scientific summary

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All-on-4 was developed to provide edentulous patients with a fast, cost-effective fixed restoration using only 4 implants to support a full-arch prosthesis. Two of these implants are tilted posteriorly. An acrylic prosthesis is immediately loaded on the four implants.

When used in the mandible, tilting of the posterior implants makes it possible to use longer implants and, thereby, achieve good bone anchorage without interfering with the mental foramina. In severely resorbed maxillae the tilted implants are an alternative to sinus floor augmentation. Tilting of the posterior implants results in a better spread of the implants along the alveolar crest which is beneficial for the load distribution and allows the final prostheses to hold as many as 12 teeth with only short cantilevers.

Published data on the All-on-4 concept shows cumulative survival rates between 92.2 and 100%. Tilting of implants has been applied in clinical practice for over a decade and shows good results. Biomechanical measurements show that tilted implants, when part of a prosthetic support, do not have a negative effect on the load distribution.
References


The increased demand for improved esthetics, along with the preference for non-metal restorative materials have increased the use of dental ceramics. The ceramic materials used for Nobel Biocare’s all-ceramic crowns, bridges, laminates and abutments consist of densely sintered, high purity (99.5%) aluminum oxide (alumina) and yttria-stabilized zirconium oxide (Y-TZP zirconia). These ceramic materials possess several desirable characteristics for use in modern dentistry, including biocompatibility and good mechanical properties1-16.

**Alumina**
Studies focused on evaluating the clinical performance of all-ceramic alumina crowns, bridges, and abutments in dental practice have shown good results2,17-45. Cumulative success rates of 98% and 92% after 5 and 10 years, respectively, have been reported for alumina crowns22,26,30,31. Tests have shown that the alumina crowns and bridges exceed the biomechanical requirements for all-ceramic fixed partial dentures33. Moreover, both short and long-term clinical studies have shown good results for the alumina abutments35-45, a cumulative success rate of 98% after 5 years41, favourable marginal bone levels, and healthy surrounding soft tissue have been reported41-43.

**Zirconia**
Zirconia has a flexural strength and fracture toughness almost twice as high as that of alumina, which makes zirconia very resistant to masticatory forces, with maintained exact precision of fit46,47,56. Clinical studies aiming at evaluating zirconia abutments have shown high success rates and good esthetic results, with healthy mucosal conditions and stable marginal bone levels48-52. Furthermore, compared to titanium, zirconia has been shown to accumulate less bacteria in vivo in terms of presence and total number of potential putative pathogens53,54. Data also reveal that the tissues around zirconia healing caps undergo a lower rate of inflammation-associated processes compared to titanium55. Clinical studies evaluating the long-term performance of zirconia crowns and bridges are ongoing.
References


The Brånemark System® Zygoma implant concept presents a non-grafting alternative for the treatment of patients with extreme resorption of the maxillary bone. The zygoma implant design and placement protocols have been described in various publications. Other reports have focused on anatomical site evaluations for the placement of zygoma implants, image-based planning procedures, and clinical validations of implant placement using drill guides.

Clinical studies have been performed with clinical success rates of 82–100% with follow-up periods of up to 5 years. Placement of multiple (2–4) zygoma implants in the same os zygomaticus, as well as immediate loading of zygoma implants, has also been reported. Sinoscopy performed in patients with zygoma implants showed no signs of infection or inflammation in the surrounding mucosa.

Zygoma implants have also been used with good results for retention of extra-oral prostheses.

A prospective multicenter study is ongoing for further evaluation of the Brånemark System® Zygoma implant.
References


A clinical evaluation of the Zygoma implant. Three years follow-up at 16 clinics. In manuscript. Ongoing study in 16 centers. Clinical Department, Nobel Biocare AB.
Brånemark System® is synonymous with the revolution in dental care by the introduction of safe and effective implants. Professor Brånemark, its inventor, always put the patient in focus and secured the outcome by meticulous clinical evidence. The first patient was treated in 1965, and Brånemark System® is today the most used and documented implant system on the market. More than 1000 articles, published in scientific journals, report on the use and the excellent outcome of Brånemark System® implants.

A dominating position
In a published review on prospective, long-term clinical studies, Brånemark System® had a dominating position; more than 50% of the reviewed articles reported on studies performed with Brånemark System® implants.

Prospective long-term clinical studies
The reference tables below shows an overview of some of the Brånemark System® long-term studies with at least 5 years of follow-up. The references are divided according to indication areas; i.e., full-arch, partial and single-tooth replacements.
### Overview of cumulative survival/success rates (CSR) in full arch replacements.

<table>
<thead>
<tr>
<th>Full arch replacements</th>
<th>Prosthesis</th>
<th>F-up</th>
<th>CSR (implants)</th>
<th>CSR (prostheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>mand</td>
<td>max</td>
</tr>
<tr>
<td>Attard NJ &amp; Zarb GA 2004</td>
<td>OD</td>
<td>15 y</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td>Attard NJ &amp; Zarb GA 2004</td>
<td>FB</td>
<td>20 y</td>
<td>87%</td>
<td></td>
</tr>
<tr>
<td>Bergendal T &amp; Engquist B 1998</td>
<td>OD</td>
<td>5 y</td>
<td>100%</td>
<td>75%</td>
</tr>
<tr>
<td>Eliasson A et al 2000</td>
<td>FB</td>
<td>5 y</td>
<td>99%</td>
<td>–</td>
</tr>
<tr>
<td>Ericsson I et al 2000</td>
<td>FB</td>
<td>5 y</td>
<td>100%</td>
<td>–</td>
</tr>
<tr>
<td>Ekelund JA et al 2003</td>
<td>FB</td>
<td>20 y</td>
<td>99%</td>
<td>–</td>
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<tr>
<td>Friberg B et al 1997</td>
<td>FB</td>
<td>5 y</td>
<td>100%</td>
<td>87%</td>
</tr>
<tr>
<td>Hemmings KW et al 1994</td>
<td>OD</td>
<td>5 y</td>
<td>93%</td>
<td>–</td>
</tr>
<tr>
<td>Jemt T 1994</td>
<td>FB</td>
<td>5 y</td>
<td>–</td>
<td>92%</td>
</tr>
<tr>
<td>Jemt T et al 2002</td>
<td>FB</td>
<td>5 y</td>
<td>–</td>
<td>93%</td>
</tr>
<tr>
<td>Naert I et al 1998</td>
<td>OD</td>
<td>5 y</td>
<td>99%</td>
<td>–</td>
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<td>OD</td>
<td>10 y</td>
<td>99%</td>
<td>–</td>
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<tr>
<td>Watson RM et al 1997</td>
<td>OD</td>
<td>5 y</td>
<td>94%</td>
<td>72%</td>
</tr>
<tr>
<td>Åstrand P et al 2004</td>
<td>FB</td>
<td>5 y</td>
<td>–</td>
<td>95%</td>
</tr>
<tr>
<td>Örtorp A et al 2004</td>
<td>FB</td>
<td>5 y</td>
<td>99.5%</td>
<td>89%</td>
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</table>

FB, fixed bridge; OD, overdenture; * The reference includes 2 study groups.
Overview of cumulative survival/success rates (CSR) in partial replacements.

<table>
<thead>
<tr>
<th>Partial replacements</th>
<th>Prosthesis</th>
<th>F-up</th>
<th>CSR (implants)</th>
<th>CSR (prostheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>mand</td>
<td>max</td>
</tr>
<tr>
<td>Attard N et al 2003</td>
<td>FPD</td>
<td>8 y</td>
<td>92%</td>
<td></td>
</tr>
<tr>
<td>Glauser R et al 2007</td>
<td>FPD</td>
<td>5 y</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>Gunne J et al 1999</td>
<td>FPD</td>
<td>10 y</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>Jemt T &amp; Lekholm U 1993</td>
<td>FPD</td>
<td>5 y</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>Jemt T et al 2003 (Group A)</td>
<td>FPD</td>
<td>5 y</td>
<td>99%</td>
<td>100%</td>
</tr>
<tr>
<td>Lekholm U et al 1994</td>
<td>FPD</td>
<td>5 y</td>
<td>94%</td>
<td>92%</td>
</tr>
<tr>
<td>Lekholm U et al 1999</td>
<td>FPD</td>
<td>10 y</td>
<td>94%</td>
<td>90%</td>
</tr>
<tr>
<td>Wyatt CCL &amp; Zarb GA 1998</td>
<td>FPD</td>
<td>5 y</td>
<td>94%</td>
<td></td>
</tr>
<tr>
<td>Zarb GA &amp; Schmitt A 1993</td>
<td>FPD</td>
<td>5 y</td>
<td>92%</td>
<td>98%</td>
</tr>
<tr>
<td>Zarb GA &amp; Schmitt A 1993</td>
<td>FB/OD</td>
<td>5 y</td>
<td>89%</td>
<td>94%</td>
</tr>
</tbody>
</table>

FB, fixed bridge; OD, overdenture; FPD, fixed partial denture

Overview of cumulative survival/success rates (CSR) in single tooth replacements.

