitting itself to the highest standards of scientific evidence in the spirit of our original pioneers. We believe today, this is more important than ever for the well being and safety of patients and for the proper advancement and acceptance of innovation.

In this first edition, we provide a user friendly guide to the scientific evidence of three important Nobel Biocare innovations: TiUnite, our unique implant surface, NobelActive, our unique implant design, and All-on-4, a ground breaking solution to treat edentulous patients. We believe the scientific evidence will speak for itself and you will be able to confidently treat patients applying these innovations.

«Designing for Life – Nobel Biocare has a deep and rich heritage in scientific leadership tracing back to Per-Ingvar Brånemark's very first patient.»

Richard Laube, CEO Nobel Biocare

High reporting standards.

Nobel Biocare's implants and solutions have proven themselves in all types of clinical studies – many of them following the more demanding one-stage protocol with immediate loading. Nobel Biocare sets the radiographic baseline at implant insertion rather than at prosthetic delivery a few weeks or months later, therefore reporting total marginal bone level change including the pronounced initial remodeling.

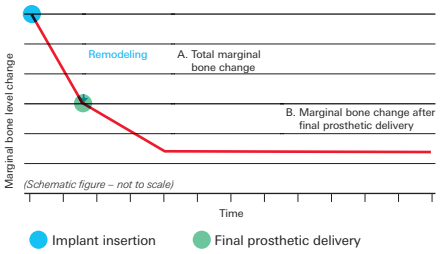
Not all study protocols are the same

Rieben et al. (2010) compared the study protocols of three major implant manufacturers in their literature review: Astra Tech, Nobel Biocare and Straumann.[1] Covering clinical articles published in peer-reviewed journals over a span of more than 14 years, they revealed noteworthy differences in the types of followed surgical and loading protocols. The study groups in which Nobel Biocare implants were used report the highest percentage (84%) of one-stage protocols and the highest percentage (45%) of immediate loading protocols. Study groups on Astra Tech implants predominantly followed a two-stage approach; and immediate loading cases were relatively underrepresented for both Astra Tech and Straumann implants.

The importance of correct comparisons

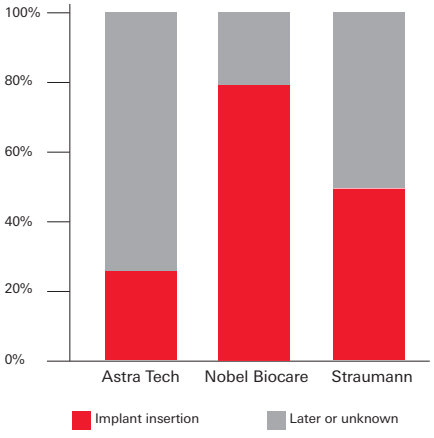
Significant differences were also seen among the points-in-time that were used as baseline for reporting marginal bone level change. Implant insertion was predominantly used as baseline in study groups on Nobel Biocare implants (79%), whereas Astra Tech (26%) and Straumann (49%) tended to set the baseline at a later point in time (e.g. loading or prosthetic delivery). Setting the radiographic baseline at a later time point reduces the reported mean bone level change, as this misses the pronounced initial bone remodeling typical after implant insertion.[2,3] When comparing figures among studies, it is therefore important to check when the radiographic baseline was set, as it is likely that studies on non-Nobel-Biocare implants left out the initial bone remodeling.

Transparent reporting on marginal bone level change



Nobel Biocare reports total marginal bone level change: Schematic illustration of mean marginal bone level change over time shows that the majority of change takes place in the first few months after implant insertion and thus prior to prosthetic delivery.

Nobel Biocare does not omit the initial bone remodeling phase



Stacked histogram showing the frequency of the various radiographic baselines utilized:[1] Setting the baseline at implant insertion ensures that the study reports total marginal bone level change.

1 Rieben AS, Jannu A, Alifanz J, Noro A, Sahlin H. Comparison of Various Study Protocols - A Literature Review [#47], in 25th Anniversary Meeting of the Academy of Osseointegration, March 4–6, 2010, Orlando, FL, USA

2 Engquist BB, Åstrand P, Anzén B, Dahlgren S, Engquist E, Feldmann H, Karlsson U, Nord PG, Sahlholm S, Svärdström P. Simplified methods of implant treatment in the edentulous lower jaw. Part II: early loading. Clin Impl Dent & Rel Res 2004;6(2):90-100

3 Petersson A, Rangert B, Randow K, Ericsson I. Marginal bone resorption at different treatment concepts using Brånemark dental implants in anterior mandibles. Clin Impl Dent & Rel Res 2001;3(3):142-7

TiUnite® – enhanced osseointegration and stable bone levels.

TiUnite is a high performance implant surface that enhances osseointegration – even under the most challenging conditions. It is a moderately rough thickened titanium oxide layer with high crystallinity and phosphorus content, with ceramic-like properties and micropores that ensure high osteoconductivity and fast anchorage of newly formed bone.

Developed for demanding situations

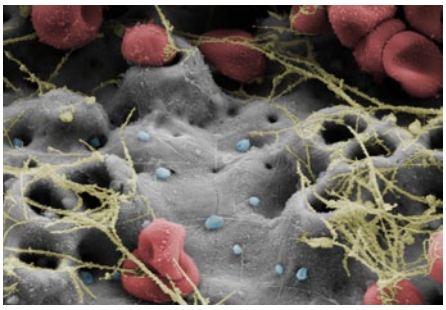
After two decades of universal use of the staged Brånemark osseointegration protocol, a series of clinical trials indicated that a one-stage procedure with early or even immediate loading was also a safe option – first in the interforaminal area,[1,2] later also in other jaw locations.[3] This procedure reduced healing time and repeated surgery. However, the impact of loading on the bone-to-implant interface seemed challenging, as micro-motion of ≥100 µm was considered a threshold value for machined ("turned") implant surfaces to osseointegrate properly.[4] A new surface which would speed up bone apposition was therefore needed. The solution was TiUnite – an increased oxide layer with moderate roughness.

Faster and stronger osseointegration

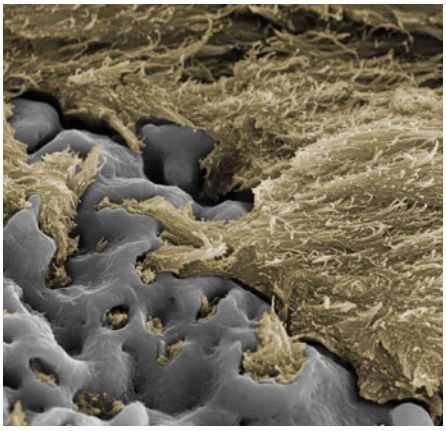
Anodic oxidation modifies the chemical composition and the degree of crystallinity, from amorphous as with machined surfaces to anatase and rutile forms. Anatase has been associated with enhanced bone growth, and the moderate roughness of TiUnite favors bone apposition (S_a range of 1.0–1.2 µm). Some of these characteristics, acting on their own, together or synergistically, result in faster and stronger osseointegration with TiUnite compared to machined surfaces.[5] Clinically retrieved implants show that bone grows into the pores of TiUnite, resulting in a strong interlock between surface and bone.[6]

Increased survival rates

TiUnite was introduced on the Brånemark System in 2000 and on the Replace implants in 2001. Since then it has virtually replaced the original machined surface. The shift from machined to TiUnite implants showed a clear decrease of early failures, especially in areas with poor bone density such as the maxilla.[7,8] TiUnite also allows for immediate loading protocols more frequently with superior outcomes;[9] and when used in revision surgeries, it increases the survival rate.[10]



Platelets attraction: The negatively charged TiUnite surface attracts blood proteins and inactive platelets (blue) immediately after implant insertion. Simultaneously, fibrils of the fibrin meshwork (yellow) become visible.



Osseoconductive bone formation: Human histology six months after implant insertion shows bone anchored in the TiUnite pores.

Images © Schüpbach Ltd, Switzerland

TiUnite® – scientific evidence.

TiUnite is one of the most clinically researched implant surfaces on the market. Since its launch in 2000 it has been clinically documented in more than 220 publications on clinical studies and case series with over 10,500 patients, 33,000 implants and up to 11 years follow-up. In total, more than 11 million implants with TiUnite surface have been used.

Key findings of the clinical studies are:

– Proven longevity with clinical follow-up data of 10 and more years.[16,17,21]

– High performance under the most challenging conditions including soft bone and immediate loading.[11,12,19,22,23,24,26]

– Stability maintained at a high level during the critical healing phase after implant insertion due to enhanced osseointegration and anchorage in surrounding bone.[13,14,15]

– Stable marginal bone levels after the initial bone remodeling phase and over the long term.[16,17,21,25]

– Cellular soft tissue adhesion behaves similarly to soft tissue around a natural tooth.[18]

– Long-term success with cumulative survival rates of 97.1–99.2% after 10 and more years.[16,17,21]

Recent clinical studies with follow-up times of 10 and more years confirm the reliable short- and long-term performance of TiUnite.

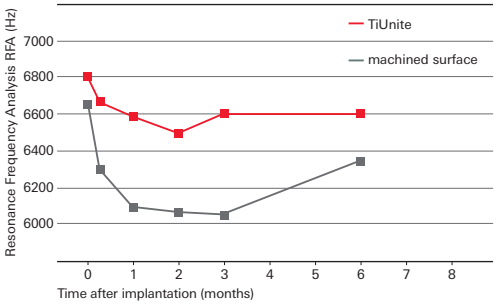
Predictable osseointegration with minimal failure rates

Olsson et al. (2012) report on the data of all patients treated with implants at the Brånemark Clinic in Gothenburg from 1986 to 2010, representing 35,444 implants.[8] In 5688 jaws machined implants were inserted, and in 3125 jaws TiUnite implants. Starting in 2002 the clinic switched gradually from machined to TiUnite implants, which had a significant impact on early failure rates: they dropped from 9.0 to 2.7% in the maxilla and from 1.8 to 1.5% in the mandible.

High survival rates after 10 and more years

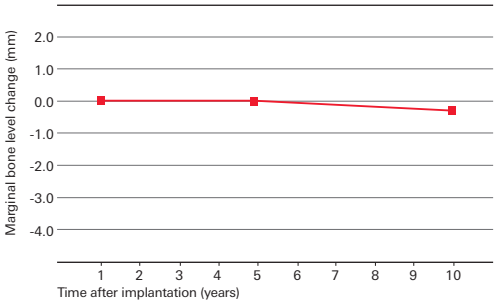
Except for the original Brånemark System, few other implant systems can present such wealth of clinical long-term data. Two studies are available with 10-year follow-up and one with 11-year follow-up.[16,17,21] All three indicate that TiUnite implants maintain marginal bone both in partial and full edentulism, even if placed in fresh extraction wounds and immediately loaded, with cumulative survival rates of more than 97%.

High stability in the critical healing phase



Higher stability with immediately loaded implants with TiUnite surface than with the same implants with machined surface in the posterior maxilla.[13]

Stable marginal bone levels over 10 years



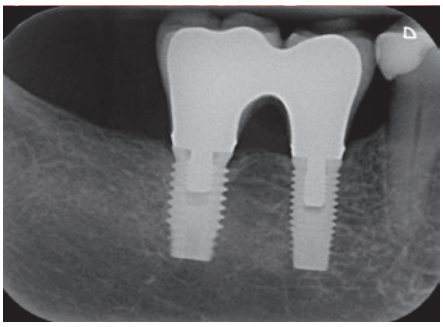
Stable marginal bone levels after initial remodeling. Baseline adjusted at year 1 to allow comparisons with other publications.[17]

Stable marginal bone levels

In a prospective 10-year study Degidi et al. (2012) followed 210 implants in 59 patients, who received a fixed provisional restoration on TiUnite implants within 1–2 hours after surgery.[16] Patients with compromising systemic diseases, bruxism and poor initial implant stability were excluded. After 4–5 months implant stability was checked and after around 7 months the final fixed restoration was placed. The implants placed in healed and fresh extraction sites achieved 98.1 and 96.5% cumulative survival rates, respectively. Mucositis was observed in 10% of the implants, and peri-implantitis in 8%, which was treated by open flap debridement. Mucositis was observed more often in partial edentulism, which can be explained by the cross-infection occurring in the oral cavity. Very reassuring is the finding that revision surgery because of recurrent peri-implantitis only occurred for 2.4% of all implants. The most common complications were minor prosthetic problems such as chipping and cement loosening. Bone resorption took mainly place during the first and second year with stable bone levels after 10 years.

In another prospective 10-year study Östman et al. (2012) report on 46 partially and totally edentulous patients with 121 TiUnite implants.[17] 20% were immediately loaded, while 80% followed the staged protocol. If needed, patients were enrolled in an oral hygiene program. Marginal bone levels were evaluated by intra-oral radiographs taken at implant insertion and after 1, 5, and 10 years of function. The cumulative survival rate was > 99% after 10 years. Mean marginal bone change between 1 and 5 years was 0.0 mm, and between 1 and 10 years 0.3 mm. Of all the implants which demonstrated more than 2 mm bone loss, the vast majority of remodeling had occurred during the first year. After 10 years only five implants demonstrated a bone loss of > 3 mm, of which two with signs of suppuration.

Glauser (2012) reports on 102 TiUnite implants in 38 patients.[21] All implants were immediately loaded and predominantly placed in soft bone. 32 patients with 66 implants were followed for 11 years. The 11-year follow-up included clinical, radiographic and microbiological evaluations to assess the treatment outcome. The cumulative survival rate was 97.1%. After initial bone remodeling during the first year, annual marginal bone level change averaged less than -0.05 mm, indicating stable bone levels over 10 years.



Stable marginal bone levels: In March 2000, the first patient was treated with TiUnite implants. Two Brånemark System Mk IV implants were placed in positions 45 and 46 and restored with screw-retained porcelain-fused-to-metal crowns.

High esthetics: Lateral view of the two crowns – which have been in place for more than 12 years – indicates that the surrounding soft tissues are both robust and healthy.

Courtesy of Dr. Roland Glauser, Switzerland

The maintenance of marginal bone in smoking patients

In a retrospective study by Watzak et al. (2006) on 50 consecutive patients, either 4 machined or 4 TiUnite implants were placed in the frontal region of the edentulous mandible to support a bar-retained removable prosthesis.[27] Both implant types were compared for their survival rates and marginal bone levels, and the peri-implant soft tissues were also assessed. The group included smokers, while radiotherapy, bruxism, clenching and alcohol abuse were exclusion criteria. The follow-up was on average nearly 3 years (range 30–47 months), but only 62% of the patients (n = 31 with a total of 124 implants) were available for the follow-up examination. This is not exceptional for retrospective studies. The reasons – deceased, moved without leaving an address, living too far away – were unrelated to the aims of the study and therefore did not jeopardize the outcome. No difference appeared in survival rates between the machined (100%) and TiUnite (98.5%) implants. The marginal bone height was measured both mesially and distally on rotational panoramic radiographs, using a precision caliper. It has been proven that the precision of such imaging is as good as intra-oral radiographs.[13] Radiographs taken at placement of the abutments (baseline) were compared with those taken at follow-up. Smokers showed significantly more bone loss around machined (1.8 mm) than around TiUnite (1.1 mm) implants. It has been reported repeatedly that the fate of machined implants in smokers is significantly less good than that of TiUnite implants.[23,28] In addition, the outliers (> 2 mm of marginal bone loss) seemed more frequent with machined implants. The clinical parameters of the soft tissues surrounding the implants were repeatedly assessed at the same mesial and distal sites as the radiographic measurements. There were no differences for any periodontal parameter between TiUnite and machined implants. Even though this study has the limitations of all retrospective studies, it indicates that marginal bone stability in smokers is better maintained with TiUnite than with machined implants.

TiUnite® – pivotal study.

Clinical Implant Dentistry and Related Research, Volume 14, Number 6, 2012

Ten Years Later. Results from a Prospective Single-Centre Clinical Study on 121 Oxidized (TiUnite™) Brånemark Implants in 46 Patients

Pär-Olov Östman, DDS, PhD;*† Mats Hellman, DDS;* Lars Sennerby, DDS, PhD‡

ABSTRACT

Background: Concerns have been raised that use of surface-modified implants may result in peri-implant infection and marked marginal bone loss over time.

Purpose: The aim of this prospective study was to evaluate the survival rate, marginal bone, and soft tissue conditions at surface-modified titanium dental implants after 10 years of function.

