



# Fixed Prosthodontics in Skeletal Class III Patients With Partially Edentulous Jaws and Age-Related Prognathism: The Basal Osseointegration Procedure

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When following up correct surgical and prosthodontic procedures, basal osseointegration (BOI) permits the rehabilitation of completely or partially edentulous jaws, even in cases in which the bite is unfavorable. Time-consuming and invasive surgical bone transplants can be avoided, and patient rehabilitation times are shortened.

*Today, prognathism in the partially or completely edentulous jaw can be treated with endosteal implants and fixed prostheses. The preferred procedure uses basal osseointegration. If the distribution of available bone is favorable, the prosthodontic suprastructures can be loaded early, taking the various phases of bone regeneration into*

*account. Invasive surgical interventions, specifically iliac crest transplants, are rarely indicated and can be avoided in most cases. Patients are able to return to their everyday lives within a few days. (Implant Dent 1999;8:241-246)*  
**Key Words:** basal osseointegration, angle class III bite, minimally invasive restoration

## TREATMENT OF CLASS III PATIENTS

In daily practice, we commonly see patients who present with a combination of the following conditions: edentulous regions in one or both jaws; advanced periodontal involvement, especially in the posterior region; and a class III skeletal relationship, whether due to micromaxillarism, true prognathism, or a combination of the two. These patients, most of whom are between 35 and 55 years old, did not receive any, or received inadequate, orthodontic or orthodontic/surgical treatment in their youth. Any restorative treatment performed would therefore retain the existing bite position and occlusal situation. On the other hand, we often observe attempts to reorganize the patient's occlusion by prosthodontic means, especially after the loss (or intentional extraction) of

the anterior maxillary teeth. Excessive leverage results in damage to the abutment teeth. If these abutment teeth are subsequently lost, the skeletal situation reemerges, and the patient is entirely or partially unable to wear dentures.

In these cases, a negative ANB-Angle (the angle between the subspinale [A], nasion [N], and supramentale [B]) coincides with crossbites of at least two anterior teeth. This classification, originally developed for evaluating adolescents, is also used for adults, and rightly so. In adults, too, the ultimate cause of tooth loss is functional overload, especially in the anterior region. As soon as there is tooth loss in the supporting zone, rapid breakdown of the anterior dentition is frequently observed. Once the anterior teeth are lost, restoration is difficult, because most patients do not wish to have the mandibular overjet reproduced.

Only a small percentage of adult patients can be convinced to have their prognathism treated surgically after orthodontic treatment. Not only

work and family obligations but also the various possible sequelae, particularly the risk of mandibular nerve damage, deter these patients. The risk of nerve involvement must not be underestimated: In follow-up examinations of 25 patients who had undergone Obwegeser-Dal Pont osteotomy, Koblin and Reil<sup>1</sup> found that 19.5% had developed sensitivity disorders that did not subside after a period of 3 to 8 years and would therefore have to be classified as permanent. A higher incidence of permanent paresthesia must be expected, especially in adults above the age of 40 years, the group relevant here.<sup>2</sup> The authors point out that none of the patients who were followed had been dissatisfied with the overall result of the prognathism operation. However, it is difficult to communicate this fact to a patient who is faced with the operation. This is, ultimately, also an ethical and legal problem.

Another problematic aspect is relapse after surgical intermaxillary correction, which is assessed differ-

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ently by different authors depending on the extent of these corrections. Jatuporn<sup>3</sup> reported that the radiographically documented rate of recurrence after prognathism surgery is higher than usually assumed. Nevertheless, the clinical result is often considered acceptable even where a recurrence is clearly demonstrable radiographically. Koblin and Reil<sup>1</sup> followed 101 patients with prognathism after surgery. The reasons they cite for recurrences are lingual function and muscular imbalance. Their most important success criterion was the extent of the area of bone apposition. Zisser<sup>4</sup> followed 425 cases of orthodontic surgery and found that there is a trend toward recurrence, especially in open-bite situations. No complete recurrence was observed in any case.

It should be noted that there may also be complications in the temporomandibular joint region.<sup>5</sup> Fischer-Brandies<sup>6</sup> points out that approximately 30% of all surgical corrections of prognathism are performed at an advanced age to address the problem of the patient's not being able to wear dentures. In this context, one would also have to mention the rather invasive option of horseshoe downfractures with iliac crest bone interposition discussed recently.<sup>7</sup> We also need to consider, especially when treating adults, the expected time away from work necessitated by the treatment.

Inasmuch as implants are used in cases of massive sagittal bone loss or a prognathic skeletal situation, the objective is usually to provide retention for a bar-supported denture. Occasionally, subperiosteal implants are used. Placement of crestal implants is usually not an option because of the expected leverage and reduced bone supply. If the as-needed basis angle and the prognathic facial profile are to be corrected, even partially, the vertical dimension of the bite must be increased considerably.<sup>8</sup> This adversely affects the leverage situation and the prognoses of the crestal implant bodies, because the vertical bone supply is usually limited. These cases can be treated by BOI in a very simple and extraordinarily successful way.