<table>
<thead>
<tr>
<th>Single tooth replacements</th>
<th>F-up</th>
<th>CSR (implants)</th>
<th>CSR (prostheses)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>mand</td>
<td>max</td>
</tr>
<tr>
<td>Andersson B et al 1998</td>
<td>5 y</td>
<td>NR</td>
<td>98.5%</td>
</tr>
<tr>
<td>Andersson B et al 1998</td>
<td>5 y</td>
<td>–</td>
<td>100%</td>
</tr>
<tr>
<td>Henry PJ et al 1996</td>
<td>5 y</td>
<td>NR</td>
<td>97%</td>
</tr>
<tr>
<td>Polizzi G et al 1999</td>
<td>5 y</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Scheller H et al 1998</td>
<td>5 y</td>
<td>NR</td>
<td>98%</td>
</tr>
</tbody>
</table>

NR, not reported in the table (< 20 implants)
References


Titanium dental implants have been used in implantology for more than 40 years. The material is proven biocompatible, and dental implant treatment has shown high long-term success rates in different indications. However, the grey color of the titanium might pose a problem in esthetic areas, especially in non-optimal soft tissue situations. Furthermore, due to periimplant soft tissue recession, implant components might become visible over time.

The increased demand for improved esthetics, along with the preference among the general population for non-metal implant materials have increased the interest for tooth-colored ceramic implant materials. Aluminum oxide has in the past been used as dental implant material (the Tübingen Implant). The implant osseointegrated well, but the biomechanical characteristics of the implants were not sufficient for long-term load. As a result, this material was withdrawn from the market as dental implant material.

Zirconia ceramics have been employed in orthopaedic surgery for approximately 30 years and have recently been introduced into dentistry as a metal replacement for crowns, bridges and implant abutments. Zirconia has a flexural strength and fracture toughness almost twice as high as that of alumina, which makes zirconia very resistant to masticatory forces. Moreover, zirconia is very resistant to corrosion and its high biocompatibility has been proven in several investigations. Furthermore, compared to titanium, zirconia has been shown to accumulate less bacteria in vivo in terms of presence and total number of potential putative pathogens. Data also reveal that the tissues around zirconia healing caps undergo a lower rate of inflammation-associated processes compared to titanium.

Commercially available zirconia implants, as well as experimental zirconia implants have been tested both in vitro and in vivo. Results from preclinical and clinical studies show that zirconia implants osseointegrate well and fulfil the biomechanical requirements for clinical use. Moreover, zirconia implants have shown good soft tissue esthetics.
References


Ceramic Implants

Groovy Implants

The Nobel Biocare groovy implants incorporate a groove at the implant thread along the entire length of the intraosseous portion of the implant. Histomorphometric analyses in rabbit tibia and femur bone have revealed an affinity for bone formation within and along the groove and have shown that bone formation occurs more often within the groove than on other parts of the implant\textsuperscript{1,2}; the observed preferential bone growth along the groove provides evidence of its osseoconductive properties. Removal torque analyses in rabbit tibia have shown as much as 30\% higher values for implants with a groove at the thread compared to control implants without a groove\textsuperscript{1}.

Nobel Biocare has received FDA clearance to claim faster bone formation within the groove resulting in faster integration of the implant and a mechanical interlock, leading to increased stability compared to implants without the groove. Clinical data on NobelSpeedy\textsuperscript{™} implants in Immediate Function\textsuperscript{™} \textsuperscript{3-5} placed at periodontally compromised\textsuperscript{3} and infected sites\textsuperscript{4} has shown good clinical outcome with respect to stability\textsuperscript{4,5}. Tapered groovy implant system used in suboptimal clinical conditions has been further discussed\textsuperscript{6}.

At present, Nobel Biocare is sponsoring two clinical pilot studies and one multicenter study on groovy implants\textsuperscript{7-9}.
References


7. Pilot study evaluating a modified Brånemark System® MkIII implant. Ongoing clinical study in one center. Clinical Research Department, Nobel Biocare AB.

8. Pilot study evaluating a modified ReplaceSelect Tapered implant. Ongoing clinical study in one center. Clinical Research Department, Nobel Biocare AB.

9. Multicenter study evaluating the NobelReplace™ Tapered Groovy Implant. Ongoing clinical study in 8 centers. Clinical Research Department, Nobel Biocare AB.
Lack of stability and retention of the mandibular denture can be solved with the use of dental implants to which an overdenture construction is attached. Predictable treatment of edentulous patients with mandibular implant overdentures has been documented in several clinical studies and there is a consensus that splinted or unsplinted implants in the anterior mandible supply a proper base for the support of an overdenture. Long term outcome of the treatment with implant-supported mandibular overdentures demonstrates good treatment outcome and high implant survival rate, between 94.5% and 100%, in a number of reports.

Early and/or immediate loading protocols for the mandibular overdenture have been documented to result in implant survival rates similar to a two-stage approach with a submerged healing.

Maintenance requirements for the implant-supported overdenture are addressed in several reports. Two studies report a more extensive maintenance during the first year as compared to later in the follow-up period. In one study following the first year more maintenance was required for fixed restorations as compared to the overdenture.
References


Flapless Surgical Technique

A flapless surgical technique has several advantages compared to the conventional surgical procedure, which includes the opening of a flap before implant insertion. Flapless surgery generates less postoperative bleeding, less discomfort for the patient, shorter surgery time, and a reduced healing time. The patients heal with minor or no swelling. The results from a histological evaluation suggest that implants placed without flap exhibited clinically relevant osseointegration similar to when implants are placed with flapped procedures.

The NobelGuide™ treatment concept includes a customized drilling template, which allows for implant placement via flapless surgery. In a prospective clinical study on patients treated according to the Teeth-in-an-Hour™ concept the post-operative pain was reported as minimal.

A minimally invasive flapless surgical procedure is also often utilized in treatment with the NobelDirect® one-piece implant.
Flapless Surgical Technique


Today, placement of implants in fresh extraction sockets combined with a two-stage surgical technique is an accepted treatment concept, provided an implant site free from infection. Besides shorter treatment time and fewer surgical sessions, the main reason for immediate implant placement following tooth extraction is to preserve volume and anatomy of original soft and hard tissues.

A growing number of clinical publications report on implant placement in extraction sockets combined with Immediate Function™. There seems to be two major indications for this treatment concept: (i) extraction of a few, hopeless teeth in a completely edentulous jaw followed by placement of implants, which coincide with an extraction socket; (ii) extraction of a single tooth followed by immediate implant placement. In addition, a newly published pilot study reports that a high survival rate can be achieved for immediately loaded implants placed into infected sites immediately following extraction.

Based on 3153 Immediate Function™ implants, a failure rate of 4.1% is calculated for implants placed in extraction sockets (n=1480) compared to a failure rate of 3.4% for implants placed in healed sites (n=1673), after varying times of follow-up. Although reported problems include difficulties in achieving primary stability and a higher risk for infection, today the placement of implants in fresh extraction sockets is not a contraindication for implant treatment.