Material and Methods: Forty-six totally and partially edentulous patients were provided with 121 Brånemark oxidized implants (TiUnite™, Nobel Biocare AB, Gothenburg, Sweden). Twenty-four (20%) implants were immediate loaded and 97 (80%) were placed using a two-stage procedure. A total of 22 single, 23 partial, and 7 total restorations were delivered. Clinical and radiographic checkups were carried out after 3, 6, 12 months, and thereafter annually up to 10 years. At these occasions, oral hygiene was evaluated and peri-implant mucosa examined by probing. If needed, patients were enrolled in an individual program for hygiene controls and professional cleaning. Marginal bone loss was evaluated in intraoral radiographs taken at baseline and after 1, 5, and 10 years of function.

Results: One (0.8%) implant failed after 8 years giving a Survival Rate (SR) of 99.2% after 10 years. A total of 11 sites (9.2%) showed bleeding on probing (BP) at the 10th annual checkup. The mean marginal bone loss was 0.7 ± 1.35 mm based on 106 readable pairs of radiographs from baseline and from the 10th annual examination. Twelve (11.3%) implants showed more than 2 mm bone loss, and five (4.7%) showed more than 3 mm of bone loss after 10 years. For the latter, all patients were smokers and had poor or acceptable oral hygiene. All five implants with >3 mm bone loss showed BP and two (1.9%) showed suppuration from the pocket. For the remaining seven implants with more than 2 mm bone loss, no correlation to smoking, oral hygiene, bleeding, or pus could be seen. Time/marginal bone level plots of the 12 implants with more than 2 mm bone loss after 10 years, showed minor changes from the first annual checkup except for the two infected implants.

Conclusions: It is concluded that good long-term clinical outcomes can be obtained with oxidized titanium dental implants. Only 1.9% of examined implants showed significant marginal bone loss together with bleeding and suppuration after 10 years of function.

KEY WORDS: long-term clinical study, marginal bone resorption, oxidized implant surface, soft tissue

*Private practice, Falun, Sweden; †assistant professor, Department Biomaterials, Institute for Clinical Sciences, Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden; ‡professor, Department Oral & Maxillofacial Surgery, Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden

Reprint requests: Dr. Pär-Olov Östman, Holmgatan 30, SE-79171 Falun, Sweden; e-mail: po@holmgatan.com

© Copyright 2013 Blackwell Verlag

Pär-Olov Östman et al.: Ten Years Later. Results from a Prospective Single-Centre Clinical Study on 121 Oxidized (TiUnite®) Brånemark Implants in 46 Patients
From: Clinical Implant Dentistry and Related Research, Volume 14, Issue 6, December 2012, Pages: 852–860, DOI: 10.1111/j.1708-8208.2012.00453.

TiUnite® – references.

1 Randow K, Ericsson I, Nilner K, Petersson A, Glantz PO. Immediate functional loading of Brånemark dental implants. An 18-month clinical follow-up study. Clin Oral Implants Res. 1999;10:8-15

2 Brånemark PI, Engstrand P, Ohrnell LO, Gröndahl K, Nilsson P, Hagberg K, Darle C, Lekholm U. Brånemark Novum: a new treatment concept for rehabilitation of the edentulous mandible. Preliminary results from a prospective clinical follow-up study. Clin Implant Dent Relat Res. 1999;1: 2-16

3 Glauser R, Rée A, Lundgren A, Gottlow J, Hämmerle CH, Schärer P. Immediate occlusal loading of Brånemark implants applied in various jawbone regions: a prospective, 1-year clinical study. Clin Implant Dent Relat Res. 2001;3: 204-13

4 Brunski JE. In vivo bone response to biomechanical loading at the bone/dental implant interface. Adv Dent Res 1999; 13:99-119

5 Albrektsson T, Johansson C, Lundgren A-K, Sul Y-T, Gottlow J. Experimental studies on oxidized implants. A histomorphometrical and biochemical analysis. Appl Osseoint Res 2000;1:21-4

6 Schüpbach P, Glauser R, Rocci A, Martignoni M, Sennerby L, Lundgren A, Gottlow J. The human bone-oxidized titanium implant interface: A light microscopic, scanning electron microscopic, back-scatter scanning electron microscopic, and energy-dispersive x-ray study of clinically retrieved dental implants. Clin Implant Dent Relat Res. 2005;7 Suppl 1:36-43

7 Balshi SF, Wolfinger GJ, Balshi TJ. Analysis of 164 titanium oxide surface implants in completely edentulous arches for fixed prosthesis anchorage using the pterygomaxillary region. Int J Oral Maxillofac Implants. 2005;20:946-52

8 Olsson, M, Stenport V, Jemt T. Incidence of first implant failure in relation to implant surface: a preliminary report on early failure. 2012 submitted

9 Jungner M, Lundqvist P, Lundgren S. Oxidized titanium implants (Nobel Biocare TiUnite) compared with turned titanium implants (Nobel Biocare Mark III) with respect to implant failure in a group of consecutive patients treated with early functional loading and two-stage protocol. Clin Oral Implants Res. 2005;16:308-12

10 Alsaadi G, Quirynen M, van Steenberghe D. The importance of implant surface characteristics in the replacement of failed implants. Int J Oral Maxillofac Implants. 2006;21:270-74

11 Glauser R. Implants with an Oxidized Surface Placed Predominately in Soft Bone Quality and Subjected to Immediate Occlusal Loading: Results from a 7-Year Clinical Follow-Up. Clin Implant Dent Relat Res 2011 [Epub ahead of print]

12 Liddelow G and Henry P. The immediately loaded single implant-retained mandibular overdenture: a 36-month prospective study. Int J Prosthodont 2010; 23:13-21

13 Glauser R, Portmann M, Ruhstaller P, Lundgren AK, Hammerle CH, Gottlow J. Stability measurements of immediately loaded machined and oxidized implants in the posterior maxilla. A comparative clinical study using resonance frequency analysis. Applied Osseointegration Research 2001; 2:27-9

14 Zechner W, Tangl S, Furst G, Tepper G, Thams U, Mailath G, Watzek G. Osseous healing characteristics of three different implant types. Clin Oral Implants Res 2003;14:150-7

15 Ivanoff CJ, Widmark G, Johansson C, Wennerberg A. Histologic evaluation of bone response to oxidized and turned titanium micro-implants in human jawbone. Int J Oral Maxillofac Implants 2003;18:341-8

16 Degidi M, Nardi D, and Piattelli A, 10-Year Follow-Up of Immediately Loaded Implants with TiUnite Porous Anodized Surface. Clin Implant Dent Relat Res 2012;14(6):828-38

17 Östman PO, Hellman M, Sennerby L. Ten years later. Results from a prospective single-centre clinical study on 121 oxidized (TiUnite) Brånemark implants in 46 patients. Clin Implant Dent Relat Res 2012 Dec;14(6):852-60

18 Schüpbach P, Glauser R. The defense architecture of the human periimplant mucosa: a histological study. J Prosthet Dent 2007; 97(6 Suppl):15-25

19 Mura P. Immediate Loading of Tapered Implants Placed in Postextraction Sockets: Retrospective Analysis of the 5-Year Clinical Outcome. Clin Implant Dent Relat Res 2010 [Epub ahead of print]

20 Rieben AS, Alifanz J, Jannu AS. Survival rates of implants with a highly crystalline phosphate enriched surface – a literature review [#191], in 20th Annual Scientific Congress of the European Association for Osseointegration. 2011: Athens, Greece

21 Glauser R. Eleven-year results of implants with an oxidized surface placed predominantly in soft bone and subjected to immediate occlusal loading. Clin Oral Impl Res 2012;23 suppl 7;140-1

22 McAllister BS, Cherry JE, Kolinski ML, Parrish KD, Pumphrey DW, Schroering RL. Two-year Evaluation of a Variable-Thread Tapered Implant in Extraction Sites with Immediate Temporization: A Multicenter Clinical Trial. Int J Oral Maxillofac Implants 2012; 27:611-8

23 Rocci A, Martignoni M, Gottlow J. Immediate loading of Brånemark System TiUnite and machined-surface implants in the posterior mandible a randomized open-ended clinical trial. Clin Implant Dent Relat Res 2003; 5 suppl 1:57-63

24 Marzola R, Scotti R, Fazi G, Schincaglia GP. Immediate loading of two implants supporting a ball attachment retained mandibular overdenture – a prospective clinical study. Clin Implant Dent Relat Res 2007; 9:136-43

25 Nickenig H, Wichmann M, Schlegel K, Nkenke E, Eitner S. Radiographic evaluation of marginal bone levels adjacent to parallel-screw cylinder machined-neck implants and rough-surfaced micro-threaded implants using digitized panoramic radiographs. Clin Oral Impl Res 2009;20:550-4

26 Arnhart C, Kielbassa AM, Martinez-de Fuentes R, Goldstein M, Jackowski J, Lorenzoni M, Maiorana C, Mericske-Stern R, Pozzi A, Rompen E, Sanz M, Strub JR. Comparison of variable-thread tapered implant designs to a standard tapered implant design after immediate loading. A 3-year multicentre randomised controlled trial. Eur J Oral Implantol. 2012;5:123-36

27 Watzak G, Zechner W, Busenlechner D, Arnhart C, Gruber R. Radiological and clinical follow-up of machined- and anodized-surface implants after mean functional loading for 33 months. Clin Oral Implants Res. 2006;17:651-7

28 Bain CA, Weng D, Meltzer A, Kohles SS, Stach RM. A meta-analysis evaluating the risk for implant failure in patients who smoke. Compend Contin Educ Dent. 2002;23:695-9

TiUnite® – summary of key studies.

The following overview groups clinical studies on TiUnite according to follow-up time. Within each group, the studies are listed according to publication date.

Only peer-reviewed clinical studies are listed. Abstracts, reviews, single case reports, technique descriptions, and animal and in vitro tests are excluded.

For more information on all studies on TiUnite visit:
nobelbiocare.com/scientific-evidence or PubMed at pubmed.gov

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Follow-up time ≥ 10 years							
Östman, Hellman, Sennerby (2012): Clin Implant Dent Relat Res, 14: 852-860	10 years	Brånemark System Mk III Brånemark System Mk IV	Prospective	1- and 2-stage surgery Variety of restorations Healed and extraction sites Osseointegration/bone preservation	46	121	99.2
Degidi, Nardi, Piattelli (2012): Clin Implant Dent Relat Res, 14: 828-838	10 years	Brånemark System Mk III	Prospective	Healed and extraction sites Immediate loading Minimally invasive Osseointegration/bone preservation	59	210	97.3
Follow-up time 5–9 years							
Arnhart, Dvorak, Trefil, Huber, Watzek, Zechner (epub ahead 2012): Clin Oral Implants Res	Mean 80 months	Brånemark System Mk III	Retrospective Comparative	Edentulous mandible Bar-retained overdenture 2-stage surgery Delayed loading Soft tissue health Patient satisfaction Osseointegration/bone preservation	34	136	98.5
Francetti, Azzola, Corbella, Taschieri, Del Fabbro (epub ahead 2012): Clin Implant Dent Relat Res	75–96 months (mean 81.8 months)	Straight and tapered implants of Replace type	Prospective Case series	Maxilla and mandible Partially edentulous Healed sites 2-stage surgery Delayed loading Patient satisfaction Soft tissue health Osseointegration/bone preservation	22	54	98.0
Jungner, Lundqvist, Lundgren (epub ahead 2012): Clin Implant Dent Relat Res	> 5 years	Brånemark System Mk III	Retrospective Comparative	1- and 2-stage surgery Variety of restorations Soft tissue health Osseointegration/bone preservation	55	154	99.4
Noelken, Kunkel, Jung, Wagner (epub ahead 2012): Clin Implant Dent Relat Res *Noelken, Morbach, Kunkel, Wagner (2007): Int J Periodontics Restorative Dent, 27: 277-285*	55–78 months Up to 27 months	NobelPerfect	Monocenter	Single teeth, esthetic area Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	20	31	96.8
Bahat, Sullivan, Smidt (2012): Quintessence Int, 43: 293-303	3–7 years	Brånemark System MK IV	Retrospective Comparative (grafting) Monocenter	Compromised and grafted maxilla Delayed loading Osseointegration/bone preservation	27	103	97.1
Paul &Held (epub ahead 2012): Clin Oral Implants Res	1–5 years	NobelPerfect	Retrospective	Extraction sites, single anterior teeth Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	28	33	100

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Mura (2012): Clin Implant Dent Relat Res, 14: 565-574	5 years	Replace Select Tapered	Retrospective Monocenter	Extraction sites Immediate loading Minimally invasive Osseointegration/bone preservation	56	79	100
Shibuya, Takata, Takeuchi, Tsuji, Ishida, Kobayashi, Suzuki, Hasegawa, Kamae, Komori (2012): Kobe J Med Sci, 58: E19-28	1–8 years	Brånemark System	Retrospective Monocenter	Maxilla and mandible Fully and partially edentulous 2-stage surgery Osseointegration/bone preservation	151	619	96.8
Malo, de Araujo Nobre, Lopes, Francischone, Rigolizzo (2012): Clin Implant Dent Relat Res, 14 Suppl 1: e139-50	5 years	Brånemark System	Retrospective Monocenter	All-on-4 Edentulous maxilla Immediate loading Minimally invasive Osseointegration/bone preservation	242	968	98.0
Turkyilmaz, Tozum, Fuhrmann, Tumer (2012): Clin Implant Dent Relat Re, 14 Suppl 1: e83-90 *Turkyilmaz, Tözüm, Tumer, Ozbek (2006): J Periodontol, 77: 1998-2004* *Turkyilmaz (2006): J Clin Periodontol, 33: 233-238*	7 year 2 years 1 years	Brånemark System Mk III	Prospective Randomized, controlled	Edentulous mandible Overdentures Early and delayed loading Soft tissue health Osseointegration/bone preservation	26	52	100
Buddula, Assad, Salinas, Garces, Volz, Weaver (2011): J Prosthet Dent, 106: 290-296	5 years	Brånemark System	Retrospective Comparative	Irradiated head and neck cancer Osseointegration/bone preservation	Not reported	139	97.1
Calandriello &Tomatis (2011): Clin Implant Dent Relat Res, 13: 311-318	5 years	Brånemark System Mk III TiUnite	Prospective Multicenter	Single lower molars Immediate loading Osseointegration/bone preservation	33	40	95.0
Cricchio, Sennerby, Lundgren (2011): Clin Oral Implants Res, 22: 1200-1212	1–6 years	Brånemark System Mk III Groovy	Prospective	Sinus membrane elevation (maxilla) Immediate/non-immediate loading Osseointegration/bone preservation	84	239	98.7
George, Choi, Rieck, Van Ess, Ivancakova, Carr (2011): Int J Prosthodont, 24: 199-203	Up to 9 years	TiUnite implants	Retrospective	All indications Immediate and early loading	24	100	99.0
Jemt, Stenport, Friberg (2011): Int J Prosthodont, 24: 345-355 *Jemt &Stenport (2011): Int J Prosthodont, 24: 356-362*	5 years	Brånemark System	Retrospective Controlled	Edentulous maxilla Delayed loading Osseointegration/bone preservation	63	310	99.4
Malo, de Araujo Nobre, Lopes, Moss, Molina (2011): J Am Dent Assoc, 142: 310-320	Up to 5 years	NobelSpeedy (subgroup)	Longitudinal study Monocenter	Edentulous mandible All-on-4 Immediate loading Minimally invasive	20.00	50	92.0
Glauser (epub ahead 2011): Clin Implant Dent Relat Res *Glauser, Zembic, Ruhstaller, Windisch (2007): J Prosthet Dent, 97: S59-68* *Glauser, Ruhstaller, Windisch, Zembic, Lundgren, Gottlow, Hammerle (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S52-59* *Glauser, Lundgren, Gottlow, Sennerby, Portmann, Ruhstaller, Hammerle (2003): Clin Implant Dent Relat Res, 5 Suppl 1: 47-56*	7 years 5 years 4 years 1 year	Brånemark System Mk IV	Prospective	Soft bone Immediate loading Minimale invasive Soft tissue health Osseointegration/bone preservation	38	102	97.1