In order to further investigate the concept of Immediate Function™ combined with implant placement in extraction sites, controlled clinical studies need to be performed, following detailed clinical protocols. Nobel Biocare is currently sponsoring several, prospective, clinical studies including this indication.
References
(Please note that Abstracts, case reports, technique descriptions, animal and in vitro tests are excluded)


2. Adriaenssens P, Herman M. Immediate implant function in the anterior maxilla: A surgical technique to enhance primary stability for Brånemark Mk III and Mk IV implants. A randomized, prospective clinical study at the 1-year follow-up. Appl Osseointegration Res 2001;2;17-21


14. Finne K, Rompen E, Toljanic J. Clinical evaluation of a prospective multi-centre study on one-piece implants. Part 1; Marginal bone level evaluation after 1 year of follow-up. Accepted for publication in International Journal Oral Implantol.


Immediate Function™ in Extraction Sockets


21 Hahn J. Clinical and radiographic evaluation of one-piece implants used for immediate function. Accepted for publication in Journal of Oral Implantology (vol 33 issue mid-June)


Historically, implants have been associated with time-consuming surgical procedures. This is no longer the case with the Nobel Biocare implants, since Nobel Biocare has received FDA clearance for Immediate Function™ of all but one of our implant systems. The NobelDirect® 3.0 is currently under 510 (k) review for immediate function.

Provided high initial stability and controlled loads, the implants can be placed into function immediately after insertion. Implants with the osseoconductive TiUnite® surface are preferred for Immediate Function™ applications, since the more rapid bone formation on TiUnite® results in better maintenance of implant stability and faster and stronger osseointegration compared to implants with a machined surface. The advantages of Immediate Function™ are obvious: less trauma for the patient and a shorter treatment time, resulting in better clinical efficiency.

The Immediate Function™ procedure has been documented in more than 90 independent clinical publications. The studies cover all oral regions and indications (single-tooth restorations, partial and full-arch fixed prostheses, as well as implant-supported overdentures), and show high success rates. The highest success rates have been reported for splinted multiple implants in sites with sufficient bone density, using TiUnite® implants. The highest risks have been encountered in single-tooth cases in the posterior maxilla in combination with soft bone quality, short implants, long supra-structures and parafunctions.
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Implant system</th>
<th>Indication</th>
<th># pat.</th>
<th># impl.</th>
<th>Time of loading</th>
<th>Time of follow-up</th>
<th>CSR %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aalam et al</td>
<td>2005</td>
<td>Brånemark system® Mk III</td>
<td>Complete mandible</td>
<td>16</td>
<td>90</td>
<td>At placement</td>
<td>3 years</td>
<td>96.6</td>
</tr>
<tr>
<td>Adriaenssens et al</td>
<td>2001</td>
<td>Brånemark system® Mk III, Mk IV</td>
<td>Maxillary incisors/ bicuspids, single tooth</td>
<td>25</td>
<td>37</td>
<td>At placement</td>
<td>1 year</td>
<td>94.6</td>
</tr>
<tr>
<td>Achilli et al</td>
<td>2007</td>
<td>Replace® Select Tapered TiUnite®</td>
<td>Maxilla &amp; mandible Posterior FPD</td>
<td>51</td>
<td>120</td>
<td>61% at placement</td>
<td>1 year</td>
<td>100</td>
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<tr>
<td>Attard et al</td>
<td>2005</td>
<td>Nobel Biocare, TiUnite®</td>
<td>Complete mandible</td>
<td>35</td>
<td>70</td>
<td>After 10 days</td>
<td>1 year</td>
<td>98.6</td>
</tr>
<tr>
<td>Balshi &amp; Wolfinger</td>
<td>1997</td>
<td>Brånemark system®</td>
<td>Complete mandible</td>
<td>10</td>
<td>40</td>
<td>At placement</td>
<td>“4.5 months”</td>
<td>80.0</td>
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<td>Balshi &amp; Wolfinger</td>
<td>2005</td>
<td>Brånemark System®</td>
<td>Complete maxilla</td>
<td>55</td>
<td>522</td>
<td>At placement</td>
<td>1 up to 4 years</td>
<td>99.0</td>
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<td>2005</td>
<td>Brånemark System®</td>
<td>Complete mandible &amp; maxilla</td>
<td>51</td>
<td>344</td>
<td>At placement</td>
<td>3 months</td>
<td>98.5</td>
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<td>Becker et al</td>
<td>2003</td>
<td>Brånemark System® Mk III</td>
<td>Complete mandible</td>
<td>20</td>
<td>92</td>
<td>After 5 days</td>
<td>1 to 4 years</td>
<td>96.3</td>
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<td>Bedrossian et al</td>
<td>2006</td>
<td>Brånemark System® Zygoma MkIV</td>
<td>Complete maxilla</td>
<td>14</td>
<td>83</td>
<td>Within 2 hours</td>
<td>1 up to 2.5 years</td>
<td>100</td>
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<td>Brochu et al</td>
<td>2005</td>
<td>Nobel Biocare, TiUnite®</td>
<td>Complete mandible</td>
<td>10</td>
<td>20</td>
<td>Within 10 days</td>
<td>4 months</td>
<td>100</td>
</tr>
<tr>
<td>Brånemark et al</td>
<td>1999</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>50</td>
<td>150</td>
<td>At placement</td>
<td>1 year</td>
<td>98</td>
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<tr>
<td>Calandriello et al</td>
<td>2003a</td>
<td>Brånemark System® (machined)</td>
<td>Single &amp; partial, upper &amp; lower jaws, mainly</td>
<td>26</td>
<td>50</td>
<td>At placement</td>
<td>1–2 years</td>
<td>98</td>
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<tr>
<td>Calandriello et al</td>
<td>2003b</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Single molar, mandible</td>
<td>44</td>
<td>50</td>
<td>At placement</td>
<td>6–12 months</td>
<td>100</td>
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<tr>
<td>Calandriello et al</td>
<td>2005</td>
<td>Brånemark system Mk IV, Replace® Select Tapered</td>
<td>Total and partially posterior maxilla</td>
<td>18</td>
<td>60</td>
<td>At placement or</td>
<td>1 year</td>
<td>96.7</td>
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<td>Chiapasco et al</td>
<td>2001</td>
<td>Brånemark System® MkII</td>
<td>Complete mandible, 10 pat.: imm.Load 10 pat.: 2-stage</td>
<td>10</td>
<td>40</td>
<td>Within 3 days</td>
<td>&gt;2 years</td>
<td>97.5</td>
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<tr>
<td>Chiapasco et al</td>
<td>2003</td>
<td>Brånemark System®, ITI, Friatec, HaTi, Mathys</td>
<td>Complete mandible Overdenture</td>
<td>82</td>
<td>328</td>
<td>Day after surg</td>
<td>3 to 8 years</td>
<td>96.1</td>
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<td>Chiapasco et al</td>
<td>2006</td>
<td>Brånemark System®, ITI</td>
<td>Complete mandible</td>
<td>6</td>
<td>23</td>
<td>Day after surg</td>
<td>1 to 3 years</td>
<td>100</td>
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<td>Chow et al</td>
<td>2001a</td>
<td>Brånemark system® (machined)</td>
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<td>14</td>
<td>56</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
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<td>2001b</td>
<td>Brånemark system® (machined)</td>
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<td>27</td>
<td>123</td>
<td>At placement</td>
<td>3–30 months</td>
<td>98.3</td>
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<td>Davo et al</td>
<td>2007</td>
<td>Brånemark System® Zygoma Mk IV</td>
<td>Complete maxilla</td>
<td>18</td>
<td>104+ 36</td>
<td>within 48 hours</td>
<td>6–29 months</td>
<td>97.1</td>
</tr>
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<td>De Bruyn et al</td>
<td>2001</td>
<td>Brånemark System® (machined)</td>
<td>Complete mandible</td>
<td>20</td>
<td>60</td>
<td>4–53 days</td>
<td>3 mo–2 years</td>
<td>90</td>
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<td>De Bruyn &amp; Collaert</td>
<td>2002</td>
<td>Brånemark System® (machined)</td>
<td>Complete mandible</td>
<td>36</td>
<td>184</td>
<td>0–52 days</td>
<td>1–2 years</td>
<td>93</td>
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<td>Degidi &amp; Platelli</td>
<td>2003</td>
<td>Frialit Z, Frialoc, IMZ, Brånemark System®, Maestro, Restore</td>
<td>All indications</td>
<td>152</td>
<td>646</td>
<td>At placement</td>
<td>2–60 months</td>
<td>98.6</td>
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<td>Degidi et al</td>
<td>2006</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Single &amp; Partial Upper &amp; lower jaw</td>
<td>29</td>
<td>142</td>
<td>At placement</td>
<td>3 years</td>
<td>100</td>
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<td>Author</td>
<td>Year</td>
<td>Implant system</td>
<td>Indication</td>
<td># pat.</td>
<td># impl.</td>
<td>Time of loading</td>
<td>Time of follow-up</td>
<td>CSR %</td>
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<td>Degidi et al</td>
<td>2007</td>
<td>Brånemark System® TiU, Ankylos, Frialit-2, Frialoc, IMZ, Maestro, Restore, XIVE</td>
<td>Complete maxilla or mandible</td>
<td></td>
<td>133</td>
<td>At placement</td>
<td>4 years</td>
<td>97.7</td>
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<tr>
<td>Dhanrajani &amp; Al-Rafee</td>
<td>2005</td>
<td>Mix of brånemark System® and other implant brands</td>
<td>Single tooth</td>
<td>24</td>
<td>24</td>
<td>At placement or within a few days</td>
<td>2 to 3 years</td>
<td>83</td>
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<tr>
<td>Engstrand et al</td>
<td>2003</td>
<td>Brånemark System® Novum</td>
<td>Complete mandible</td>
<td>95</td>
<td>285</td>
<td>67% at implant placement, the rest 1–40 days</td>
<td>1 to 5 years</td>
<td>93.3</td>
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<td>Engquist et al</td>
<td>2004</td>
<td>Brånemark System® (MkIII, machined)</td>
<td>Complete mandible</td>
<td>26</td>
<td>104</td>
<td>After 2–3 weeks</td>
<td>1 year</td>
<td>93</td>
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<td>Engquist et al</td>
<td>2005</td>
<td>Brånemark System® (MkIII, machined)</td>
<td>Complete mandible</td>
<td>26</td>
<td>104</td>
<td>After 2–3 weeks</td>
<td>1 year</td>
<td>93</td>
</tr>
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<td>Ericsson et al</td>
<td>2000</td>
<td>Brånemark System®</td>
<td>Single tooth, incisors</td>
<td>14</td>
<td>14</td>
<td>Within 24 hours</td>
<td>1.5 years 5 years</td>
<td>85.7</td>
</tr>
<tr>
<td>Ericsson et al</td>
<td>2001</td>
<td>Brånemark System®</td>
<td>Single tooth, incisors</td>
<td>14</td>
<td>14</td>
<td>Within 24 hours</td>
<td>1.5 years 5 years</td>
<td>85.7</td>
</tr>
<tr>
<td>Finne</td>
<td>2007</td>
<td>NobelDirect®</td>
<td>All indications, mandible</td>
<td>87</td>
<td>152</td>
<td>At placement</td>
<td>1 year</td>
<td>97.9</td>
</tr>
<tr>
<td>Finne et al</td>
<td>2007</td>
<td>NobelDirect®, NobelPerfect® one-piece</td>
<td>All indications</td>
<td>56</td>
<td>82</td>
<td>At placement</td>
<td>2 years</td>
<td>98.8</td>
</tr>
<tr>
<td>Fröberg et al</td>
<td>2006</td>
<td>Brånemark System® (machined vs TiUnite®)</td>
<td>Complete mandible</td>
<td>15</td>
<td>89</td>
<td>Day of surg</td>
<td>18 months</td>
<td>100</td>
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<tr>
<td>Glauser et al</td>
<td>2001A</td>
<td>Brånemark System® (MkIV, machined)</td>
<td>All indications</td>
<td>41</td>
<td>127</td>
<td>Within 1 week</td>
<td>1 year</td>
<td>82.7</td>
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<td>Glauser et al</td>
<td>2001B</td>
<td>Brånemark System® (machined, vs TiUnite®)</td>
<td>Partial, posterior maxilla</td>
<td>24</td>
<td>47</td>
<td>Within 1 week</td>
<td>6 months</td>
<td>100</td>
</tr>
<tr>
<td>Glauser et al</td>
<td>2002A</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Bone quality 4</td>
<td>19</td>
<td>27</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
</tr>
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<td>Glauser et al</td>
<td>2003A</td>
<td>Brånemark System® (MkIV, TiUnite®)</td>
<td>All indications</td>
<td>38</td>
<td>102</td>
<td>At placement</td>
<td>1 year</td>
<td>97.1</td>
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<td>Glauser et al</td>
<td>2003B</td>
<td>Brånemark System® (MkIV, TiUnite®)</td>
<td>All indications</td>
<td>38</td>
<td>102</td>
<td>At placement</td>
<td>4 years</td>
<td>97.1</td>
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<td>Glauser et al</td>
<td>2003C</td>
<td>Brånemark System® (MkIV, TiUnite®)</td>
<td>All indications</td>
<td>38</td>
<td>102</td>
<td>At placement</td>
<td>5 years</td>
<td>97.1</td>
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<td>2003D</td>
<td>Brånemark System® (MkIV, TiUnite®)</td>
<td>All indications</td>
<td>38</td>
<td>102</td>
<td>At placement</td>
<td>5 years</td>
<td>97.1</td>
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<td>Groisman et al</td>
<td>2003</td>
<td>Replace®</td>
<td>Single, maxillary incisors</td>
<td>92</td>
<td>92</td>
<td>At placement</td>
<td>6–24 months</td>
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<td>Hahn</td>
<td>2007</td>
<td>NobelDirect®</td>
<td>Maxilla &amp; Mandible Single, partial</td>
<td>30</td>
<td>47</td>
<td>At placement</td>
<td>3 years</td>
<td>97.9</td>
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<tr>
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<td>Brånemark System® (machined)</td>
<td>Complete mandible</td>
<td>35</td>
<td>105</td>
<td>At placement</td>
<td>2–36 months</td>
<td>97.7</td>
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<td>Hatano</td>
<td>2003</td>
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<td>43</td>
<td>129</td>
<td>At placement</td>
<td>Final, screw-retained bridge</td>
<td>97.6</td>
</tr>
<tr>
<td>Henry et al</td>
<td>2003</td>
<td>Brånemark System® (machined)</td>
<td>Complete mandible</td>
<td>51</td>
<td>153</td>
<td>At placement or within 1 week</td>
<td>1 year</td>
<td>90.7</td>
</tr>
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<td>Hui et al</td>
<td>2001</td>
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<td>Single tooth, maxillary incisors</td>
<td>24</td>
<td>24</td>
<td>At placement</td>
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<td>Horiuchi et al</td>
<td>2000</td>
<td>Brånemark System®</td>