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Bedrossian (2010): Int J Oral Maxillofac Implants, 25: 1213-1221	Up to 7 years	Brånemark System Mk IV NobelSpeedy	Prospective	Edentulous maxilla Immediate loading Minimally invasive Osseointegration/bone preservation	36	98	100
Cehreli, Uysal, Akca (2010): Clin Implant Dent Relat Res, 12: 114-121	5 years	Brånemark Mk III TiUnite	Prospective Comparative	Edentulous mandible Overdentures Early loading Osseointegration/bone preservation	10	22	100
Friberg &Jemt (2010): Clin Implant Dent Relat Res, 12 Suppl 1: e95-e103	5 years	Brånemark System Mk III and Mk IV	Retrospective	All indications Mainly delayed loading (subgroups G1, G2) Osseointegration/bone preservation	111	280	G1: 97.1 G2: 98.4
Koo, Wikesjo, Park, Kim, Seol, Ku, Rhyu, Chung, Lee (2010): J Periodontol, 81: 1242-1249	1–5 years	Brånemark System Mk III TiUnite	Retrospective	Second molars Immediate and delayed loading	489	521	95.1
Urban &Lozada (2010): Int J Oral Maxillofac Implants, 25: 1203-1212	1–5 years	Brånemark System Mk III and Mk IV NobelReplace NobelSpeedy	Prospective	Grafted maxilla Delayed loading Osseointegration/bone preservation	79	245	99.6
Alfadda, Attard, David (2009): Int J Prosthodont, 22: 368-373	5 years	TiUnite implants	Monocenter	Edentulous mandible Overdentures Immediate loading Patient satisfaction	35	70	98.4
Balshe, Assad, Eckert, Koka, Weaver (2009): Int J Oral Maxillofac Implants, 24: 1113-1118 *Balshe et al. Balshe, Eckert, Koka, Assad, Weaver (2008): Int J Oral Maxillofac Implants, 23: 1117-1122*	Up to 5 years	TiUnite implants	Retrospective Comparative (surfaces)	Variety of indications Delayed loading	905	2425	94.5
Cosyn &De Rouck (2009): Clin Oral Implants Res, 20: 1063-1069	6–68 months	Tapered implants of Replace type	Retrospective	Single tooth in anterior maxilla Delayed loading Minimally invasive Soft tissue health Osseointegration/bone preservation	27	27	100
Shibuya, Kobayashi, Takeuchi, Asai, Murata, Umeda, Komori (2009): Kobe J Med Sci, 55: E73-81	1–5 years	Brånemark System	Retrospective	All indications Delayed loading	110	472	96.6
Urban, Jovanovic, Lozada (2009): Int J Oral Maxillofac Implants, 24: 502-510	1–6 years	Brånemark System Replace	Retrospective	Grafted maxilla Delayed loading Soft tissue health Osseointegration/bone preservation	Not reported	69	100
Jung, Choi, Kim, Cho, Chai, Kim, Choi (2008): J Periodontol, 79: 1857-1863	5 years	Brånemark System	Comparative	Mandibular posterior single implants Immediate and non-immediate loading	111	112	96.4
Turkyilmaz, Aksoy, Mc-Glumphy (2008): Clin Implant Dent Relat Res, 10: 231-237	1–5 years	Brånemark Mk III	Two center-study	Posterior maxilla Osseointegration/bone preservation	22	60	96.6
Malo, de Araujo Nobre, Rangert (2007): J Prosthet Dent, 97: S86-95	1–5 years	Brånemark System	Retrospective Prospective Monocenter	Periodontally compromised Immediate loading Soft tissue health Osseointegration/bone preservation	103	268	96.0
Sanna, Molly, van Steenberghe (2007): J Prosthet Dent, 97: 331-339	Up to 5 years	TiUnite implants	Retrospective	Edentulous jaws NobelGuide Minimally invasive (flapless) Immediate loading Smoker (S) and Non-smokers (NS) Osseointegration/bone preservation	30	212	NS: 98.9 S:81.2

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Follow-up time < 5 years							
Agliardi, Pozzi, Stappert, Benzi, Romeo, Gherlone (epub ahead 2012): Clin Implant Dent Relat Res	36–78 months (mean 55.5 months)	Brånemark System Mk IV NobelSpeedy Groovy	Prospective Multicenter	Edentulous maxilla Axial and tilted implants Extraction and healed sites Immediate loading Minimally invasive Osseointegration/bone preservation	32	192	99.0
Bell, Bell, Bell (epub ahead 2012): J Oral Implantol	Not reported	NobelActive	Prospective Multicenter	Anterior maxilla Extraction sites Immediate loading (IL) vs delayed loading (DL) Minimally invasive Soft tissue health Osseointegration/bone preservation	109	126	IL: 92.9 DL: 97.6 (n.s)
Pozzi, Agliardi, Tallarico, Barlattani (epub ahead 2012): Clin Implant Dent Relat Res	1 year	NobelActive NobelSpeedy Groovy	Prospective Randomized, controlled Split-mouth	Partially edentulous Delayed loading Soft tissue health Osseointegration/bone preservation	34	88	100
Vasak, Kohal, Lettner, Rohner, Zechner (epub ahead 2012): Clin Oral Implants Res	1 year	NobelReplace Tapered	Prospective Multicenter	Posterior mandible Immediate loading Minimally invasive NobelGuide Soft tissue health Osseointegration/bone preservation	30	163	98.8
Finne, Rompen, Toljanic (2012): Int J Oral Maxillofac Implants, 27: 458-466 *Finne, Rompen, Toljanic (2007): J Prosthet Dent, 97: S79-85*	3 years 2 years	One-piece implants	Prospective Multicenter	All indications Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	56	82	98.8
Abtahi, Tengvall, Aspenberg (2012): Bone, 50: 1148-1151	6 months	Brånemark System Mk III	Prospective Randomized, controlled Split-mouth	Osseointegration/bone preservation Experimental coating (not presented here)	16	16	100
Antoun, Belmon, Cherfane, Sitbon (2012): Int J Periodontics Restorative Dent, 32: e1-9	3–56 months (mean 17.6 months)	Brånemark System TiUnite	Retrospective	Edentulous mandible and maxilla Immediate loading Extraction and healed sites All-on-4 (axial and tiled implants) Minimally invasive Osseointegration/bone preservation	44	205	98.5
Babbush &Brokloff (2012): Implant Dent, 21: 28-35	Up to 31 months	NobelActive	Retrospective Monocenter	All indications	293	1001	97.4
Behneke, Burwinkel, Knierim, Behneke (2012): Clin Oral Implants Res, 23: 137-143 *Behneke, Burwinkel, Behneke (2012): Clin Oral Implants Res, 23: 416-423*	> 4 months	NobelReplace	Prospective	Maxilla and mandible Partially edentulous NobelGuide Osseointegration/bone preservation	Not reported	43	100
Carneiro, da Cunha, Leles, Mendonca (2012): Dentomaxillofac Radiol, 41: 241-247	1 year	Brånemark System Mk III	Prospective Comparative	Maxilla and mandible Single tooth replacement Immediate and delayed loading Osseointegration/bone preservation	12	12	100
Cosyn, Eghbali, De Bruyn, Dierens, De Rouck (epub ahead 2012): Clin Implant Dent Relat Res *Eghbali, De Bruyn, De Rouck, Cleymaet, Wyn, Cosyn (2012): Clin Implant Dent Relat Res, 14: 336-346*	17–41 months	NobelReplace Tapered	Cross-sectional Comparative	Healed and extraction sites Delayed loading Soft tissue health Osseointegration/bone preservation	44	49	94.0

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Cosyn, De Bruyn, Cleymaet (epub ahead 2012): Clin Implant Dent Relat Res	1 year	NobelActive	Prospective	Single implants Extraction sites Soft tissue health Immediate loading Osseointegration/bone preservation	22	22	95.5
Cosyn, Eghbali, Hanselaer, De Rouck, Wyn, Sabzevar, Cleymaet, De Bruyn (epub ahead 2012): Clin Implant Dent Relat Res *Cosyn, Sabzevar, De Bruyn (2012): J Clin Periodontol, 39: 895-903*	> 17 months	Tapered implants of Replace type	Retrospective Comparative	Anterior maxilla Healed and extraction sites Immediate and delayed loading Soft tissue health Osseointegration/bone preservation Patient satisfaction	104	104	93.0
Dasmah, Hallman, Sennerby, Rasmusson (2012): Clin Implant Dent Relat Res, 14: 259-265	1 year	TiUnite implants	Prospective	Edentulous maxilla Sinus floor elevation Osseointegration/bone preservation	10	40	97.5
Galindo & Butura (2012): Int J Oral Maxillofac Implants, 27: 628-633	1 year	NobelActive NobelSpeedy Groovy	Retrospective Monocenter	Edentulous mandible All-on-4 (axial and tilted implants) Immediate loading Osseointegration/bone preservation	183	732	99.9
Gillot, Cannas, Buti, Noharet (2012): Eur J Oral Implantol, 5: 71-79	6 months	Brånemark System Mk III Brånemark System Mk IV NobelActive NobelSpeedy	Retrospective Single-cohort	Edentulous maxilla Healed and extraction sites Immediate loading Minimally invasive Osseointegration/bone preservation	113	675	99.1
Hartlev, Kohberg, Ahlmann, Gotfredsen, Andersen, Isidor, Schou (epub ahead 2012): Clin Oral Implants Res	Mean 33 months	Replace Select Tapered	Retrospective	Single crowns Extraction sites Immediate loading Soft tissue health Minimale invasive Osseointegration/bone preservation	68	68	98.0
Hernandez, Lopez-Pintor, Arriba, Torres, de Vicente (2012): Clin Oral Implants Res, 23: 726-732	Mean 53 months	NobelDirect and other TiUnite implants	Prospective Controlled	Lichen planus (OLP) / healthy (CG) Delayed loading Soft tissue health	36	118	OLP: 100 CG: 96.8
Komiyama, Hultin, Nasstrom, Benchimol, Klinge (2012): Clin Implant Dent Relat Res, 14: 157-169	1 year	Brånemark System Mk III TiUnite	Prospective Single-cohort	Edentulous Immediate loading Soft tissue health Osseointegration/bone preservation	29	165	98.2
Malo, Nobre Mde, Lopes (2012): Int J Oral Maxillofac Implants, 27: 1177-1190	1–107 months (mean 26 months)	Brånemark System Mk III Brånemark System Mk IV NobelSpeedy	Prospective Single-cohort	Edentulous maxilla (MX) and mandible (MN) All-on-4 Immediate loading Osseointegration/bone preservation	142	227	MX: 97.7 MN: 94.8
McAllister, Cherry, Kolinski, Parrish, Pumphrey, Schroering (2012): Int J Oral Maxillofac Implants, 27: 611-618	2 years	NobelActive	Prospective Multi-center	Extraction sites Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation Patient satisfaction	55	60	98.3
Meloni, De Riu, Pisano, Massarelli, Tullio (2012): Br J Oral Maxillofac Surg, 50: 726-31	> 1 year	NobelReplace Tapered Groovy	Prospective Monocenter	NobelGuide Immediate and non-immediate loading Minimally invasive Osseointegration/bone preservation	10	56	95.0
Mozzati, Arata, Gallesio, Mussano, Carossa (epub ahead 2012): Clin Implant Dent Relat Res	2 years	Brånemark System Mk III NobelSpeedy Groovy	Retrospective Monocenter	Edentulous mandible All-on-4 Extraction sites Minimally invasive Immediate loading Osseointegration/bone preservation	50	200	100
Nickenig, Schlegel, Wichmann, Eitner (2012): Int J Oral Maxillofac Implants, 27: 671-676	4 months	Straight implants of the Replace type	Prospective Comparative Split-mouth	2-stage surgery Delayed loading Soft tissue health Osseointegration/bone preservation Immunohistochemical analysis	6	24	100

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Pozzi, Sannino, Barlattani (2012): J Prosthet Dent, 108: 286-297	36–54 months (mean 43.3 months)	NobelSpeedy Replace NobelSpeedy Groovy	Prospective Monocenter	Atrophic posterior maxilla Immediate loading Graftless Flapless or mini-flap Guided surgery Minimal invasive Axial and tilted implants CAD/CAM abutments (zirconia & titanium) NobelProcera Osseointegration/bone preservation	27	81	96.3
Rungcharassaeng, Kan, Yoshino, Morimoto, Zimmerman (2012): Int J Periodontics Restorative Dent, 32: 657-663	> 6 months	NobelActive NobeReplace NobelPerfect	Prospective Comparative	Extraction sites Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	46	46	100
Shibuya, Takeuchi, Asai, Takeuchi, Suzuki, Komori (2012): Implant Dent, 21: 91-96	15 months	Brånemark System	Monocenter	Maxillary sinus floor elevation	9	20	95.0
Weinstein, Agliardi, Fabbro, Romeo, Francetti (2012) Clin Implant Dent Relat Res, 14: 434-441	20–48 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective	Edentulous mandible All-on-4 Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	20	80	100
Zembic, Johannesen, Schou, Malo, Reichert, Farella, Hammerle (2012): Clin Oral Implants Res, 23: 49-54	1 year	NobelDirect	Prospective Multicenter	Small diameter Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	47	57	98.0
Urban, Kostopoulos, Wenzel (2012): Clin Oral Implants Res, 23: 1389–1397 *Urban, Kostopoulos, Wenzel (2012): Clin Oral Implants Res, 23: 220-227*	1 year	Brånemark System Mk III Groovy	Prospective Randomized, controlled	Molar region Extraction sites Bone reconstruction Delayed loading Minimally invasive Soft tissue health	92	92	82.6
Nicu, Van Assche, Coucke, Teughels, Quirynen (2012): J Clin Periodontol, 39: 1183–1119 *Van Assche, Coucke, Teughels, Naert, Cardoso, Quirynen (2012): Clin Oral Implants Res, 23: 617-624* *Quirynen &Van Assche (2012): Clin Oral Implants Res, 23: 625-634*	3 years 1 year	Brånemark System Mk III	Prospective Randomized, controlled	Fully and partially edentulous Periodontitis Delayed loading Soft tissue health Osseointegration/bone preservation	18	42	100
Slotte, Lenneras, Gothberg, Suska, Zoric, Thomsen, Nannmark (2012): Clin Implant Dent Relat Res, 14: 723-736	90 days	Brånemark System Mk III	Prospective Randomized, controlled	Partially edentulous Immediate and delayed loading Soft tissue health	18	54	92.6
Shibly, Kutkut, Patel, Albandar (2012): Clin Implant Dent Relat Res, 14: 663-671 *Shibly, Patel, Albandar, Kutkut (2010): J Periodontol, 81: 1743-1751*	2 years 1 year	NobelReplace Straight Groovy	Prospective Randomized, controlled	Extraction sockets Immediate (IL) and delayed (DL) loading Soft tissue health Osseointegration/bone preservation	60	60	IL:96.7 DL: 93.3

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Kronström, Davis, Loney, Gerrow, Hollender (epub ahead 2012): Clin Implant Dent Relat Res *Kronström, Davis, Loney, Gerrow, Hollender (2010): Int J Oral Maxillofac Implants, 25: 181-188*	3 years 1 year	Brånemark System Mk III Groovy	Prospective Randomized, controlled	Edentulous mandible Overdentures Immediate loading Osseointegration/bone preservation	36	55	81.8
Arnhart, Kielbassa, Martinez-de Fuentes, Goldstein, Jackowski, Lorenzoni, Maiorana, Mericske-Stern, Pozzi, Rompen, Sanz, Strub (2012): Eur J Oral Implantol, 5: 123-136 *Kielbassa, Martinez-de Fuentes, Goldstein, Arnhart, Barlattani, Jackowski, Knauf, Lorenzoni, Maiorana, Mericske-Stern, Rompen, Sanz (2009): J Prosthet Dent, 101: 293-305*	3 years 1 year	NobelReplace (NR) NobelActive (NI, NE)	Prospective Multicenter Randomized, controlled	Partially edentulous maxilla and mandible Immediate and early loading Soft tissue health Osseointegration/bone preservation	177	325	NR: 96.6 NI: 95.7 NE: 96.3
Babbush, Kutsko, Brokloff (2011): J Oral Implantol, 37: 431-445	Up to 29 months	NobelActive	Monocenter Retrospective	Edentulous All-on-4 Immediate loading Minimally invasive	165	708	99.6
Botos, Yousef, Zweig, Flinton, Weiner (2011): Int J Oral Maxillofac Implants, 26: 492-498	1 year	Replace Select	Prospective Comparative	Edentulous mandible Overdentures Immediate loading Soft tissue health Osseointegration/bone preservation	15	30	96.7
Cosyn, Eghbali, De Bruyn, Collys, Cleymaet, De Rouck (2011): J Clin Periodontol, 38: 746-753	3 years	NobelReplace	Prospective	Single tooth in anterior maxilla Extraction sites Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	25	25	96.0
De Bruyn, Atashkadeh, Cosyn, van de Velde (2011): Clin Implant Dent Relat Res, 13: 175-183	3 years	Brånemark System	Retrospective Comparative	Single implants Delayed loading Flap and flapless Minimally invasive Osseointegration/bone preservation	49	53	100
De Santis, Cucchi, Longhi, Vincenzo (2011): Int J Oral Maxillofac Implants, 26: 393-403	1–3 years	Brånemark Mk III Shorty NobelSpeedy Shorty	Prospective	Short implants in posterior regions Delayed loading Minimally invasive Osseointegration/bone preservation	46	107	98.1
den Hartog, Raghoebar, Stellingsma, Vissink, Meijer (2011): J Clin Periodontol, 38: 186-194	18 months	NobelReplace Tapered Groovy	Prospective Randomized, controlled	Maxillary anterior tooth Immediate (IL) and delayed loading (DL) Minimally invasive Osseointegration/bone preservation	62	62	IL: 96.8 DL: 100
den Hartog, Meijer, Stegenga, Tymstra, Vissink, Raghoebar (2011): Clin Oral Implants Res, 22: 1289-1297	18 months	NobelReplace (NR) Replace Select (RS) NobelPerfect (NP)	Prospective Randomized, controlled	Anterior tooth in the maxilla Delayed loading Minimally invasive Osseointegration/bone preservation	93	93	NR: 100 RS: 97.0 NP: 100
Demanet, Merheb, Simons, Leroy, Quirynen (2011): Le Dentiste, 426: 22-25	3 years	NobelActive	Retrospective Field study	All indications Immediate and non-immediate loading Osseointegration/bone preservation	172	466	99.1
Froum, Cho, Elian, Romanos, Jalbout, Natour, Norman, Neri, Tarnow (2011): Int J Periodontics Restorative Dent, 31: 591-601	1 year	NobelDirect	Prospective Randomized, controlled Monocenter	Single-tooth replacements Early and delayed loading Flap and flapless Osseointegration/bone preservation	60	60	100
Gillot, Noharet, Buti, Cannas (2011): Eur J Oral Implantol, 4: 247-253	4 months	Brånemark System Mk III NobelSpeedy	Retrospective	Edentulous mandible Immediate loading Minimally invasive	105	448	98.2