<td>Edentulous Maxillae (5) Mandibles (12)</td>
<td>14</td>
<td>140</td>
<td>At placement</td>
<td>8–24 months</td>
<td>97.2</td>
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<tr>
<td>Jungner et al</td>
<td>2005</td>
<td>Brånemark System® (Mk III, machined &amp; TiUnite®)</td>
<td>Complete mandible</td>
<td>24</td>
<td>92</td>
<td>After 13–62 days</td>
<td>&gt; 5 months</td>
<td>100</td>
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<tr>
<td>Kan et al</td>
<td>2003</td>
<td>Replace®, HA</td>
<td>Single tooth, anterior maxilla</td>
<td>35</td>
<td>35</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
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<tr>
<td>Kan et al</td>
<td>2007</td>
<td>NobelPerfect®</td>
<td>Single tooth, maxilla</td>
<td>29</td>
<td>38</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
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<td>Kikkerterp et al</td>
<td>2003</td>
<td>Replace®, HA</td>
<td>Partial anterior maxilla</td>
<td>6</td>
<td>14</td>
<td>At placement</td>
<td>12–34 months</td>
<td>100</td>
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<td>Year</td>
<td>Implant system</td>
<td>Indication</td>
<td># pat.</td>
<td># impl.</td>
<td>Time of loading</td>
<td>Time of follow-up</td>
<td>CSR %</td>
</tr>
<tr>
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<td>Kirketerp et al</td>
<td>2002</td>
<td>Replace® Select, HA</td>
<td>Single tooth, anterior maxilla</td>
<td>35</td>
<td>36</td>
<td>At placement</td>
<td>1 year</td>
<td>97.2</td>
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<td>Kronström et al</td>
<td>2003</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>17</td>
<td>68</td>
<td>Within 2–11 weeks</td>
<td>1 year</td>
<td>93</td>
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<tr>
<td>Liddelow et al</td>
<td>2007</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>28</td>
<td>28</td>
<td>89% at placement</td>
<td>1 year</td>
<td>100</td>
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<tr>
<td>Malo et al</td>
<td>2000</td>
<td>Brånemark System®</td>
<td>Single tooth, Partial, Esthetic zone</td>
<td>49</td>
<td>94</td>
<td>At placement</td>
<td>1–2 years</td>
<td>95.7</td>
</tr>
<tr>
<td>Malo et al</td>
<td>2003a</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>44</td>
<td>176</td>
<td>At placement</td>
<td>6 months</td>
<td>96.7</td>
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<td>Malo et al</td>
<td>2003b</td>
<td>Brånemark System®</td>
<td>Single (s), partial (p), upper and lower jaw, esthetic region</td>
<td>76</td>
<td>116</td>
<td>At placement or within few days</td>
<td>1 year</td>
<td>96.9</td>
</tr>
<tr>
<td>Malo et al</td>
<td>2005</td>
<td>Brånemark System®</td>
<td>Complete maxilla</td>
<td>32</td>
<td>128</td>
<td>Within 3 hours</td>
<td>1 year</td>
<td>97.6</td>
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<td>Malo et al</td>
<td>2006</td>
<td>NobelSpeedy™ (TiUnite®)</td>
<td>Complete maxilla &amp; mandible (All-on-4)</td>
<td>46</td>
<td>189</td>
<td>Day of surg</td>
<td>1 year</td>
<td>98.9</td>
</tr>
<tr>
<td>Malo et al</td>
<td>2007</td>
<td>NobelSpeedy™ (TiUnite®)</td>
<td>Complete maxilla &amp; mandible (All-on-4)</td>
<td>23</td>
<td>92</td>
<td>Day of surg</td>
<td>1 year</td>
<td>97.8</td>
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<td>Malo et al</td>
<td>2007</td>
<td>Brånemark System®</td>
<td>All indications</td>
<td>184</td>
<td>433</td>
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<td>5 year</td>
<td>91.0</td>
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<tr>
<td>Olsson et al</td>
<td>2003</td>
<td>Brånemark System®</td>
<td>Complete maxilla</td>
<td>10</td>
<td>61</td>
<td>Within 1–9 days</td>
<td>1 year</td>
<td>93.4</td>
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<td>Ostman et al</td>
<td>2005</td>
<td>Brånemark System®, Replace® Select Tapered, TiUnite®</td>
<td>Complete maxilla</td>
<td>20</td>
<td>123</td>
<td>Within 12 hours</td>
<td>1 year</td>
<td>99.2</td>
</tr>
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<td>Payne et al</td>
<td>2001</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>10</td>
<td>20</td>
<td>After 2 weeks</td>
<td>2–52 weeks</td>
<td>100</td>
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<td>Petersson et al</td>
<td>2001</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>13</td>
<td></td>
<td>Within 3 weeks</td>
<td>5 years</td>
<td>100</td>
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<tr>
<td>Proussaefs et al</td>
<td>2002</td>
<td>Replace®, HA</td>
<td>Single tooth, maxillary premolars</td>
<td>10</td>
<td>10</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
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<tr>
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<td>2004</td>
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<td>Single tooth, maxillary premolars</td>
<td>10</td>
<td>10</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
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<td>2003</td>
<td>Brånemark System®</td>
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<td>40</td>
<td>170</td>
<td>Within 6 weeks</td>
<td>3 years</td>
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<td>Complete mandible</td>
<td>16</td>
<td>88</td>
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<td>100</td>
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<td>Rao &amp; Benzi</td>
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<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>13</td>
<td>72</td>
<td>Within 3 weeks</td>
<td>5 years</td>
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<td>Replace® Select TiUnite®</td>
<td>Mandibular single, molar</td>
<td>46</td>
<td>51</td>
<td>At placement</td>
<td>1–3 years</td>
<td>100</td>
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<td>Rocci et al</td>
<td>2001</td>
<td>Brånemark System®</td>
<td>Maxillary; single &amp; partial</td>
<td>46</td>
<td>97</td>
<td>At placement</td>
<td>1 year</td>
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<td>Rocci et al</td>
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<td>Maxillary; single &amp; partial</td>
<td>46</td>
<td>97</td>
<td>At placement</td>
<td>1 year</td>
<td>90.7</td>
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<td>Rocci et al</td>
<td>2003b</td>
<td>Brånemark System®</td>
<td>Partial, posterior mandibles</td>
<td>22 m</td>
<td>55 m T</td>
<td>At placement</td>
<td>1 year</td>
<td>84.6</td>
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<tr>
<td>Rompen et al</td>
<td>2007</td>
<td>Replace® Select TiUnite®</td>
<td>Maxilla &amp; mandible, single tooth</td>
<td>41</td>
<td>54</td>
<td>96% at placement</td>
<td>Up to 2 years</td>
<td>100</td>
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<td>Rungharmaasaeng et al</td>
<td>2002</td>
<td>HA, SteriOss</td>
<td>Complete mandible</td>
<td>5</td>
<td>20</td>
<td>After 1-2 weeks</td>
<td>1 year</td>
<td>100</td>
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<td>Schincaglia et al</td>
<td>2007</td>
<td>Brånemark System®</td>
<td>Partial mandible</td>
<td>10</td>
<td>42</td>
<td>Within 24 hours</td>
<td>1 year</td>
<td>95.0</td>
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<td>Schnitman et al</td>
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<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>10</td>
<td>28</td>
<td>At placement</td>
<td>8–10 years</td>
<td>85.7</td>
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<td>1995</td>
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<td>Complete mandible</td>
<td>10</td>
<td>28</td>
<td>At placement</td>
<td>8–10 years</td>
<td>85.7</td>
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<td>Schnitman et al</td>
<td>1997</td>
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<td>Complete mandible</td>
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<td>28</td>
<td>At placement</td>
<td>8–10 years</td>
<td>85.7</td>
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<td>Maxilla &amp; mandible, single tooth, partial</td>
<td>58</td>
<td>92</td>
<td>At placement</td>
<td>17 months</td>
<td>100</td>
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<td>Implant system</td>
<td>Indication</td>
<td># pat.</td>
<td># impl.</td>
<td>Time of loading</td>
<td>Time of follow-up</td>
<td>CSR %</td>
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<tr>
<td>-----------------</td>
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<td>Complete mandible</td>
<td>26</td>
<td>78</td>
<td>65% within 7 days, 35% after 12 weeks</td>
<td>2 years</td>
<td>100</td>
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<td>1997</td>
<td>Brånemark System®, TiOblast, Astra, Benefit, ITI, 3i</td>
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<td>10</td>
<td>69</td>
<td>At placement</td>
<td>1-5 years</td>
<td>97.4</td>
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<td>2002</td>
<td>SteriOss Southern Implants</td>
<td>Complete mandible</td>
<td>24</td>
<td>48</td>
<td>After 6 weeks</td>
<td>2 years</td>
<td>70.8</td>
</tr>
<tr>
<td>Tozum et al</td>
<td>2007</td>
<td>Brånemark System®</td>
<td>Complete mandible, overdenture</td>
<td>17</td>
<td>36</td>
<td>53% at implant placement, the rest after 12 week</td>
<td>18 months</td>
<td>100</td>
</tr>
<tr>
<td>Turkyilmaz</td>
<td>2006</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Maxillary single tooth</td>
<td>19</td>
<td>34</td>
<td>After 6 weeks</td>
<td>3 weeks</td>
<td>94.4</td>
</tr>
<tr>
<td>Turkyilmaz</td>
<td>2006a</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Complete mandible, overdenture</td>
<td>20</td>
<td>40</td>
<td>50% within 7 days, 50% after 12 weeks</td>
<td>1 year</td>
<td>100</td>
</tr>
<tr>
<td>Turkyilmaz</td>
<td>2006b</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Complete mandible, overdenture</td>
<td>26</td>
<td>52</td>
<td>Within 7 days</td>
<td>1 year</td>
<td>100</td>
</tr>
<tr>
<td>Vanden Bogaerde</td>
<td>2003</td>
<td>Brånemark System® (machined)</td>
<td>Partial maxillas &amp; posterior mandibles</td>
<td>31</td>
<td>124</td>
<td>After 1–3 weeks</td>
<td>18 months</td>
<td>96.8</td>
</tr>
<tr>
<td>Vanden Bogaerde et al</td>
<td>2004</td>
<td>Brånemark System® (TiUnite®)</td>
<td>Partial mandibles &amp; maxillas</td>
<td>31</td>
<td>111</td>
<td>Within 16 days</td>
<td>18 months</td>
<td>99.1</td>
</tr>
<tr>
<td>Vanden Bogaerde et al</td>
<td>2005</td>
<td>Brånemark System®, Mk IV TiUnite®</td>
<td>Partial maxillae and posterior mandibles</td>
<td>19</td>
<td>50</td>
<td>At placement</td>
<td>18 months</td>
<td>100</td>
</tr>
<tr>
<td>van Steenberghe et al</td>
<td>2002</td>
<td>Brånemark System® (machined)</td>
<td>Complete maxilla</td>
<td>8</td>
<td>61</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
</tr>
<tr>
<td>van Steenberghe et al</td>
<td>2004</td>
<td>Brånemark System® (Novum) Complete mandible</td>
<td>Within 10 days</td>
<td>50</td>
<td>150</td>
<td>Within 10 days</td>
<td>1 year</td>
<td>92.7</td>
</tr>
<tr>
<td>van Steenberghe et al</td>
<td>2005</td>
<td>Brånemark System® Mk III TiUnite®</td>
<td>Complete maxilla</td>
<td>27</td>
<td>184</td>
<td>At placement</td>
<td>1 year</td>
<td>100</td>
</tr>
<tr>
<td>Vassos</td>
<td>1997</td>
<td>HA, SteriOss</td>
<td>Complete mandible</td>
<td>27</td>
<td>125</td>
<td>1 to 5 days after placement</td>
<td>19 days–4 years</td>
<td>99.2</td>
</tr>
<tr>
<td>Villa et al</td>
<td>2005</td>
<td>Brånemark System®</td>
<td>Partial or complete mandible</td>
<td>20</td>
<td>97</td>
<td>Within 3 days</td>
<td>1 year</td>
<td>100</td>
</tr>
<tr>
<td>Villa et al</td>
<td>2007</td>
<td>Brånemark System®</td>
<td>Maxilla, all indications</td>
<td>33</td>
<td>76</td>
<td>At placement</td>
<td>1 year</td>
<td>97.4</td>
</tr>
<tr>
<td>Wölfinger et al</td>
<td>2003</td>
<td>Brånemark System®</td>
<td>Complete mandible</td>
<td>10</td>
<td>40</td>
<td>At placement</td>
<td>5 years</td>
<td>80</td>
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<tr>
<td>Wöhrle</td>
<td>1998</td>
<td>SteriOss (TPS, HA)</td>
<td>Single tooth, maxillary incisors</td>
<td>14</td>
<td>14</td>
<td>At placement</td>
<td>9–36 months</td>
<td>100</td>
</tr>
</tbody>
</table>

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33. Finne K, Rompen E, Toljancic J. Clinical evaluation of a prospective multi-centre study on one-piece implants. Part 1; Marginal bone level evaluation after one-year of follow-up. Accepted for publication in International Journal Oral Implantol.


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Schnitman PA, Wöhrle PS, Rubenstein JE. Immediate fixed interim prostheses supported by 2-stage threaded implants. Methodology and results. J Oral Implantol 1990;16:96-105


A computerized treatment planning procedure based on 3-D CT-scan images was developed in a cooperation between the Catholic University of Leuven and Nobel Biocare AB\(^1\)-\(^3\). The planning procedure makes it possible to preview suggested implant placement and fabrication of a customized surgical template. The combination of the Procera\(^8\) Software planning program and a customized drilling template allows for implant placement via flapless surgery (NobelGuide\(^\text{™}\)), and also immediate placement of a pre-fabricated fixed prosthesis (Teeth-in-an-Hour\(^\text{™}\))\(^4\)-\(^11\). In a retrospective study 30 consecutive patients, including 212 implants, have been followed up to 5 years\(^12\).

Results from a prospective clinical study on the Teeth-in-an-Hour\(^\text{™}\) concept showed that the treatment procedure allowed for precise implant placement, which made immediate delivery of the final prosthesis possible in all patients. The post-operative pain was reported as minimal, and all prostheses and individual implants were recorded as stable after one year \(^7\). The concept, with minimal invasive and simplified surgery, reduces the treatment time and post-surgical discomfort\(^9\)-\(^10\). A preliminary evaluation of the All-on-4 concept and treatment according to the NobelGuide\(^\text{™}\) procedure has shown promising results in a prospective clinical study\(^11\).
References


Traditionally, endosseous implants with a flat implant-abutment interface were designed for treating completely edentulous patients with a bone crest made flat by resorption. However, the bone tissue morphology of partially edentulous jaws significantly differs from that of completely edentulous jaws. The NobelPerfect® implant, which features a scalloped profile, was designed to mimic the scalloped irregular bony and soft tissue topography that is mostly present in situations of tooth loss adjacent to natural teeth\(^1\)\(^3\). Several case reports and case series have been presented\(^4\)\(^\text{--}\)\(^11\). Reports describing treatment of patients with a scalloped margin implant have demonstrated esthetical clinical outcomes characterized by scalloped soft tissue profiles\(^4\)\(^7\). Subjects with immediate placement of implants have shown similar enhanced first bone-to-implant contact levels when compared to the cases with delayed placement\(^11\). In addition, a prospective study on 38 implants has been presented, showing a favourable implant success rate and peri-implant tissue response\(^12\).
References


The Nobel Biocare Procera® is a system developed for manufacturing of individualized dental restorations. Utilizing the latest scanning, CAD/CAM and manufacturing technologies, high accuracy and a perfect precision of fit is ensured. By combining the Procera® manufacturing technology with the use of alumina and zirconia ceramics, which are biocompatible materials with good mechanical properties, Nobel Biocare provides individualized, highly esthetical dental solutions.

Since the introduction in 1991, more than 7 million Procera® ceramic crowns have been produced.

**Procera® Crowns, Bridges and Laminates**
The Procera® Crown Titanium was the first restoration to be produced by the Procera® System. It was introduced already in 1984, and long-term studies evaluating its clinical performance have shown good results. Over the time, the use of the Procera® Crown Titanium has been replaced by the all-ceramic Procera® Crown Alumina and Procera® Crown Zirconia.

The Procera® Crown Alumina was introduced in 1991, and clinical long-term studies have shown cumulative success rates of 98% after 5 years and 92% after 10 years in function. Results from long-term studies have also revealed a good prognosis for Procera® Crown Alumina on posterior teeth. In addition, the good precision of fit of the Procera® Crown Alumina has been repeatedly reported and its use is still recommended.

The Procera® Bridge Alumina was introduced in 1999. Tests have shown that the restorations exceed the biomechanical requirements for all-ceramic fixed partial dentures, and excellent esthetic and functional outcomes have been reported. The Procera® Bridge Alumina is available in up to 4 units, and is intended for anterior regions.

The Procera® Crown Zirconia was introduced in 2001, and in 2004 the Procera® Bridge Zirconia was launched. Zirconia has a flexural strength and fracture toughness almost twice as high as that of alumina, which makes zirconia very resistant to masticatory forces, still with maintained exact precision of fit. The Procera® Bridge Zirconia is available in up to 14 units.

The Procera® Implant Bridge was introduced in 1996. Both full and partial bridge frameworks are available. The bridges are produced using CAD/CAM technology and are milled out of one piece of pure titanium. Good precision of fit as well as good clinical performance has been reported. A cumulative survival rate of 98% after 5 years of function has been reported.