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Hahn (2011): J Oral Implantol, 37: 259-265 *Hahn (2007): J Oral Implantol, 33: 152-155*	4 years 3 years	NobelDirect	Prospective Monocenter	Partially edentulous Immediate loading Minimally invasive Osseointegration/bone preservation	30	47	97.9
Hatano, Yamaguchi, Yaita, Ishibashi, Sennerby (2011): Clin Oral Implants Res, 22: 1265-1269	Min. 1 year	Brånemark System TiUnite	Retrospective	Edentulous mandible Immediate and early loading Minimally invasive	Not reported	253	98.8
Ho, Yeung, Zee, Curtis, Hell, Tumuluri (epub ahead 2011): Clin Oral Implants Res	6 months	NobelActive Brånemark System	Prospective Randomized, controlled Split-mouth	Healed sites Early loading Osseointegration/bone preservation	32	64	92.1
Irinakis (2011): J Oral Maxillofac Surg, 69: 134-141	Min. 1 year	NobelReplace NobelActive	Retrospective Controlled	Resorbed maxilla Delayed loading Osseointegration/bone preservation	49	49	100
Malo &de Araujo Nobre (2011): Clin Implant Dent Relat Res, 13: 95-103	1 month –several years	Brånemark System NobelSpeedy	Retrospective Monocenter	Narrow diameter in posterior regions Mixed loading Osseointegration/bone preservation	Not reported	120	97.5
Malo, Nobre, Lopes (2011): Eur J Oral Implantol, 4: 47-53	1 year	NobelSpeedy Shorty	Prospective Monocenter	Posterior jaws Immediate and non-immediate loading Minimally invasive Osseointegration/bone preservation	127	217	95.4
Noelken, Kunkel, Wagner (2011): Int J Periodontics Restorative Dent, 31: 175-183	13–36 months	NobelPerfect	Monocenter	Extraction sockets Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	16	18	100
Parel & Phillips (2011): J Prosthet Dent, 106: 359-366	4–33 months	TiUnite implants	Retrospective	Edentulous maxilla restored with 4 implants Immediate loading	285	1140	96.5
Patil, van Brakel, Iyer, Huddleston Slater, de Putter, Cune (epub ahead 2011): Clin Oral Implants Res	> 4 months	Replace Select	Split-mouth Monocenter	Soft tissue health Delayed loading	29	58	100
Rokn, Ghahroudi, Mesgarzadeh, Miremadi, Yaghoobi (2011): J Dent (Tehran), 8: 186-200	2 months	Replace Select	Prospective Monocenter Comparative	Maxilla and mandible Healed sites 1-stage surgery No active periodontitis No need for bone grafting Osseointegration/bone preservation	Not reported	153	100
Tallarico, Vaccarella, Marzi, Alviani, Campana (2011): Quintessence Int, 42: 635-644	> 6 months	Brånemark System Mk III Groovy NobelSpeedy Groovy	Prospective Case-control	1- and 2-stage treatments Early loading Osseointegration/bone preservation	29	61	100
Tallarico, Vaccarella, Marzi (2011): Eur J Oral Implantol, 4: 13-20	1 year	Brånemark System Mk III Groovy NobelSpeedy Groovy	Prospective Randomized, controlled	1- (1S) and 2-stage (2S) treatments Early loading Osseointegration/bone preservation	47	89	1S:94.7 2S: 100
Tymstra, Raghoebar, Vissink, Meijer (2011): Clin Oral Implants Res, 22: 207-213	1 year	NobelReplace Groovy	Prospective Comparative Pilot study	Anterior region with two missing teeth Delayed loading Minimally invasive Soft tissue health Osseointegration/ bone preservation	10	15	100
Tymstra, Raghoebar, Vissink, Den Hartog, Stellingsma, Meijer (2011): J Clin Periodontol, 38: 74-85	1 year	NobelPerfect NobelReplace Tapered Groovy	Prospective Randomized, controlled	Two adjacent implants Delayed loading Soft tissue health Osseointegration/bone preservation	40	80	100
Urban, Nagursky, Lozada (2011): Int J Oral Maxillofac Implants, 26: 404-414	Mean 45.8 months	Brånemark System	Prospective Case series	Grafted bone Delayed loading	22	58	100
Weinländer, Lekovic, Spadijer-Gostovic, Milicic, Wegscheider, Piehslinger (2011): Clin Oral Implants Res, 22: 743-752	1 year	NobelReplace Tapered Groovy	Prospective Split-mouth	Healed sites Immediate loading Soft tissue health Osseointegration/bone preservation	10	20	100

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Agliardi, Clerico, Ciancio, Massironi (2010): Quintessence Int, 41: 285-293	19–47 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective	Edentulous atrophic mandible All-on-4 Immediate loading Soft tissue health Osseointegration	24	96	100
Agliardi, Panigatti, Clerico, Villa, Malo (2010): Clinical Oral Implants Research, 21: 459-465	4–59 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective	Edentulous maxilla (MA) and mandible (MN) Immediate loading Soft tissue health Osseointegration	173	692	98.4 (MA) 99.7 (MN)
Aparicio, Ouazzani, Aparicio, Fortes, Muela, Pascual, Codesal, Barluenga, Manresa, Franch (2010): Clin Implant Dent Relat Res, 12: 55-61	36–48 months	TiUnite implants	Single-cohort	Edentulous maxilla Immediate loading Osseointegration	20	104	100
Aparicio, Ouazzani, Aparicio, Fortes, Muela, Pascual, Codesal, Barluenga, Franch (2010): Clin Implant Dent Relat Res, 12 Suppl 1: e77-82	2–5 years	TiUnite implants	Single-cohort	Resorbed maxilla Immediate and early loading	25	129	99.2
Bilhan, Kutay, Arat, Cekici, Cehreli (2010): Implant Dent, 19: 437-446	2 years	Brånemark System	Comparative	Partially edentulous Delayed loading Soft tissue health Osseointegration/bone preservation	Not reported	36	100
Carinci, Brunelli, Franco, Viscioni, Rigo, Guidi, Strohmenger (2010): Clin Implant Dent Relat Res, 12: 91-98	Mean 26 months	TiUnite implants	Retrospective Comparative	Grafted maxilla Delayed loading Osseointegration/bone preservation	Not reported	83	97.6
Davo, Pons, Rojas, Carpio (2010): Eur J Oral Implantol, 3: 323-334	1 year	Brånemark Zygoma	Prospective	Edentulous maxilla Immediate loading Minimally invasive	17	64	100
Deng, Zhang, Shao, He, Zhang (2010): Int J Oral Maxillofac Implants, 25: 1036-1040	1 year	Brånemark System Mk III TiUnite NobelSpeedy	Prospective Comparative Non-randomized	Edentulous jaws Periodontally compromised Healed and extraction sites Immediate loading Minimally invasive	12	84	95.2
Friberg &Jemt (2010): Clin Implant Dent Relat Res, 12 Suppl 1: e56-e62	1 year	Brånemark System TiUnite	Retrospective	Edentulous mandible Early loading Minimally invasive Osseointegration/bone preservation	75	300	98.5
Gillot, Noharet, Cannas (2010): Clin Implant Dent Relat Res, 12 Suppl 1: e104-113	12–51 months	Brånemark System Mk III/ IV TiUnite NobelSpeedy	Single-cohort	Edentulous maxilla NobelGuide Immediate loading Minimally invasive	33	211	98.1
Liao, Kan, Rungcharassaeng, Lozada, Herford, Goodacre (2010): Int J Oral Maxillofac Implants, 25: 784-790	1 year	Replace Select Straight with 3 mm machined collar	Prospective	Edentulous mandible Overdentures Immediate loading Minimally invasive Osseointegration/bone preservation	10	17	94.0
Liddelow &Henry (2010): Int J Prosthodont, 23: 13-21	3 years	Brånemark System Mk III	Prospective Randomized, controlled	Edentulous Single implant-retained mandibular overdenture Immediate loading Osseointegration/bone preservation	25	25	100
Meloni, De Riu, Pisano, Cattina, Tullio (2010): Eur J Oral Implantol, 3: 245-251	18 months	NobelReplace Tapered Groovy	Retrospective Monocenter	Edentulous maxilla NobelGuide Immediate loading Minimally invasive (flapless) Osseointegration/bone preservation	15	90	97.8
Nickenig, Wichmann, Schlegel, Nkenke, Eitner (2010): Clin Oral Implants Res, 21: 1386-1393	0.3–0.7 years	NobelReplace Straight Groovy	Comparative Monocenter	Posterior regions Delayed loading Flapless and flap Minimally invasive Osseointegration/bone preservation	644	1244	Not applicable

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Puig (2010): Eur J Oral Implantol, 3: 155-163	1 year	Brånemark System Mk III Groovy NobelSpeedy Groovy	Retrospective	Edentulous jaws NobelGuide Immediate loading Minimally invasive (flapless)	30	195	98
Rasouli Ghahroudi, Talaeepour, Mesgarzadeh, Rokn, Khorsand, Mesgarzadeh, Kharazi Fard (2010): J Dent (Tehran), 7: 89-97	1 year	NobelReplace Groovy Replace Select	Retrospective Cross-sectional	Maxilla and mandible Osseointegration/bone preservation	31	170	Not reported
Sanchez-Garces, Costa-Berenguer, Gay-Escoda (epub ahead 2010): Clin Implant Dent Relat Res	> 18 months	Brånemark System Mk III Replace Select Tapered Replace Select Straight	Retrospective	Short Implants Delayed loading Minimally invasive Osseointegration/bone preservation	Not reported	80	92.5
Zembic, Glauser, Khraisat, Hammerle (2010): Clin Oral Implants Res, 21: 481-489	3 years	Brånemark System Mk IV	Prospective Randomized, controlled	Free end mandible Immediate (IL) and early (EL) loading Osseointegration/bone preservation	11	51	IL: 85.0 EL: 100
Lee, Piao, Koak, Kim, Kim, Ku, Rhyu, Han, Heo (2010): J Oral Rehabil, 37: 538-544 *Piao, Lee, Koak, Kim, Rhyu, Han, Herr, Heo (2009): J Oral Rehabil, 36: 748-754*	3 years 1 year	Brånemark System Mk III	Prospective Randomized, controlled Monocenter	Variety of indications Delayed loading Osseointegration/bone preservation	17	45	100
Agliardi, Francetti, Romeo, Del Fabbro (2009): Int J Oral Maxillofac Implants, 24: 887-895	18–42 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective	Edentulous maxilla Immediate loading Axial and tilted implants Osseointegration	20	120	100
Bahat (2009): Int J Oral Maxillofac Implants, 24: 325-334	3 years	Replace Select Tapered	Prospective	Compromised maxillary bone Drilling protocol Delayed loading Osseointegration	126	290	99.3
Balshi, Wolfinger, Balshi (2009): Int J Oral Maxillofac Implants, 24: 335-341	Not reported	Brånemark System Zygoma (subgroup)	Retrospective Single cohort	Edentulous maxilla Immediate loading Minimally invasive Osseointegration/bone preservation	Not reported	34	100
Carinci, Guidi, Franco, Viscioni, Rigo, De Santis, Tropina (2009): Quintessence Int, 40: 413-419	Mean 27 months (incl. other brands)	TiUnite implants	Retrospective Comparative	Grafted bone Delayed loading Osseointegration/bone preservation	Not reported	26	100
De Rouck, Collys, Wyn, Cosyn (2009): Clin Oral Implants Res, 20: 566-570	1 year	Tapered implants of the Replace family	Prospective Singe-blind Randomized Comparative	Single tooth in extraction sockets Immediate (IL) and delayed (DL) loading Minimally invasive Soft tissue health Osseointegration/bone preservation	49	49	IL: 96.0 DL: 92.0
Eliasson, Blomqvist, Wennerberg, Johansson (2009): Clin Implant Dent Relat Res, 11: 134-148	Up to 5 years	Brånemark System Mk III	Retrospective Comparative	Edentulous mandible Early and delayed loading Osseointegration/bone preservation	26	117	94.0
Fischer, Bäckström, Sennerby (2009): Clin Implant Dent Relat Res, 11: 69-80	1 year	Replace Select	Prospective	Partially edentulous maxilla Immediate/early loading Osseointegration/bone preservation	32	53	98.1
Franco, Viscioni, Rigo, Guidi, Zollino, Avantaggiato, Carinci (2009): J Appl Oral Sci, 17: 301-306	Mean 25 months (incl. other brands)	TiUnite implants	Retrospective	Narrow diameter implants in allografts Delayed loading Minimally invasive Osseointegration/bone preservation	Not reported	41	97.6
Johansson, Friberg, Nilson (2009): Clin Implant Dent Relat Res, 11: 194-200	1 year	Brånemark System Mk III TiUnite	Prospective Multicenter	Edentulous maxilla Immediate loading NobelGuide Minimally invasive Osseointegration/bone preservation	52	312	99.4

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Güncü, Tozum, Guncu, Yamalik, Tumer (2009): Implant Dent, 18: 27-37 *Güncü, Aslan, Tumer, Guncu, Uysal (2008): Clin Oral Implants Res, 19: 335-341*	1 year	Brånemark System Mk III TiUnite	Prospective Randomized, controlled	Molar sites in mandible Immediate (IL) and conventional (CL) loading Minimally invasive Osseointegration/bone preservation	12	24	IL: 91.7 CL: 100
Kan, Rungcharassaeng, Morimoto, Lozada (2009): J Oral Maxillofac Surg, 67: 40-48	1–4 years	NobelReplace Tapered Groovy NobelPerfect	Case study Monocenter	Extraction sockets Immediate loading Soft tissue health Osseointegration/bone preservation	20	20	100
Li, Chow, Hui, Lee, Chow (2009): J Oral Maxillofac Surg, 67: 2653-2662	11.5–71 months	Brånemark System Mk III and Mk IV NobelSpeedy Replace Select/ NobelReplace Tapered Replace Select/ NobelReplace Straight	Retrospective	Edentulous maxilla and mandible Immediate loading Osseointegration/bone preservation	111	690	98.7
Nickenig, Wichmann, Schlegel, Nkenke, Eitner (2009): Clin Oral Implants Res, 20: 550-554	1.9–2.1 years	Replace Select Straight NobelReplace Straight Groovy	Split-mouth Comparative	Posterior region in mandible Delayed loading Osseointegration/bone preservation	34	133	100
Van de Velde, Thevissen, Persson, Johansson, De Bruyn (2009): Clin Implant Dent Relat Res, 11: 183-193	2 years	NobelDirect	Retrospective	Partially edentulous Delayed loading Soft tissue health Osseointegration/bone preservation	10	12	75.0
Becker, Goldstein, Becker, Sennerby, Kois, Hujoel (2009): J Periodontol, 80: 347-352 *Becker, Goldstein, Becker, Sennerby (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S21-27*	3–4 years 2 years	TiUnite implants	Prospective Multicenter	Minimally invasive (flapless) Soft tissue health Osseointegration/bone preservation	57	79	98.7
Alsaadi, Quirynen, Michiles, Teughels, Komarek, van Steenberghe (2008): J Clin Periodontol, 35: 51-57	6 months	Brånemark System Mk III	Prospective Monocenter	Variety of indications Two-stage surgery	283	720	98.1
Becktor, Hallstrom, Isaksson, Sennerby (2008): J Oral Maxillofac Surg, 66: 780-786	Several months	TiUnite implants	Prospective	Maxillary sinus floor augmentation Delayed loading Osseointegration	Not reported	38	97.4
Davo, Malavez, Rojas, Rodriguez, Regolf (2008): Eur J Oral Implantol 1: 141-150	12–42 months	Brånemark System Zygoma Replace	Retrospective	Atrophic maxilla Minimally invasive Immediate loading	Not reported	177	97.7
De Rouck, Collys, Cosyn (2008): J Clin Periodontol, 35: 649-657	1 year	NobelReplace Tapered	Prospective	Extraction sockets Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	30	30	97.0
Francetti, Agliardi, Testori, Romeo, Taschieri, Del Fabbro (2008): Clin Implant Dent Relat Res, 10: 255-263	6–43 months	Brånemark System Mk III NobelSpeedy	Prospective	Edentulous mandible All-on-4 Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	62	248	100
Franco, Tropina, De Santis, Viscioni, Rigo, Guidi, Carinci (2008): Stomatologija, 10: 127-132	2 years	TiUnite implants	Single-cohort	Augmentation with homografts Delayed loading Osseointegration/bone preservation	Not reported	62	96.8
Friberg &Jemt (2008): Clin Implant Dent Relat Res, 10: 47-54	1 year	Brånemark System	Retrospective	Edentulous mandible Early loading Osseointegration/bone preservation	90	450	100
Komiyama, Klinge, Hultin (2008): Clin Oral Implants Res, 19: 677-685	6–44 months	Brånemark System Mk III TiUnite	Prospective Single-cohort	Edentulous Immediate loading	29	176	89.0

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Merli, Bernardelli, Esposito (2008): Eur J Oral Implantol, 1: 61-69	8 months	NobelSpeedy Groovy	Prospective Pilot study	Edentulous maxilla NobelGuide Immediate loading Minimally invasive	13	89	94.4
Mozzati, Monfrin, Pedretti, Schierano, Bassi (2008): Int J Oral Maxillofac Implants, 23: 308-314	2 years	Brånemark System Mk III and Mk IV	Case reports	Edentulous maxilla Immediate loading Minimally invasive	7	34	100
Östman, Hellman, Sennerby (2008): Int J Oral Maxillofac Implants, 23: 315-322	1–4 years	Brånemark System	Prospective	Partially edentulous mandible Immediate loading Osseointegration/bone preservation	Not reported	180	99.6
Schincaglia, Marzola, Giovanni, Chiara, Scotti (2008): Int J Oral Maxillofac Implants, 23: 474-480	1 year	Brånemark System Mk III TiUnite	Prospective Randomized, controlled	Single lower molars Immediate (IL) and delayed (DL) loading Osseointegration/bone preservation	30	30	IL: 93.3 DL: 100
Sennerby, Rocci, Becker, Jonsson, Johansson, Albrektsson (2008): Clin Oral Implants Res, 19: 219-226	1–18 months	NobelDirect	Retrospective Multicenter	Maxilla and mandible All types of loading Osseointegration	43	117	94.9
Achilli, Tura, Euwe (2007): J Prosthet Dent, 97: S52-58	1 year	Replace Select Tapered	Prospective Comparative Multicenter	Maxilla and mandible Posterior FPD Immediate and early loading Osseointegration	51	120	100
Albrektsson, Gottlow, Meireles, Ostman, Rocci, Sennerby (2007): Clin Implant Dent Relat Res, 9: 65-70	1 month–2 years	NobelDirect	Retrospective Multicenter	Minimally invasive Mix of loading protocols	269	550	89.1
Davo, Malevez, Rojas (2007): J Prosthet Dent, 97: S44-51	6–29 months	Brånemark System Mk IV TiUnite	Retrospective	Edentulous maxilla Immediate loading Minimally invasive Osseointegration/bone preservation	18	68	95.6
Degidi, Piattelli, Iezzi, Carinci (2007): Int J Oral Maxillofac Surg, 36: 1172-1176	Mean 3 years	TiUnite implants	Retrospective Comparative	Cemented restorations Immediate loading Minimally invasive Osseointegration/bone preservation	Not reported	60	100
Finne, Rompen, Toljanic (2007): Int J Oral Maxillofac Implants, 22: 226-234	1 year	NobelDirect NobelPerfect	Prospective Multicenter	All indications Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	87	152	98.7
Hatano, Sennerby, Lundgren (2007): Clin Implant Dent Relat Res, 9: 150-155	12–34 months	Brånemark Mk III	Case series	Augmented sinus Delayed loading	6	14	92.9
Kan, Rungcharassaeng, Liddelow, Henry, Goodacre (2007): J Prosthet Dent, 97: S109-118	1 year	NobelPerfect	Prospective Pilot study Multicenter	Single-unit restorations in the maxilla Immediate loading Minimally invasive Soft tissue health Osseointegration/bone preservation	29	38	100
Kan, Rungcharassaeng, Sclar, Lozada (2007): J Oral Maxillofac Surg, 65: 13-19	1 year	Replace Select NobelPerfect	Monocenter	Extraction sockets Immediate loading Soft tissue health Osseointegration/bone preservation	23	23	100
Liddelow &Henry (2007): J Prosthet Dent, 97: S126-137	1 year	Brånemark System Mk III TiUnite	Prospective	Edentulous Single implant-retained mandibular overdenture Mix of loading protocols Soft tissue health Osseointegration/bone preservation	28	28	100
Malo, de Araujo Nobre, Rangert (2007): Clin Implant Dent Relat Res, 9: 15-21	> 1 year	Brånemark System NobelSpeedy Shorty	Retrospective Monocenter	Short implants Mix of loading protocols Osseointegration/bone preservation	Not reported	136	100
Malo, de Araujo Nobre, Lopes (2007): J Prosthet Dent, 97: S26-34	1 year	NobelSpeedy	Preliminary study Monocenter	Edentulous maxilla and mandible All-on-4 Immediate loading Osseointegration/bone preservation	23	92	97.8

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Marzola, Scotti, Fazi, Schincaglia (2007): Clin Implant Dent Relat Res, 9: 136-143	1 year	Brånemark System MK III TiUnite	Prospective Monocenter	Edentulous mandible Overdentures Immediate loading Minimally invasive	17	34	100
Matsui, Ohno, Nishimura, Shirota, Kim, Miyashita (2007): Cleft Palate Craniofac J, 44: 444-447	> 21 months	Brånemark System	Retrospective Monocenter	Alveolar clefts Delayed loading	Not reported	13	100
Ostman, Hellman, Albrektsson, Sennerby (2007): Clin Oral Implants Res, 18: 409-418	1 year	NobelDirect NobelPerfect	Prospective	Maxilla and mandible Crowns and bridges Immediate loading Osseointegration/bone preservation	48	115	94.8
Rao &Benzi (2007): J Prosthet Dent, 97: S3-S14	1–3 years	Replace Select Tapered	Prospective	Single molars in mandible Immediate loading Minimally invasive (flapless)	46	51	100
Rompen, Raepsaet, Domken, Touati, Van Dooren (2007): J Prosthet Dent, 97: S119-125	Up to 2 years	Replace Select TiUnite (prototype)	Pilot study	Single-unit restorations mainly in maxilla Mainly immediate loading Soft tissue health Extraction and healed sites	41	54	100
Schincaglia, Marzola, Scapoli, Scotti (2007): Int J Oral Maxillofac Implants, 22: 35-46	1 year	Brånemark System TiUnite	Prospective Randomized, controlled Split-mouth	Posterior mandible Immediate loading Osseointegration/bone preservation	10	20	100
Siepenkothen (2007): J Prosthet Dent, 97: S69-78	Mean of 17 months	NobelDirect	Retrospective Monocenter	Single- and multiple-unit restorations in maxilla and mandible Immediate loading Osseointegration/bone preservation	58	92	100
Stephan, Vidot, Noharet, Mariani (2007): J Prosthet Dent, 97: S138-145	2 years	Brånemark System Mk III	Pilot study Comparative	Edentulous mandible Overdentures Immediate, early and delayed loading Soft tissue health Osseointegration/bone preservation	26	78	100
Turkyilmaz, Avci, Kuran, Ozbek (2007): Clin Implant Dent Relat Res, 9: 222-227	4 years	Brånemark System Mk III TiUnite	Prospective Comparative	Maxillary single-unit restorations Early (EL) and delayed (DL) loading Osseointegration/bone preservation	29	59	EL: 94.4 DL: 95.7
Tözüm, Turkyilmaz, Yamalik, Karabulut, Eratalay (2007): J Periodontol, 78: 1675-1682	6 months	Brånemark System Mk III	Prospective Randomized, controlled	Edentulous mandible Overdentures Immediate and delayed loading Osseointegration/bone preservation	17	34	100
Villa &Rangert (2007): J Prosthet Dent, 97: S96-S108	1 year	Brånemark System NobelSpeedy	Prospective Pilot study	Maxilla Extraction sockets of infected teeth Immediate and early loading Minimally invasive Osseointegration/bone preservation	33	76	97.4
Turkyilmaz &Tumer (2007): J Oral Rehabil, 34: 773-780 *Turkyilmaz, Tumer, Avci, Hersek, Celik-Bagci (2006): Int J Prosthodont, 19: 515-519* *Turkyilmaz, Sennerby, Tumer, Yenigul, Avci (2006): Clin Oral Implants Res, 17: 501-505*	2 years 1 year	Brånemark System Mk III TiUnite	Prospective Randomized, controlled	Edentulous mandible Overdentures Early and delayed loading Soft tissue health Osseointegration/bone preservation	20	40	100
Alsaadi, Quirynen, van Steenberghe (2006): Int J Oral Maxillofac Implants, 21: 270-274	>9 months	Brånemark System	Retrospective Comparative (machined)	Replacement of failed implants Osseointegration	Not reported	29	96.5
Bedrossian, Rangert, Stumpel, Indresano (2006): Int J Oral Maxillofac Implants, 21: 937-942	1–2.5 years	Brånemark System Mk IV TiUnite	Retrospective	Edentulous maxilla Immediate loading Minimally invasive Osseointegration/bone preservation	14	55	100
Degidi, Perrotti, Piattelli (2006): Clin Implant Dent Relat Res, 8: 169-177	3 years	Brånemark System	Prospective Comparative Non-randomized	Minimally invasive Immediate loading	29	142	100

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Fröberg, Lindh, Ericsson (2006): Clin Implant Dent Relat Res, 8: 187-197	18 months	Brånemark System	Prospective Randomized, controlled	Edentulous mandible Immediate loading Minimally invasive Osseointegration/bone preservation	15	44	100
Malo, Nobre Mde, Petersson, Wigren (2006): Clin Implant Dent Relat Res, 8: 223-232	1 year	NobelSpeedy	Retrospective Monocenter Case series	Edentulous maxilla and mandible All-on-4 Immediate loading Osseointegration/bone preservation	46	189	98.9
Merli, Migani, Bernardelli, Esposito (2006): Int J Oral Maxillofac Implants, 21: 600-606	Several months	Brånemark System Mk III Brånemark System Mk IV	Retrospective Comparative	Posterior maxilla and mandible Partially edentulous Bone grafting Osseointegration/bone preservation	13	21	100
Nowzari, Chee, Yi, Pak, Chung, Rich (2006): Clin Implant Dent Relat Res, 8: 1-10	18 months	NobelPerfect	Retrospective	Scalloped implants Mix of loading protocols Minimally invasive (flapless)	6	17	100
Turkyilmaz (2006): Int J Prosthodont, 19: 389-390	3 years	Brånemark System Mk III	Prospective Monocenter	Maxillary single-unit restorations Early loading Osseointegration/bone preservation	19	36	94.4
Watzak, Zechner, Busenlechner, Arnhart, Gruber, Watzek (2006): Clin Oral Implants Res, 17: 651-657	> 30 months	Brånemark System Mk III	Retrospective	Edentulous mandible Delayed loading Soft tissue health Osseointegration/bone preservation	16	60	98.4
Aalam &Nowzari (2005): Int J Oral Maxillofac Implants, 20: 793-798	2 years	TiUnite implants	Comparative	Variety of indications Mix of loading protocols Osseointegration/bone preservation	25	58	100
Attard, David, Zarb (2005): Int J Prosthodont, 18: 463-470	1 year	TiUnite implants	Prospective Monocenter	Edentulous mandible Overdentures Immediate and early loading	35	70	98.6
Balshi, Wolfinger, Balshi (2005): Clin Implant Dent Relat Res, 7: 24-31	1 up to 4 years	Brånemark System	Prospective	Edentulous maxilla Immediate loading Minimally invasive	Not reported	486	98.8
Balshi, Wolfinger, Balshi (2005): Int J Oral Maxillofac Implants, 20: 946-952	Up to several years	Brånemark System	Prospective	Edentulous Immediate and delayed loading Minimally invasive	82	794	98.6
Brechter, Nilson, Lundgren (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S83-87	Min. 1 year	Brånemark Mk III	Retrospective Comparative	Edentulous Reconstructive jaw surgery Delayed loading Osseointegration/bone preservation	47	200	98.5
Brochu, Anderson, Zarb (2005): Int J Prosthodont, 18: 506-512	4 months	Nobel Biocare TiUnite implants	Prospective Pilot study Comparative	Edentulous mandible Overdentures Early and delayed loading	22	41	100
Friberg, Dahlin, Widmark, Ostman, Billstrom (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S70-75	1 year	Brånemark Mk III Brånemark Mk IV	Prospective Multicenter	All indications Predominantly delayed loading Osseointegration/bone preservation	187	478	98.9
Jungner, Lundqvist, Lundgren (2005): Clin Oral Implants Res, 16: 308-312	> 5 months	Brånemark System	Comparative	Edentulous Early and delayed loading	69	199	100
Malo, Rangert, Nobre (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S88-94	1 year	Brånemark System Mk III/ IV TiUnite	Retrospective Monocenter	Edentulous maxilla All-on-4 Immediate loading Minimally invasive Osseointegration/bone preservation	32	128	97.6
Östman, Hellman, Sennerby (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S60-69	1 year	Brånemark System Replace Select Tapered	Prospective	Edentulous maxilla Immediate loading Osseointegration/bone preservation	20	123	99.2
Parel &Schow (2005): J Oral Maxillofac Surg, 63: 2-10	2.5–32 months	NobelDirect	Monocenter	Single-tooth replacements Immediate loading Minimally invasive (flapless)	35	45	97.8
Renouard &Nisand (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S104-110	Min. 2 years	Brånemark System	Retrospective	Short implants in resorbed maxilla Delayed loading Minimally invasive Osseointegration/bone preservation	Not reported	42	97.6

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	TiUnite implant	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
van Steenberghe, Glauser, Blomback, Andersson, Schutyser, Pettersson, Wendelhag (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S111-120	1 year	Brånemark System Mk III TiUnite	Prospective Multicenter	Edentulous maxilla NobelGuide Immediate loading Minimally invasive (flapless) Osseointegration/bone preservation	27	184	100
Vanden Bogaerde, Rangert, Wendelhag (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S121-130	18 months	Brånemark System Mk IV TiUnite	Prospective	Partial maxilla and posterior mandible Extraction sites Immediate loading Minimally invasive Osseointegration/bone preservation	19	50	100
Villa &Rangert (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S28-35	1 year	Brånemark System	Monocenter	Mandible Infected extraction sites Immediate and early loading Minimally invasive Osseointegration/bone preservation	Not reported	38	100
Calandriello &Tomatis (2004): Applied Osseointegration Research, 4: 32-40	> 1 year	Brånemark System	Prospective Comparative	Single teeth Immediate loading Osseointegration/bone preservation	Not reported	66	100
Lundgren, Andersson, Gualini, Sennerby (2004): Clin Implant Dent Relat Res, 6: 165-173	12 months	Brånemark Mk III	Monocenter	Maxillary sinus floor augmentation Delayed loading	10	19	100
Payne, Tawse-Smith, Thomson, Duncan, Kumara (2004): Clin Implant Dent Relat Res, 6: 61-74	1 year	Brånemark System	Prospective Randomized, controlled Monocenter	Edentulous maxilla Overdentures Early loading Osseointegration/bone preservation	19	57	92.9
Vanden Bogaerde, Pedretti, Dellacasa, Mozzati, Rangert, Wendelhag (2004): Clin Implant Dent Relat Res, 6: 121-129	18 months	Brånemark System	Prospective Multicenter	Partial mandible and maxilla Early loading Osseointegration/bone preservation	31	111	99.1
Calandriello, Tomatis, Vallone, Rangert, Gottlow (2003): Clin Implant Dent Relat Res, 5 Suppl 1: 74-80	6–12 months	Brånemark System	Prospective Multicenter	Single molars in mandible Immediate loading Osseointegration/bone preservation	44	50	100
Olsson, Urde, Andersen, Sennerby (2003): Clin Implant Dent Relat Res, 5 Suppl 1: 81-87	1 year	Brånemark System	Case series	Edentulous maxilla Immediate and early loading Osseointegration/bone preservation	10	61	93.4
Rocci, Martignoni, Gottlow (2003): Clin Implant Dent Relat Res, 5 Suppl 1: 57-63	1 year	Brånemark System	Prospective Randomized, controlled	Partial, posterior mandibles Immediate loading Osseointegration/bone preservation	22	66	95.5
Glauser, Gottlow, Lundgren, Sennerby, Portmann, Ruhstaller, Hammerle (2002): Appl Osseointegration Res, 3: 22-24	1 year	Brånemark System Mk IV	Monocenter	Bone quality 4 Immediate loading	19	27	100
Lundgren &Brechter (2002): Appl Osseointegration Res, 1: 18-20	12–21 months	TiUnite implants	Retrospective Monocenter	Augmented bone Delayed loading	Not reported	171	99.4
Glauser, Portmann, Ruhstaller, Lundgren, Hammerle, Gottlow (2001): Appl Osseointegration Res, 2: 27-29	6 months	Brånemark System Mk IV	Comparative study	Partial, posterior maxilla	9	20	100

*Includes all eligible patients that received the TiUnite implant type(s) stated. Non-TiUnite implants are not reported in the table.
**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

NobelActive® – high initial stability allows for immediate loading.