The Procera® Implant Bridge Zirconia was introduced in 2007, and is available in up to 14 units. Clinical studies with the aim to evaluate the long-term performance of the Procera® Implant Bridge Zirconia are ongoing.

Procera® Laminates are thin (0.25-0.40 mm) alumina shells, used for patients with discolored anterior teeth, providing possibilities for excellent esthetics.

**Procera® Abutments**
The Procera® Abutment Titanium was launched in 1998 and the Procera® Abutment Alumina and Procera® Abutment Zirconia were introduced on the market in 2002 and 2003, respectively. In vitro studies, case reports and prospective clinical studies have proven the good performance of these individualized abutments. Good esthetic results have been reported. The Procera® Abutment Alumina was completely replaced by the Procera® Abutment Zirconia in June 2005.
References


The NobelDirect® one-piece implant has a TiUnite® surface for bone and soft tissue contact. The implant design makes it possible to avoid manipulation of the soft tissue after initial healing. The abutment portion of the implant is preparable, which makes it possible to create an individualized preparation borderline that follows the anatomy of the soft tissue margin, without violating the soft tissue seal. Soft tissue in contact with the TiUnite® surface has been shown to result in a normal appearance of the periimplant mucosa and a functional epithelium attached to the surface1,2.

Case reports with excellent implant stability, esthetics and patient satisfaction in the short-term perspective have been published3,4. Four maxillary one-piece implants placed immediately post extraction using a flapless surgical technique, and immediately provisionalised, have been evaluated after 12 months; a mean marginal bone loss of 0.50 mm, clinically preserved papillae, and optimal esthetic results were reported4. In a study evaluating the peri-implant marginal bone levels in patients with maxillary partial edentulism6, a mean bone loss of 0.27 mm during the first 9 months has been reported.

Early clinical experience with NobelDirect® implants for the restoration of single tooth defects has been reported for an observation period of 2.5 to 32 months, during which one implant failure occurred, resulting in a survival rate of 97.8%7. Forty-seven consecutively placed implants in one clinic were followed for up to 3 years. One implant failed resulting in an overall survival rate of 97.9%. The marginal bone level remained stable over time8. In another single center study with 92 consecutively placed implants in 58 patients, no implant failure occurred. After a mean time of 17 months, healthy soft tissue conditions were present with the average bone level positioned at the first thread10.

A retrospective evaluation of the clinical performance of the NobelDirect® implant was performed on 1009 consecutively placed implants in 25 clinics. The evaluation demonstrated an overall survival rate of 98.2% with stable marginal bone levels over time11.

Additional prospective multicenter studies12-14 are ongoing for further evaluation of the hard and soft tissue response to NobelDirect® implants; 1-year results from one of these studies demonstrate a mean marginal bone level slightly above the first thread and a 98.7% cumulative implant survival rate12. The 2-year results from this study show stable margin bone level and soft tissue health13.
References


9. Hahn J. Clinical and radiographic evaluation of one-piece implants used for immediate function. Accepted for publication in Journal of Oral Implantology (vol 33 issue mid-June)


14. Clinical evaluation of NobelDirect® implants diameter 3 mm. Ongoing study in four centers. Clinical Research Department, Nobel Biocare AB.
Preclinical and clinical studies show that the bone formation pattern on and in the vicinity of TiUnite® differs from that around implants with a machined surface. Bone contacts at machined implant surfaces, as observed histologically, are mainly the result of bone growth in a perpendicular direction toward the implant.

On TiUnite®, however, newly formed bone, emanating from existing bone structures, also grows by osseoconduction along and in direct contact with the implant surface. This bone formation pattern has been observed repeatedly in histological investigations of TiUnite® implants, and has been visualized in detail in a microscopic study. From an osseoconduction point of view, the bone-healing pattern on TiUnite® resembles that on hydroxyapatite, which is a well-known osseoconductive material.

Histomorphometrical analyses demonstrate that the enhanced bone response to TiUnite® results in faster coverage of the implant surface compared with machined implants, which translates into a higher bone-to-implant contact already during the early stages of healing. The intimate anchorage between TiUnite® and the surrounding bone results in better maintenance of implant stability during the early healing phase compared to machined implants.

The osseoconductive properties of TiUnite® implants are further enhanced by the addition of a macroscopic groove along the thread of the implant, such as on Nobel Biocare’s Groovy implants. Histological studies demonstrate preferential and faster bone growth by osseoconduction within and along the groove compared to the surrounding surfaces, resulting in a further increase of the rate of osseointegration of the TiUnite® Groovy implants.
References


High esthetical demands, strength, precision of fit, colour stability and wear characteristics - to mention just a few of the factors that are combined in the Procera® all-ceramic concept.\(^1\)\(^2\)

The intra-oral environment exposes the cement-ceramic bond to chemical, thermal and mechanical forces. In addition, the preparation design and the 3-dimensional geometry of the restoration also influence the long-term clinical outcome of the Procera® ceramic prosthesis.

Mechanical tests or In vitro tests form the basis for material selections and clinical recommendations. Two of the main objectives when designing an in vitro test are to eliminate influential parameters and to limit the variables.

A carefully designed in vitro study is an invaluable way of identifying superior materials and techniques and may lead to revised clinical recommendations.

In the current literature there are several reports of short and long-term outcome of different in vitro tests performed on Procera® ceramic materials and products comparing a variety of luting agents, techniques and surface treatments.\(^8\)\(^-\)\(^20\).
References

Clinical studies on Replace® Tapered and Straight Implants

The Replace® implants are available with a straight and a tapered body, and with two different surfaces: TiUnite® and HA. The documentation referred to below consists of articles and abstracts published, or accepted for publication, in scientific journals.

TiUnite® surface

The TiUnite® surface was introduced on the market in the year 2000. It has proven to support the healing process and to preserve implant stability during healing better than machined surfaces in both experimental and clinical studies1-28. Numerous studies have evaluated the use of TiUnite® implants in various clinical and preclinical situations, using different types of protocols, and with various follow-up times29-59. Five-year data have been published, demonstrating good long-term results for TiUnite® implants9.

HA-surface

The HA-coated surface has been documented in long-term studies including more than 3600 implants placed in about 1400 patients followed for 5 years after prosthetic loading. The results show high cumulative implant success rates, between 95 and 98%, after 1 year of prosthetic loading. The results show high cumulative implant success rates, between 97 and 100%, after 1 year of prosthetic loading. The Replace® Select straight implants have the same body design as the Bränemark System® implants. This implant design is extensively documented in the many long-term (up to 20 years follow-up), prospective clinical studies performed over the last decades93-133. In June 2005, NobelReplace™ was introduced. This implant has the same implant body as the Replace® Select with the additional features of TiUnite® surface on the entire implant body and grooves on threads and collar. Clinical studies on NobelReplace™ are currently ongoing134-135.
References


57 Xiropaidis A V, Qahash, W H Lim, R H Shanaman, R G Sorensen, J M Wozney, U M Wikesjö, J Hall. Bone-implant contact at calcium phosphate and titanium porous oxide (TiUnite®) modified dental implants. IADR Abstract. J Dent Res, Spec iss A 2002;81. p 489. #4001


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Wyatt CC, Zarb GA. Treatment outcomes of patients with implant-supported fixed partial prostheses. Int J Oral Maxillofac Implants 1998;13:204-211


A pilot study evaluating a modified Replace Select Tapered implant. Ongoing study in 1 center. Clinical Research Department, Nobel Biocare AB.

Clinical evaluation of the Nobel Replace Tapered Groovy Implant. Ongoing study in 8 centers. Clinical Research Department, Nobel Biocare AB.
Resin Bonded Bridges

The development of the resin bonded bridge started in the early 70’ies when Rochette described a periodontal splint using a perforated cast metal. The retention of the Rochette bridge was created by a mechanical interlock of the perforations in the metal splint, the composite resin and the acid-etched enamel of the abutment teeth. Over the years the bridge design and materials as well as luting agents and techniques developed and resulted in an increased longevity.

However, the metal ceramic bridge has an unmistakable aesthetic disadvantage, especially in the anterior region. The metal retainer wings of the prosthesis compromise the natural translucency of the abutment teeth and render them a greyish appearance. Further disadvantages as compromised biocompatibility with the use of non-precious alloys and problems with corrosion is also of importance.

The all-ceramic resin bonded bridge on the other hand, offers a restorative alternative with a good biocompatibility, requiring minimal tooth preparation and results in a high aesthetical outcome.

The first all-ceramic alternatives on the market showed high failure rates when the brittle nature of the ceramics together with poor bonding cements and techniques resulted in fractures and debonding. Today, further development of the ceramic materials, bridge design and luting agents has increased the longevity of the all-ceramic bridges.

The novel Procera® Maryland Bridge is precision milled from a single block of sintered yttrium stabilized zirconia using the Procera® CAD/CAM technology. The zirconia material exhibits higher flexural strength than any other dental ceramic material available on the market today. In recently published articles it is suggested that the use of zirconia will further increase the strength and longevity of the resin bonded bridge.

At present a pilot study evaluating the clinical success and survival rate for the Procera® Maryland Bridge veneered with NobelRondo™ Zirconia porcelain is ongoing, and a global multi-center study is in the start-up phase.
References


Short Implants

Surgical and restorative procedures in the posterior region of both the mandible and the maxilla present a complex task. The posterior regions usually exhibit less favourable bone quality and less bone volume, while they are exposed to greater loads than anterior regions of the mouth. Anatomical structures such as the inferior alveolar nerve and maxillary sinus may further restrict the possibility to place implants at posterior sites.

Thus short implants (i.e. ≤ 10 mm) are best to use, which creates a dilemma, since short implants historically have been associated with higher failure rates than longer implants. However, no direct correlation between implant length and stability, anchorage or bone stress have been demonstrated. Instead poor bone quality is likely the most significant factor associated with short implant failure.

Development of implant design, surface structure and improved surgical technique have proven short implants to be a viable concept with survival rates comparable to longer implants. Short, wide diameter, self-tapping implants with wider threads have been shown beneficial in situations of limited bone height. Furthermore, short implants with TiUnite® surface have demonstrated high survival rates, between 94.6 and 100%, and excellent performance. Recent clinical studies have also demonstrated that short implants may be viable long-term solutions, up to 20-year follow-up, for sites with limited bone height.

There are several review articles discussing the impact of implant length.
References


Short Implants


The esthetic outcome of implant rehabilitation is of great importance for patient satisfaction. Esthetics is, to a great extent, determined by the level and appearance of the periimplant soft tissues, including the shape of the papillae. The term Soft Tissue Integration™ was coined as an analogue to the term osseointegration. While osseointegration can be described as “the establishment of immediate and long-term implant stability”, Soft Tissue Integration™ refers to “the establishment and long-term maintenance of soft tissue health and esthetics”.

Soft Tissue Integration™ is influenced by several factors, such as surgical/clinical technique, macro- and micro (surface) design, biocompatibility of the transmucosal component, as well as soft tissue morphology, including biotype, papilla fill, and degree of scalloped gingival margin1-6.

An example of clinical handling which may jeopardize the Soft Tissue Integration™ is repeated disconnection and reconnection of the transmucosal abutment. This has been reported to result in a more apical position of the connective tissue7.

As for biocompatibility, the use of gold alloy transmucosal abutments has been shown to result in receded soft tissue margins and occurrence of bone resorption, while the use of titanium and ceramic abutments result in the formation of a mucosal seal8. Observations from clinical studies evaluating the influence of surface topography on Soft Tissue Integration™ indicate that TiUnite® stabilizes the supracrestal soft tissues9,10. In healthy situations, the soft tissue forms a barrier around the implant by attachment of the junctional epithelium. Studies have shown that the cells of the junctional epithelium form a firm, direct attachment to the TiUnite® surface via hemidesmosomes6,11.

Ongoing and planned activities aim at further evaluating the influence of different factors on Soft Tissue Integration™.
References


TiUnite® is a highly crystalline and phosphate enriched titanium oxide characterized by a microstructured surface with open pores in the low micrometer range. The TiUnite® implant surface has repeatedly proven to give an enhanced bone response compared to machined implant surfaces. Nobel Biocare has received FDA clearance to claim a more rapid bone formation and greater amount of bone in contact with the TiUnite® surface during healing. The enhanced bone response to TiUnite® results in faster and stronger osseointegration and, thereby, better maintenance of the implant stability compared to machined titanium implants.

When placed in soft bone and immediately loaded, the enhanced osseointegration of Nobel Biocare TiUnite® implants results in higher success rates compared to machined implants. These claims are supported by extensive research.

In addition to the publications supporting the FDA-cleared claims for the TiUnite® implant surface, more than fifty references are available, which cover the use of TiUnite® implants in various clinical and preclinical situations, using different types of protocols, and with various follow-up times.
References


53 Hahn J. Clinical and radiographic evaluation of one-piece implants used for immediate function. Accepted for publication in Journal of Oral Implantology (vol 33 issue mid-June).

54 Hahn J. Clinical evaluation of one-piece implants used for immediate function. European J Dent Implantol 2006;2:1 suppl


73 Siepenkothen T, Clauder A, Mehlau R. Multiple center clinical and radiographic evaluation of one-piece implants. European J Dent Implantol 2006;2:1 suppl
The alveolar bone resorption that occurs around implants following abutment/restorative component attachment is a well-documented observation in cases where the diameter of the implant platform and restorative components coincides. In contrast, when components of a smaller diameter are placed on wider diameter implant platforms, a concept called platform shifting, the amount of bone remodeling is noticeably reduced.

It has been suggested that the success of platform shifting is, in part, because it increases the length of the soft tissue-to-implant interface and thus stabilizes the connective tissue adhesion. Studies have demonstrated that a minimum of approximately 3 mm soft tissue is needed for the formation of a functional biological width around the implant, which protects the underlying tissue from colonizing bacteria and other antigens from the oral cavity. The bone resorption that will occur to provide enough space for soft tissue adhesion can thus be avoided or minimized by applying platform shifting.

Furthermore, it has been proposed that crestal bone loss is a response to local inflammation at the abutment-implant interface where the soft tissue attempts to establish the biological width around the top of the implant.

It has been suggested that through the platform shifting concept, the inflammatory cell infiltrate will move away from the crestal bone and into a more confined area thus minimizing bone resorption.

Historically when using abutments with the same diameter as the implant platform or abutments with a divergent profile soft tissue recession of 0.5-1.5 mm most often occurs around implants within the first few months following the procedure. Recently a study using a concave transmucosal abutment design showed very good to excellent esthetic outcome with vertical augmentation or no recession of soft tissue in 87% of the situations. It is believed that the concave abutment shape creates a void chamber that facilitates blood clotting and thus soft tissue regeneration. Furthermore, the concave profile increases the length of the soft tissue-to-implant interface and stabilizes the connective tissue adhesion favorable for the maintenance of the biological width.
References

our qualifications are your security

Achievements
- Inheritors and developers of the work of Professor Brånemark – founder of modern implantology. World leader in the field
- Providers of the most comprehensive and flexible crown, bridge and implant solutions in the world
- Creators of biocompatible material TiUnite® for optimal osseointegration, Immediate Function™ and Soft Tissue Integration™
- Inventors of unique Procera® System and CAD/CAM dentistry
- FDA cleared for Immediate Function™ (except 3.0 and Zygoma)
- More clinical studies on immediate or early loading than all other competitors combined (Medline April 2007)
- More prospective clinical studies with at least 5-year follow-up than all other competitors combined (Berglund et al 2002)

Quality and Environment
- Certified according to ISO 13485:2003 and ISO 14001:2004
- Between 2003–2006, passed a total of 86 external assessments “with excellence.” Zero non-conformities in 2004 FDA inspections of Nobel Biocare production units in Gothenburg, Karlskoga and Stockholm

Research
- Formal collaboration with over 50 academic institutions and 600 independent scientists around the world
- More clinical studies on immediate or early loading than all other competitors combined (Medline April 2007)
- More prospective clinical studies with at least 5-year follow-up than all other competitors combined (Berglund et al 2002)

Support
- Over 340,000 dental professionals trained in 40 countries during 2006
- Nobel Biocare sales organizations with local Nobel Biocare staff in 34 countries

for details of our patient program visit www.nobelsmile.com