The design of NobelActive is unique. Its implant body and threads condense bone during insertion, which ensures high initial stability. Its back-tapered collar and built-in platform shifting maximize alveolar bone and soft tissue volume; and the drilling blades on the apex allow for adjusting the implant to the optimal restorative orientation.

Enhanced osseointegration

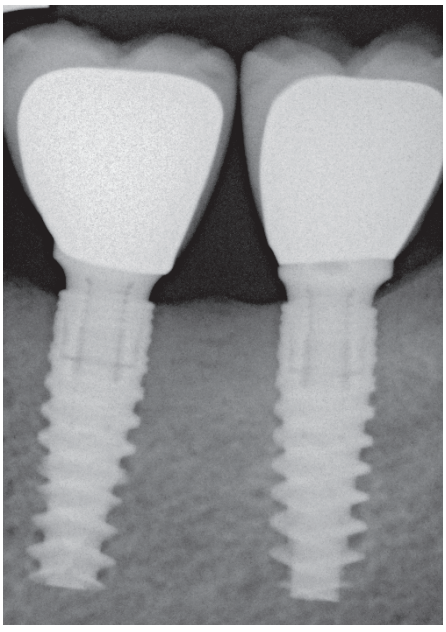
The NobelActive implant was introduced in 2008 with a tapered design and sharp and widely spaced (1.2 mm) double-lead threads, which have grooves and are gradually expanding. Threads with grooves are known to favor bone growth;[1] and the moderately rough TiUnite surface has proven to achieve rapid bone apposition.[2]

High initial stability

Due to its unique thread design, NobelActive advances 2.4 mm with each rotation, which is up to four times more than other implants. With maximum torque forces of up to 70 Ncm, the bone gets gradually compressed both axially and radially during insertion. This results in an exceptionally high immediate stability even in fresh extraction sockets and poor bone quality, allowing for immediate loading also under demanding conditions.

Stable bone levels and healthy papilla

NobelActive features an internal conical connection with hexagonal interlocking for a tight seal and secure positioning of abutments. The built-in platform shifting promotes favorable soft tissue adaptation and maintenance of marginal bone.[3] In addition, NobelActive enables experienced clinicians to adjust the implant position for optimal restorative orientation (e.g. in extraction sockets).



Stable bone levels three years later: Immediately loaded single crowns.

Courtesy of Prof. M. Lorenzoni, Austria

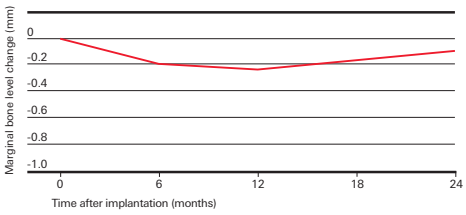
NobelActive® – scientific evidence.

NobelActive supports esthetic excellence with minimal bone remodeling and increasing papilla size. It achieves exceptionally high initial stability and is therefore a successful and predictable implant also under demanding conditions such as immediate post-extraction tooth replacements. More than 2500 implants have been clinically documented in over 1000 patients.

Key findings of the clinical studies are:
– Minimal marginal bone remodeling followed by stable or increasing bone levels.[4,5,6,8,9,13]
– Significant improvement in papilla size during first year, followed by stable papilla conditions during the second and third year, indicating healthy and esthetic soft tissue.[4,5,8,9]
– High cumulative survival rates under various clinical conditions and using immediate function protocols.[4–14]
– High initial stability in all bone types.[8,14,15]
– Bone condensing and redirection capability confirmed.[15]
– Excellent treatment outcome using All-on-4.[10]

Clinical studies with follow-up times of up to three years confirm the exceptional performance of NobelActive.

Minimal marginal bone remodeling followed by increasing bone levels



Graph shows entire bone remodeling from day of implant placement to two-year follow-up.[5]

In-depth study prior to launch

Already at launch, clinical 1-year follow-up data was available from a multicenter (12 university centers) randomized controlled study that was initiated in early 2006. The 1-year data was gathered prior to the full market introduction in 2008 and published in 2009. The 3-year follow-up was published in 2012.[4] The aim of this study was to verify whether immediate loading could be applied with NobelActive while achieving the same stable marginal bone levels and soft tissue healing as with the well-documented NobelReplace Tapered implant. 177 partially edentulous patients were randomly allocated to receive NobelActive (n=199) or NobelReplace implants (n=126) in healed extraction sites. The NobelActive group was divided into implants with internal conical (n=117) and with external hex connection (n=82). In total, 325 implants were followed (222 in the mandible and 103 in the maxilla). Immediate provisional restorations were installed the same day in all but three patients, who received their restorations two to four days later due to logistical reasons. Ten implants failed during the first year. After three years, the cumulative survival rate was 96–97% in all three groups. Marginal bone levels were measured on intraoral radiographs. After initial bone remodeling, they demonstrated the same stable or improving levels during the second and third year. The mean papilla score (Jemt's Papilla Index, see next page) increased significantly in all treatment groups.

NobelActive
A tapered implant with straight drilling protocol

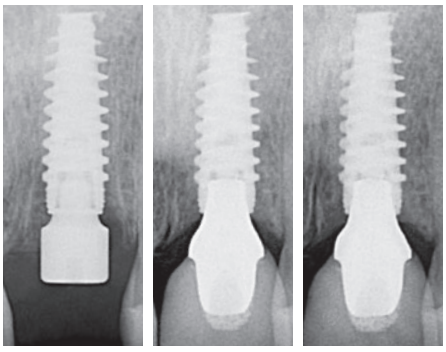
NobelReplace
A tapered implant with tapered drilling protocol

High marginal bone maintenance

McAllister et al. (2012) report in their clinical multicenter study on 60 immediately loaded implants placed in extraction sockets of 55 patients.[5] Final restorations (58 single crowns and one two-unit bridge) were placed within the first year. The cumulative survival rate was 98.3% at the two-year follow-up. One implant failed prior to the three-month follow-up visit. The mean marginal bone remodeling from implant insertion to the one-year follow-up was -0.22 mm, followed by an average bone gain of +0.12 mm between 12 months and 24 months. Mean marginal bone remodeling was therefore only -0.10 mm from implant insertion to two-year follow-up. Papilla size, measured by Jemt's Papilla Index (see below) increased significantly ($p < 0.001$) over the two years; and also patient assessment of function, esthetics and self-esteem, measured on a VAS scale of 1 to 100, showed significant improvement.

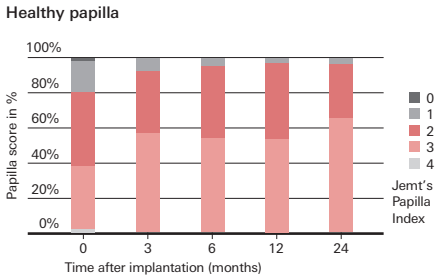
A large-scale clinical assessment of NobelActive for different indications

In a retrospective monocenter study Babbush and Brokloff (2012) report on 1001 NobelActive implants, consecutively inserted in partially and fully edentulous patients.[7] In completely edentulous jaws, the All-on-4 treatment concept was used. All 1001 implants achieved primary stability at placement. 94% of the 293 patients followed a one-stage protocol, with a fixed provisional acrylic prosthesis immediately loaded on the day of implant placement. Occlusal contact was limited to the anterior area in total maxillary and mandibular reconstructions; in partial edentulism, provisional restorations were placed out of occlusal contact. The final restorations were delivered within 6 to 8 months after implant insertion. The follow-up was available for 960 implants at more than 1 year and for 216 implants at 2 years. The overall cumulative survival rate was 97.4% with no difference between upper and lower jaws, indicating that the routine use of NobelActive with immediate loading for different indications offers a high short-term survival rate.



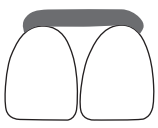
Stable bone levels: Radiographs from a case in McAllister et al. (2012) highlighting the increasing bone levels over time.[5]

Courtesy of Dr. M. Kolinski, USA

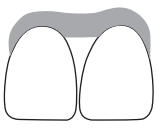


Papilla scores increased significantly between implant insertion and two-year follow-up, with most of the increase occurring during the first year.[5]

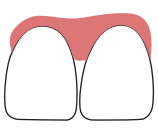
Explanation of Jemt's Papilla Index[16]



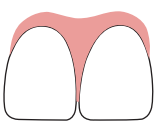
Score 0
No papilla



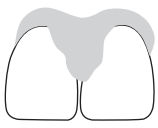
Score 1
Less than half of the papilla height



Score 2
Half or more of the papilla height



Score 3
Optimal soft tissue contour with papilla filling up the entire proximal space



Score 4
Hyperplastic papilla covering too much of the restoration and/or adjacent tooth

NobelActive® – pivotal study.

Christoph Arnhart, Andrej M. Kielbassa, Rafael Martinez-de Fuentes, Moshe Goldstein, Jochen Jackowski, Martin Lorenzoni, Carlo Maiorana, Regina Mericske-Stern, Alessandro Pozzi, Eric Rompen, Mariano Sanz, Jörg R. Strub

Comparison of variable-thread tapered implant designs to a standard tapered implant design after immediate loading. A 3-year multicentre randomised controlled trial

Key words *dental implant, peri-implant bone remodelling, soft tissue evaluation, variable-thread design*

Objectives: This randomised, controlled multicentre trial aimed at comparing two versions of a variable-thread dental implant design to a standard tapered dental implant design in cases of immediate functional loading for 36 months after loading.

Materials and methods: 177 patients (325 implants) were included at 12 study centres and randomly allocated into one of three treatment groups: NAI (variable-thread design, NobelActive internal connection), NAE (variable-thread design, NobelActive external connection) and, as control, NR (standard tapered design, NobelReplace tapered groovy). Inclusion criteria concerned healed bony implant sites and feasibility for immediate loading. Clinical and radiographic examinations were performed at implant placement and after 3, 6, 12, 24 and 36 months. The outcome measures were marginal bone remodelling (primary outcome), implant survival and success, papilla score, plaque accumulation, and bleeding on probing.

Results: 127 patients (NAI: 45, NAE: 41, NR: 41) were followed-up and evaluated after 36 months. No significant differences in cumulative survival rates were seen for the groups (NAI: 95.7%; NAE: 96.3%; NR: 96.6%). In all groups, bone remodelling occurred during the first 3 months, with stable or even increasing bone levels after the initial remodelling period. The bone remodelling from insertion to 36 months for the NAI group (-0.89 ± 1.65 mm) was comparable ($P = 0.98$) to that of the NR group (-0.85 ± 1.32 mm). The NAE group showed comparable bone remodelling during the first year, with an increase in following years resulting in significantly less overall bone loss (-0.16 ± 1.06 mm) ($P = 0.041$). Overall improvement in papilla size was observed in all treatment groups.

Conclusions: Over 36 months, the results show stable or improving bone levels for all treatment groups after the initial bone remodelling seen during the first 3 months after placement. The variable-thread implants showed results comparable to those of standard tapered implants in cases of immediate function, and therefore can be considered as a treatment option for immediate loading.

Conflict-of-interest statement: *The present study (T-117) was supported by Nobel Biocare Services AG, Kloten, Switzerland. All authors were funded by their institutions. The authors declare that there is no affiliation or any other conflict of interest to the sponsor. The final protocol was elaborated and finalised in a consensus between all participating centres during an investigator meeting prior to the start of the study. The study was conducted independently at each centre according to the study protocol. Information on the study protocol can be found online at http://clinicaltrials.gov/ (NCT01397617).*

Christoph Arnhart, DDS
Senior Staff, Oral Surgery, Bernhard Gottlieb Dental School, Medical University of Vienna, Vienna, Austria

Andrej M. Kielbassa, DDS, PhD
Professor, Head of the Centre for Operative Dentistry and Periodontology, Dean of the University of Dental Medicine and Oral Health, Danube Private University (DPU), Krems, Austria

Rafael Martinez-de Fuentes, DDS, PhD
Associate Professor, Department of Prosthodontics, Faculty of Dentistry, University of Seville, Seville, Spain

Moshe Goldstein, DMD
Senior Staff, Department of Periodontology, The Hebrew University – Hadassah Medical Center, Jerusalem, Israel

Jochen Jackowski, DDS, PhD
Professor, Head of the Department of Oral Surgery, University Witten/Herdecke, Witten, Germany

Martin Lorenzoni, MD, DDS, PhD
Professor, Department of Prosthodontics, Medical University of Graz, Graz, Austria

Carlo Maiorana, MD
Professor and Chair, Oral Surgery and Implantology, Dental Clinic Fondazione IRCCS Policlinico, University of Milan, Milan, Italy

© Copyright 2012 Quintessence Publishing Co. Ltd.
Comparison of variable-thread tapered implant designs to a standard tapered implant design after immediate loading. A 3-year multicentre randomised controlled trial
From: European Journal of Oral Implantology, Volume 5, Issue 2, Summer 2012, Pages: 123-36

NobelActive® – references.

1 Hall J, Miranda-Burgos P, Sennerby L. Stimulation of directed bone growth at oxidized titanium implants by macroscopic grooves: an in vivo study. Clin Implant Dent Relat Res. 2005;7(suppl 1):76-82

2 Albrektsson T, Johansson C, Lundgren A-K, Sul Y-T, Gottlow J. Experimental studies on oxidized implants. A histomorphometrical and biochemical analysis. Appl Osseoint Res 2000;1:21-4

3 Canullo L, Pellegrini G, Allievi C, Trombelli L, Annibali S, Dellavia C: Soft tissues around long-term platform switching implant restorations: a histological human evaluation. Preliminary results. J Clin Periodontol 2011;38: 86-94

4 Arnhart C, Kielbassa AM, Martinez-de Fuentes R, Goldstein M, Jackowski J, Lorenzoni M, Maiorana C, Mericske-Stern R, Pozzi A, Rompen E, Sanz M, Strub JR. Comparison of variable-thread tapered implant designs to a standard tapered implant design after immediate loading. A 3-year multicenter randomised controlled trial. Eur J Oral Implantol. 2012 5:123-36

5 McAllister BS, Cherry JE, Kolinski ML, Parrish KD, Pumphrey DW, Schroering RL. Two-year Evaluation of a Variable-Thread Tapered Implant in Extraction Sites with Immediate Temporization: A Multicenter Clinical Trial. Int J Oral Maxillofac Implants. 2012 May-Jun;27:611-18

6 Cosyn J, De Bruyn H, Cleymaet R. Soft tissue preservation and pink aesthetics around single immediate implant restorations: A 1-year prospective study. Clin Implant Dent Relat Res. 2012. [Epub ahead of print]

7 Babbush CA, Brokloff J. A Single-Center Retrospective Analysis of 1001 Consecutively Placed NobelActive Implants. Implant Dent. 2012 Feb;21:28-35

8 Kielbassa AM, Martinez-de Fuentes R, Goldstein M, Arnhart C, Barlattani A, Jackowski J, Knauf M, Lorenzoni M, Maiorana C, Mericske-Stern R, Rompen E, Sanz M. Randomized controlled trial comparing a variable-thread novel tapered and a standard tapered implant: interim one-year results. J Prosthet Dent. 2009 May;101:293-305

9 Cherry JE, Kolinski ML, McAllister BS, Parrish KD, Pumphrey DW, Schroering RL. One-year follow-up of NobelActive® variable-thread, tapered implant, in extraction sites. Poster presentation at the 26th AO meeting, Washington D.C., March 2011

10 Babbush CA, Kutsko GT, Brokloff J. The all-on-four immediate function treatment concept with NobelActive implants: a retrospective study. J Oral Implantol. 2011 Aug;37:431-45

11 Navarro Jr JM. Early results of 409 consecutively placed novel tapered, variable thread design implants. Clin Oral Implants Res 2009 20:Abstract 027

12 Aspriello SD, Rasicci P, Ciolino F, Zizzi A, Rubini C, Procaccini M, Piemontese M. Immediate loading of NobelActive implants in postmenopausal osteoporotic women: 2-years follow up study. Oral Implants Res 2011 22:Abstract 222

13 Gultekin A, Yalcin S. Clinical effect of different implant designs on peri-implant tissues. Clin Oral Implants Res 2010;21:Abstract 094

14 Irinakis T, Wiebe C. Initial torque stability of a new bone condensing dental implant. A cohort study of 140 consecutively placed implants. J Oral Implantol. 2009;35:277-82

15 Irinakis T, Wiebe C. Clinical evaluation of the NobelActive implant system; a case series of 107 consecutively placed implants and a review of the implant features. J Oral Implantol. 2009;35:283-8

16 Jemt T. Regeneration of gingival papillae after single-implant treatment. Int J Periodont Rest Dent 1997;17:327-33

17 Pozzi A, Agliardi E, Tallarico M, Barlattani A. Clinical and Radiological Outcomes of Two Implants with Different Prosthetic Interfaces and Neck Configurations: Randomized, Controlled, Split-Mouth Clinical Trial. Clin Implant Dent Relat Res. 2012

18 Prosper L, Redaelli S, Pasi M, Zarone F, Radaelli G, Gherlone EF. A randomized prospective multicenter trial evaluating the platform-switching technique for the prevention of postrestorative crestal bone loss. Int J Oral Maxillofac Implants 2009; 24:299–308

NobelActive® – summary of key studies.

The following overview lists clinical studies on NobelActive according to follow-up time.

Only peer-reviewed clinical studies are listed. Reviews, single case reports, technique descriptions, and animal and in vitro tests are excluded.

For more information on all studies on NobelActive visit:
nobelbiocare.com/scientific-evidence or PubMed at pubmed.gov

Reference	Follow-up time	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Follow-up time ≥ 2 years						
Arnhart, Kielbassa, Martinez-de Fuentes, Goldstein, Jackowski, Lorenzoni, Maiorana, Mericske-Stern, Pozzi, Rompen, Sanz, Strub (2012): Eur J Oral Implantol, 5: 123-136 *Kielbassa, Martinez-de Fuentes, Goldstein, Arnhart, Barlattani, Jackowski, Knauf, Lorenzoni, Maiorana, Mericske-Stern, Rompen, Sanz (2009): J Prosthet Dent, 101: 293-305*	3 years 1 year	Prospective Multicenter Randomized, controlled	Partially edentulous maxilla and mandible Immediate loading Soft tissue health Osseointegration/bone preservation	64	117	95.7
Babbush & Brokloff (2012): Implant Dent, 21: 28-35	Up to 31 months	Retrospective Monocenter	All indications Osseointegration/bone preservation	293	1001	97.4
McAllister, Cherry, Kolinski, Parrish, Pumphrey, Schroering (2012): Int J Oral Maxillofac Implants, 27: 611-618	2 years	Prospective Multicenter	Extraction sites Immediate loading Soft tissue health Osseointegration/bone preservation	55	60	98.3
Aspriello, Rasicci, Ciolino, Zizzi, Rubini, Procaccini, Piemontese (2011): 20th Annual Scientific Congress of the European Association for Osseointegration	2 years	Retrospective	Compromised patients (osteoporotic) Immediate loading Osseointegration/bone preservation	38	98	100
Babbush, Kutsko, Brokloff (2011): J Oral Implantol, 37: 431-445	Up to 29 months	Monocenter Retrospective	Edentulous maxilla and mandible All-on-4 Minimally invasive Immediate loading	165	708	99.6
Demanet, Merheb, Simons, Leroy, Quirynen (2011): Le Dentiste, 426: 22-25	Up to 3 years	Retrospective Field study	All indications Immediate and non-immediate loading Osseointegration/bone preservation	172	466	99.1
Follow-up time < 2 years						
Bell, Bell, Bell (epub ahead 2012): J Oral Implantol	Not reported	Retrospective Comparative	Anterior maxilla Extraction sites Single implants Immediate (IL) vs delayed loading (DL)	109	126	IL: 92.9 DL: 97.6 (n.s.)
Cosyn, De Bruyn, Cleymaet (epub ahead 2012): Clin Implant Dent Relat Res	1 year	Prospective	Extraction sites Single implants Immediate loading Soft tissue health Osseointegration/bone preservation	22	22	95.5
Pozzi, Agliardi, Tallarico, Barlattani (epub ahead 2012): Clin Implant Dent Relat Res	1 year	Prospective Randomized Split-mouth	Single implants Delayed loading Osseointegration/bone preservation	34	44	100
Ho, Yeung, Zee, Curtis, Hell, Tumuluri (epub ahead 2011): Clin Oral Implants Res	6 months	Prospective Randomized, controlled Split-mouth	Healed sites Early loading Osseointegration/bone preservation	32	32	87.5

Reference	Follow-up time	Study type	Indication/study focus	Number of patients*	Number of implants*	CSR %**
Galindo &Butura (2012): Int J Oral Maxillofac Implants, 27: 628-633	1 year	Retrospective	Edentulous All-on-4 Immediate loading	Not reported	60	100
Ganeles, Norkin, Zfaz (2012): 27th Annual Meeting of the Academy of Osseointegration	6 months	Prospective	Extraction sites Single implants Immediate loading Minimally invasive Osseointegration/bone preservation	15	15	100
Imburgia (2012): 20th Anniversary Meeting of the European Association for Osseointegration, 23: 145	18 months	Prospective	Extraction sites Single implants Immediate loading Minimally invasive Osseointegration/bone preservation	32	32	100
Pintado (2012): 27th Annual Meeting of the Academy of Osseointegration	1 year	Retrospective	Anterior maxilla Extraction sites Immediate loading Minimally invasive Osseointegration/bone preservation	37	54	100
Slagter, Meijer, Den Hartog, Vissink, Raghoebar (2012): 20th Anniversary Meeting of the European Association for Osseointegration, 23: 23	1 year	Prospective Randomized, controlled	Extraction sites Single implants Immediate and delayed loading Minimally invasive Soft tissue health Osseointegration/bone preservation	40	40	100
de Santis, Alberti, Rigoni, Verlato, Nocini (2011): 89th General Session of the International Association for Dental Research	1 year	Prospective	Edentulous maxilla Immediate and delayed loading Smokers Osseointegration/bone preservation	34	86	Not reported
Gultekin &Yalcin (2010): 19th Annual Scientific Meeting of the European Association for Osseointegration, 1027	1 year	Prospective Randomized, controlled	Two-stage surgery Delayed loading Osseointegration/bone preservation	25	43	97.7
Lope, Rosello, Altuna, Ferres-Padro, Hernandez-Alfaro (2010): 19th Annual Scientific Meeting of the European Association for Osseointegration, 1077	6 months	Prospective Comparative	Mandibular overdenture Edentulous Immediate and delayed loading Patient satisfaction	8	16	100
Irinakis &Wiebe (2009): J Oral Implantol, 35: 277-282	Not reported	Prospective	All indications Osseointegration/bone preservation	84	140	97.9
Irinakis &Wiebe (2009): J Oral Implantol, 35: 283-288	5 to 13 months (mean 9.25 months)	Prospective	All indications Soft tissue health Osseointegration/bone preservation	67	107	98.1
Navarro Jr (2009): 18th Annual Scientific Meeting of the European Association for Osseointegration, 871-872	1 year	Retrospective	Immediate and delayed loading	138	409	98.0

*Includes all eligible patients that received the NobelActive implant.

**If the CSR is not reported in the study, the percentage of surviving implants was calculated.

All-on-4® – efficient and reliable full-arch restorations.

The All-on-4 treatment concept provides edentulous patients with an efficient and effective restoration using only four implants to support an immediately delivered full-arch prosthesis.

4 versus 6 implants

Quite soon after the worldwide introduction of the osseointegration technique for oral rehabilitation, the controversy started on the optimal number of implants to anchor a fixed dental prosthesis in edentulous patients. Some clinicians tended to install as many implants as possible, even one implant per tooth, assuming that this was favorable from a biomechanical point of view. Others considered this a purely mechanistic concept. Only long-term clinical data could clarify the opposing views. The records of the early patients operated by P-I Brånemark allowed for a retrospective study.[1] More than 150 consecutive edentulous patients were checked, all with a fixed prosthesis on either 4 or 6 original Brånemark machined implants of 7 to 10 mm length. The reason for installing only four implants was mostly due to the limited remaining bone volume. After the 10 years observation period the survival rates were the same for restorations with 4 and 6 implants.

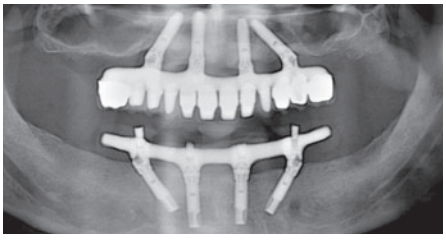
Reduced need for bone grafting

Advanced resorption of the edentulous lower jaw makes a full-arch reconstruction challenging, as it is often impossible to insert implants distal to the mental foramina without prior grafting procedure and/or nerve lateralization. Therefore the concept of tilting the two distal implants was introduced. This offered a substantial gain in prosthesis support, as it widened the dental arch and reduced the tensile stresses caused by the cantilever prosthesis.[2] In addition, the cumulative survival rate after 5 years was superior for the tilted implants (98%) compared to the axial ones (93%) in the maxilla. In the mandible, no failures occured at all.

Immediate loading, even in fresh extraction wounds

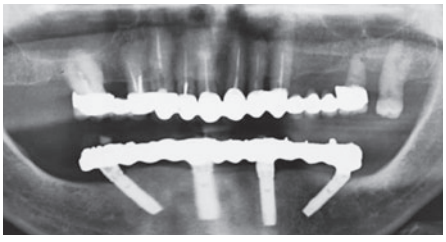
In 2003, reassured by the good results with immediate loading of implants in the mandible,[3] Paulo Malo and Bo Rangert introduced the concept of immediate loading of four implants in edentulous lower and soon after also upper jaws with two tilted distal implants, taking advantage of the bone that remains in the front part of the jaws and avoiding the mandibular canal or maxillary sinus. This one-stage procedure substantially reduced the costly and time-consuming bone grafting procedures, number of surgeries and healing time, and reduced the cantilever bridge to one tooth.

All-on-4 treatment concept: Four implants – two straight implants in the anteror and two tilted ones in the posterior – support a fixed full-arch prosthesis with maximum 12 teeth (also in cases with minimum bone volume).



7-year follow-up: Panoramic radiograph (OPG) showing All-on-4 with NobelSpeedy Groovy implants and NobelProcera Implant Bridge both in maxilla and mandible.

Courtesy of Dr. Paulo Malo, Portugal



8-year follow-up: Panoramic radiograph (OPG) showing All-on-4 with NobelSpeedy Groovy implants and NobelProcera Implant Bridge in mandible.

Courtesy of Dr. Enrico Agliardi, Italy

All-on-4® – scientific evidence.

The All-on-4 treatment concept allows for reliable full-arch restorations in the maxilla and mandible with only four implants. Both tilted and axial implants show favorable bone levels and soft tissue parameters.

– Proven long-term solution – up to 10 years follow-up in the mandible[4] and 5 years in the maxilla.[5]
– High cumulative survival rates in both edentulous maxilla and mandible,[4-22] also with guided treatment concept NobelGuide.[14,18]
– Favorable marginal bone levels for tilted and axial implants.[7,9,10,11,12]
– Favorable soft tissue parameters for tilted and axial implants.[10,12,15]

Clinical studies with follow-up times of up to 10 years confirm the reliable short- and long-term performance of the treatment concept All-on-4.

High survival rates for tilted implants
Already in his first study Malo reported a cumulative survival rate of 96.7% for implants and 100% for prostheses. Since then, Malo and colleagues have repeatedly reproduced high survival rates for both upper and lower jaw. Today, the All-on-4 treatment concept is used worldwide with similar high survival rates and patient satisfaction at limited costs.[4]

In a single-center cohort study 170 patients were treated with full-arch restorations of the edentulous upper or lower jaw with often advanced bone resorption, with immediate installation of a provisional functional acrylic prosthesis on 4 implants (Brånemark System Mk IV and NobelSpeedy Groovy).[9] The two anterior implants were placed axially, the two distal ones were tilted, thereby avoiding grafting procedures. The finalization of the prosthesis occurred 4–6 months later. Nearly 700 implants were inserted (404 in the mandible and 288 in the maxilla). All kinds of opposing dentitions were encountered: removable prostheses (50), natural teeth (15), natural teeth with fixed prostheses (15), and implant-supported bridges (9). The outcome analysis was based on about 90% of the enrolled patients (154), who had their prosthesis in function for at least 1 year. The overall follow-up range was between 4 and 59 months. From the axially placed implants in the maxilla 4 failed (in 4 patients), while only one tilted implant failed. All failures occurred within 6 months due to mobility, and revision surgery was successful in all cases. Since no late (> 1 year) failures occurred, the cumulative implant survival rate remained high for up to 5 years. Marginal bone level change averaged 0.9 +/- 0.7 mm in the maxilla and 1.2 +/- 0.9 mm in the mandible, with no difference between axial and tilted implants. Fracture of the provisional acrylic prosthesis occurred in 14% of the patients. This large scale cohort study proves that very high survival rates can be achieved with the All-on-4 treatment concept and that grafting procedures can be avoided in cases with advanced bone resorption.

High cumulative survival rates (CSR)

Short-term 0.5–1 year	97.6–100% [6,8,11,12,16]
Mid-term 3–4 years	96.9–100% [10,11]
Mid-term 4–5 years	98.4–99.7% [9]
Long-term 5–10 years	94.8–98.0% [4,5]

Duplicating excellent results in other centers

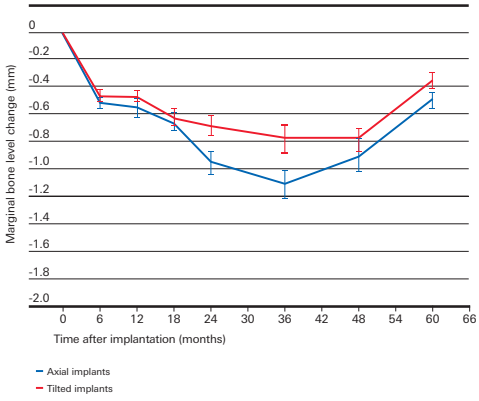
Most of the first data available on All-on-4 originate from Paulo Malo and his team, but several other centers have duplicated their results successfully. The All-on-4 treatment concept has reached very high survival rates for both implants and prosthesis with different implant types worldwide. Babbush et al. (2011) used All-on-4 with the NobelActive implant in a single-center retrospective study.[6] They inserted approximately 700 NobelActive implants in 165 patients, who were edentulous in either the upper or lower jaw. A cumulative survival rate of 99.6% (99.3% in the maxilla and 100% in the mandible) was reached after up to 29 months. The survival rate of the final prosthesis was 100%.

In another retrospective study Cavalli et al. (2012) used Brånemark System Mk IV and NobelSpeedy Groovy implants in 34 patients with edentulous maxillae.[22] The final prosthesis was installed within 6 months. Control visits happened weekly during the first month and every 3 months afterwards, and tissue healing and oral hygiene were monitored. All patients passed the one year control and the mean follow-up was nearly 40 months. The cumulative implant survival rate reached 100%, while most complications were observed with the provisional prosthesis.

Marginal bone maintenance around tilted implants

Francetti et al. (2012)[7] focus on the fate of the marginal bone around tilted implants, since it has been proven in vitro and through finite element analysis that the marginal bone may be more stressed by the bending of tilted implants.[23] However, splinting of tilted implants in a somewhat rigid superstructure changes the biomechanics.[24] 47 patients were treated with 196 implants 4 mm in diameter (64 in the maxilla, 132 in the mandible) and were followed for an average of 4 years. Marginal bone levels were repeatedly assessed on intra-oral radiographs using the paralleling technique and subjected to image analysis software and subsequently read by two independent blinded evaluators. The interim report from this prospective study shows that there is no difference between axial and tilted implants with regards to marginal bone level change over 3 years, and that there is no difference between maxilla and mandible.

Favorable marginal bone levels with both axial and tilted implants



Implants loaded within 48 hours after implant placement with radiographic baseline at time of insertion. Therefore all bone remodeling is reported. Graph shows results for mandible, but results for maxilla are similar.[7]

All-on-4® – pivotal study.

Clinical Implant Dentistry and Related Research, Volume 14, Supplement 1, 2012

"All-on-4" Immediate-Function Concept for Completely Edentulous Maxillae: A Clinical Report on the Medium (3 Years) and Long-Term (5 Years) Outcomes

Paulo Maló, DDS, PhD;* Miguel de Araújo Nobre, RDH;† Armando Lopes, DDS;‡
Carlos Francischone, DDS, PhD;§ Mauricio Rigolizzo, DDS, PhD¶

ABSTRACT

Background: Immediate implant function has become an accepted treatment modality for fixed restorations in totally edentulous mandibles, whereas experience from immediate function in the edentulous maxilla is limited.

Purpose: The purpose of this study was to report on the medium- and long-term outcomes of a protocol for immediate function of four implants (All-on-4™, Nobel Biocare AB, Göteborg, Sweden) supporting a fixed prosthesis in the completely edentulous maxilla.

Materials and Methods: This retrospective clinical study included 242 patients with 968 immediately loaded implants (Brånemark System® TiUnite™, Nobelspeedy™, Nobel Biocare AB) supporting fixed complete-arch maxillary all-acrylic prostheses. A specially designed surgical guide was used to facilitate implant positioning and tilting of the posterior implants to achieve good bone anchorage and large interimplant distance for good prosthetic support. Follow-up examinations were performed at 6 months, 1 year, and thereafter every 6 months. Radiographic assessment of the marginal bone level was performed after 3 and 5 years in function. Survival was estimated at patient level and implant level using the Kaplan–Meier product limit estimation with 95% confidence intervals.

Results: Nineteen immediately loaded implants were lost in seventeen patients, giving a 5-year survival rate estimation of 93% and 98% at patient and implant level, respectively. The survival rate of the prosthesis was 100%. The marginal bone level was, on average, 1.52 mm (standard deviation [SD] 0.3 mm) and 1.95 mm (SD 0.4 mm) from the implant/abutment junction after 3 and 5 years, respectively.

Conclusion: The high survival rates at patient and implant level indicates that the immediate-function concept for completely edentulous maxillae using the present protocol is viable in the medium- and long-term outcomes.

KEY WORDS: Brånemark System®, edentulous maxilla, immediate function, immediate load, Nobelspeedy®, surgical guide, tilted implants

*Oral Surgery, Malo Clinic, Lisboa, Portugal; †research and development, Malo Clinic, Lisboa, Portugal; ‡Oral Surgery, Malo Clinic, Lisboa, Portugal; §Prosthodontics, Malo Clinic, Lisboa, Portugal; ¶Oral Surgery, Malo Clinic, Lisboa, Portugal

Reprint requests: Dr. Miguel de Araújo Nobre, Malo Clinic, Avenida dos Combatentes, 43, 8, Edificio Green Park, 1600-042 Lisboa, Portugal; e-mail: mnobre@maloclinics.com

© Copyright 2013 Blackwell Verlag
Original article: Paulo Maló et al.: "All-on-4" Immediate-Function Concept for Completely Edentulous Maxillae: A Clinical Report on the Medium (3 Years) and Long-Term (5 Years) Outcomes
From: Clinical Implant Dentistry and Related Research, Volume 14, Issue s1, May 2012, Pages: e139–e150, DOI: 10.1111/j.1708-8208.2011.00395.

All-on-4® – references.

1 Brånemark PI, Svensson B, van Steenberghe D. Ten-year survival rates of fixed prostheses on four or six implants ad modum Brånemark in full edentulism. Clin Oral Implants Res. 1995;6:227-31

2 Krekmanov L, Kahn M, Rangert B, Lindstrom H. Tilting of posterior mandibular and maxillary implants for improved prosthesis support. Int J Oral Maxillofac Implants. 2000;15:405-14

3 Brånemark PI, Engstrand P, Öhrnell LO, et al. A new treatment concept for rehabilitation of the edentulous mandible. Preliminary results from a prospective clinical follow-up study. Clin Implant Dent Relat Res 1999;1:2–16

4 Malo P, de Araújo Nobre M, Lopes A, Moss SM, Molina GJ. A longitudinal study of the survival of All-on-4 implants in the mandible with up to 10 years of follow-up. J Am Dent Assoc 2011;142:310-20

5 Malo P, de Araújo Nobre M, Lopes A et al. All-on-4 immediate function concept for completely edentulous maxillae: a clinical report on the medium (3 years) and long term (5 years) outcomes. Clin Implant Dent Relat Res 2012 May;14 Suppl 1:e139-50

6 Babbush CA, Kutsko GT, Brokloff J. The all-on-four immediate function treatment concept with NobelActive implants: a retrospective study. J Oral Implantol. 2011 Aug;37:431-45

7 Francetti L, Romeo D, Corbella S, Taschieri S, Del Fabbro M. Bone level changes around axial and tilted implants in full arch fi xed immediate restorations. Interim results of a prospective study. Clin Implant Dent Relat Res 2010 [Epub ahead of print]

8 Agliardi E, Clericò M, Ciancio P, Massironi D. Immediate loading of full-arch fixed prosthesis supported by axial and tilted implants for the treatment of edentulous atrophic mandible. Quintessence Int 2010;41:285-93

9 Agliardi E, Panigatti S, Clericò M, Villa C, Malò P. Immediate rehabilitation of the edentulous jaws with full fixed prostheses supported by four implants. Interim results of a 5-year single cohort prospective study. Clin Oral Implants Res 2010;21: 459-65

10 Pomares C. A retrospective clinical study of edentulous patients rehabilitated according to the 'all on four' or the 'all on six' immediate function concept. Eur J Oral Implantol 2009;2(1):55-60

11 Agliardi E, Francetti L, Romeo D, Del Fabbro M. Immediate rehabilitation of the edentulous maxilla: preliminary results of a single-cohort prospective study. Int J Oral Maxillofac Implants 2009 Sep-Oct;24:887-95

12 Francetti L, Agliardi E, Testori T et al. Immediate rehabilitation of the mandible with fixed full prosthesis supported by axial and tilted implants: interim results of a single cohort prospective study. Clin Implant Dent Relat Res 2012 Oct;14(5):646-54

13 Malo P, de Araujo Nobre M et al. Implants placed in immediate function in periodontally compromised sites: a five-year retrospective and one-year prospective study. J Prosthet Dent 2007;97(6 Suppl):86-95

14 Malo P, de Araujo Nobre M et al. The use of computer-guided flapless implant surgery and four implants placed in immediate function to support a fixed denture: preliminary results after a mean follow-up period of thirteen months. J Prosthet Dent 2007;97 (6 Suppl):26-34

15 Malo P, Nobre M de A et al. A pilot study of complete edentulous rehabilitation with immediate function using a new implant design: case series. Clin Implant Dent Relat Res 2006;8:223-32

16 Malo P, Rangert B, Nobre M. All-on-4 immediate-function concept with Brånemark System implants for completely edentulous maxillae: a 1-year retrospective clinical study. Clin Implant Dent Relat Res 2005;7 Suppl 1:88-94

17 Malo P, Rangert B et al. "All-on-Four" immediate-function concept with Brånemark System implants for completely edentulous mandibles: a retrospective clinical study. Clin Implant Dent Relat Res 2003;5 Suppl 1:2-9

18 Puig CP. A retrospective study of edentulous patients rehabilitated according to the 'all-on-four' or the 'all-on-six' immediate function concept using flapless computer-guided implant surgery. Eur J Oral Implantol, 2010; 3(2):155-63

19 Graves S, Mahler BA, Javid B, Armellini D, Jensen OT. Maxillary all-on-four therapy using angled implants: a 16-month clinical study of 1110 implants in 276 jaws. Oral Maxillofac Surg Clin North Am, 2011; 23(2):277-87

20 Weinstein R, Agliardi E, Fabbro MD, Romeo D, Francetti L. Immediate Rehabilitation of the Extremely Atrophic Mandible with Fixed Full-Prosthesis Supported by Four Implants. Clin Implant Dent Relat Res 2012 Jun;14(3):434-41

21 Mozzati M, Arata V, Gallesio G, Mussano F, Carossa S. Immediate Postextractive Dental Implant Placement with Immediate Loading on Four Implants for Mandibular-Full-Arch Rehabilitation: A Retrospective Analysis. Clin Implant Dent Relat Res 2012 [Epub ahead of print]

22 Cavalli N, Barbaro B, Spasari D, Azzola F, Ciatti A, Francetti L Tilted Implants for Full-Arch Rehabilitations in Completely Edentulous Maxilla: A Retrospective Study Int. J. Dent. 2012 in press

23 Rangert B, Jemt T, Sullivan RM. Load factor control for implants in the posterior partially edentulous segment. Int J Oral Maxillofac Implants 1997;12: 360-70

24 Zampelis A, Rangert B, Heijl L. Tilting of splinted implants for improved prosthodontic support: a two-dimensional finite element analysis. J Prosthet Dent 2007;97:35-43

All-on-4® – summary of key studies.

The following overview groups clinical studies on the treatment concept All-on-4 according to follow-up time. Within each group, the studies are listed according to publication date.

Only peer-reviewed clinical studies are listed. Abstracts, reviews, single case reports, technique descriptions, and animal and in vitro tests are excluded.

For more information on all studies on All-on-4 visit:
nobelbiocare.com/scientific-evidence or PubMed at pubmed.gov

Reference	Follow-up time	Implant type	Study type	Indication/study focus	Number of patients	Number of implants	CSR %*
Follow-up time ≥ 10 years							
Malo, de Araujo Nobre, Lopes, Moss, Molina (2011): J Am Dent Assoc, 142: 310-320	10 years	Brånemark System Mk II, III and IV NobelSpeedy	Prospective	All-on-4 in mandible	245	980	94.8
Follow-up time 5–9 years							
Malo, de Araujo Nobre, Lopes, Francischone, Rigolizzo (2012): Clin Implant Dent Relat Res 2012 May;14 Suppl 1:e139-50.	5 years	Brånemark System Mk III and Mk IV TiUnite NobelSpeedy	Prospective	All-on-4 in maxilla	242	968	98.0
Cavalli, Barbaro, Spasari, Azzola, Ciatti, Francetti (2012): Int J Dent, 2012: 180379	12-73 months	Brånemark System Mk IV NobelSpeedy Groovy	Retrospective	All-on-4 in maxilla	34	136	100
Agliardi, Panigatti, Clerico, Villa, Malo (2010): Clin Oral Implants Res, 21: 459-465	Up to 5 years	Brånemark System Mk IV NobelSpeedy Groovy	Prospective Single-cohort	All-on-4 in maxilla (max) and mandible (man)	173	692	Max: 98.4 Man: 99.7
Follow-up time 2–4 years							
Babbush & Brokloff (2012): Implant Dent, 21: 28-35	Up to 31 months	NobelActive	Retrospective	All-on-4 in maxilla (max) and mandible (man)	293	1001	Max: 97.1 Man: 98.0
Malo, Nobre Mde, Lopes (2012): Int J Oral Maxillofac Implants, 27: 1177-1190	Mean of 2 years	Brånemark System Mk III and IV TiUnite NobelSpeedy	Prospective	All-on-4 in maxilla (max) and mandible (man)	142	227	Max: 97.7 Man: 94.8
Mozzati, Arata, Gallesio, Mussano, Carossa (epub ahead 2012): Clin Implant Dent Relat Res	2 years	Brånemark System Mk III TiUnite NobelSpeedy Groovy	Retrospective	All-on-4 in mandible Post-extraction sites	50	200	100
Babbush, Kutsko, Brokloff (2011): J Oral Implantol, 37: 431-445	2 years	NobelActive	Retrospective	All-on-4 in maxilla and mandible	165	708	99.6
Francetti, Romeo, Corbella, Taschieri, Del Fabbro (epub ahead 2010): Clin Implant Dent Relat Res	30-66 months (mandible) 22-40 months (maxilla)	Brånemark System Mk III and Mk IV TiUnite NobelSpeedy Groovy	Prospective	All-on-4 in maxilla (max) and mandible (man)	47	196	Max: 100 Man: 100
Weinstein, Agliardi, Fabbro, Romeo, Francetti (epub ahead 2010): Clin Implant Dent Relat Res	20-48 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective	All-on-4 in mandible	20	80	100
Agliardi, Clerico, Ciancio, Massironi (2010): Quintessence Int, 41: 285-293	14-44 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective Single-cohort	All-on-4 in mandible	24	96	100
Agliardi, Francetti, Romeo, Del Fabbro (2009): Int J Oral Maxillofac Implants, 24: 887-895	18-42 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective Single-cohort	All-on-4 in maxilla	20	120	100
Pomares (2009): Eur J Oral Implantol, 2: 55-60	At least 2 years	NobelSpeedy Groovy	Retrospective	All-on-4 in maxilla and mandible	20	127	96.9

*If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Reference	Follow-up time	Implant type	Study type	Indication/study focus	Number of patients	Number of implants	CSR %*
Francetti, Agliardi, Testori, Romeo, Taschieri, Fabbro (2008): Clin Implant Dent Relat Res, 10: 255-263	6-43 months	Brånemark System Mk IV NobelSpeedy Groovy	Prospective Single-cohort	All-on-4 in mandible	62	248	100
Malo, Rangert, Nobre (2003): Clin Implant Dent Relat Res, 5 Suppl 1: 2-9	3 years	Brånemark System Mk II and III	Retrospective	All-on-4 in mandible	44	176	96.7
Follow-up time < 2 years							
Galindo &Butura (2012): The International Journal of Oral & Maxillofacial Implants, 27: 628-633	1 year	NobelSpeedy Groovy NobelActive	Retrospective	All-on-4 in mandible	183	732	99.9
Graves, Mahler, Javid, Armellini, Jensen (2011): Oral Maxillofac Surg Clin North Am, 23: 277-287, vi	13-16 months	NobelActive	Retrospective	All-on-4 in maxilla	276	1110	97.5
Puig (2010): Eur J Oral Implantol, 3: 155-163	1 year	Brånemark System Mk III Groovy NobelSpeedy Groovy	Retrospective	All-on-4 in maxilla and mandible	30	195	98.0
Malo, de Araujo Nobre, Lopes (2007): J Prosthet Dent, 97: S26-S34	6-21 months	NobelSpeedy Groovy	Prospective Single-cohort	All-on-4 in maxilla and mandible Flapless NobelGuide	23	92	98.0
Malo, Nobre Mde, Petersson, Wigren (2006): Clin Implant Dent Relat Res, 8: 223-232	1 year	Brånemark System Mk III and Mk IV TiUnite NobelSpeedy Groovy	Retrospective	All-on-4 in maxilla and mandible	46	234	98.9
Malo, Rangert, Nobre (2005): Clin Implant Dent Relat Res, 7 Suppl 1: S88-S94	1 year	Brånemark System Mk III and Mk IV TiUnite	Retrospective	All-on-4 in mandible	32	128	97.6

*If the CSR is not reported in the study, the percentage of surviving implants was calculated.

Notes.

75384 B GB 1408 Printed in Sweden © Nobel Biocare Services AG, 2013. All rights reserved.
Nobel Biocare, the Nobel Biocare logotype and all other trademarks are, if nothing else is stated or is evident from the context in a certain case, trademarks of Nobel Biocare.
Disclaimer: Some products may not be regulatory cleared/released for sale in all markets. Please contact the local Nobel Biocare sales office for current product assortment and availability.

Nobel Biocare®

nobelbiocare.com