## DEVELOPMENT OF BOI

A brief summary of the historical development of BOI follows. In 1972, Julliet<sup>9</sup> introduced T3D implants. Their underlying context was to anchor the basal portion of the implant horizontally and bicortically. This system, however, received little attention until 1988, when Scortecchi<sup>10</sup> produced the rotationally symmetrical disk implant with a homologous cutter. This system was not an economic success either, which is understandable if we look at it from our vantage point today. At that time, two basic principles had not been recognized. One was the need to produce the larger implant diameters that are so urgently required. Larger diameters distribute the masticatory forces to a larger bone area while increasing the size of the polygon support defined by the implants below the superstructure. Hence, the probability is that all force vectors are directed at locations within the polygon. (It is this very factor that is of particular importance in the treatment of skeletal class III situations and age-related prognathism in edentulous patients in general.) The disk diameters that were available for many years (5, 6, 7, and 8 mm) play only a small role in BOI today, not the least because it was usually impossible for the implant to actually reach the opposing cortical bone in the desired depth of the basal mandibular or maxillary bone.

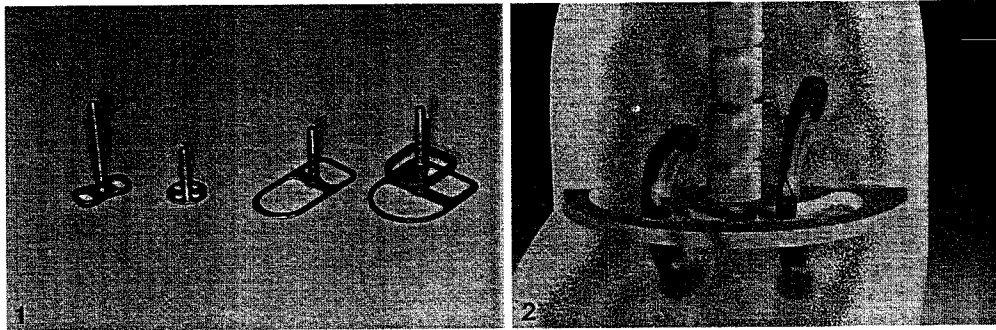
Nor was it recognized at that time that the blood supply to the segment of the alveolar bone located crestally from the disk must be ensured. This blood supply is largely dependent on the presence of large apertures in the implant disks. The microperforations the disks possessed at the time did not allow for an adequate blood supply and the concomitant immune reaction.

It was ultimately Spahn<sup>11</sup> and his ICD (Implantclub Deutschland) group in Germany who enlarged the microperforations intraoperatively to obtain kidney-shaped slots and later succeeded in convincing the manufacturer to produce larger disks already suitably perforated by the manufacturer. Spahn was also instru-

mental in creating anatomically formed implants in which the crestal disk has a smaller diameter than the basal disk. This development culminates, for now, in the so-called S forms. Once load distribution studies<sup>12</sup> conducted at the Technical University at Rapperswil, Switzerland, had yielded theoretical proof that the design of the double-disk implants produced by Scortecchi<sup>10</sup> implied that more forces are transmitted to the bone by the crestal disk rather than by the basal disk, it became clear why osteolysis was still frequently observed around the crestal disk while the basal disk initially remained unaffected. Spahn had already reported earlier, on the basis of clinical experience, that it was frequently necessary to remove the crestal disk but that this did not adversely affect the implant's prognosis in and of itself. The only deciding factor was early surgical intervention to remove the crestal disk. Today's S types were developed in Germany and Switzerland. They are characterized by the cuboid shape of the basal disk on the insertion side and the single bar of the crestal disk positioned at a right angle to the basal bar.<sup>13</sup> The distance between the disks was increased from 3 to 5 mm (Figs. 1, 2).

Spahn<sup>10</sup> showed that a general advantage of BOI is that little or no load has to necessarily be transmitted along the implant shaft. The important load transmission occurs in the baseplate region. This means that the place of bacterial invasion no longer coincides with the place of load transmission, offering the affected bone structures a better chance for self-defense. The bone can react more forcefully to bacterial invasion, and the vertical bone loss known from crestal implants does not occur. An added advantage is the smaller diameter of the implant shaft.

In the treatment of prognathic situations, we can use another factor to our advantage. In BOI, the point of insertion of the shaft in the crestal bone in a sagittal direction does not coincide with the most anteriorly located load transmission area (Figs. 3-5). Similar to what is done in subperiosteal implants, it is possible to



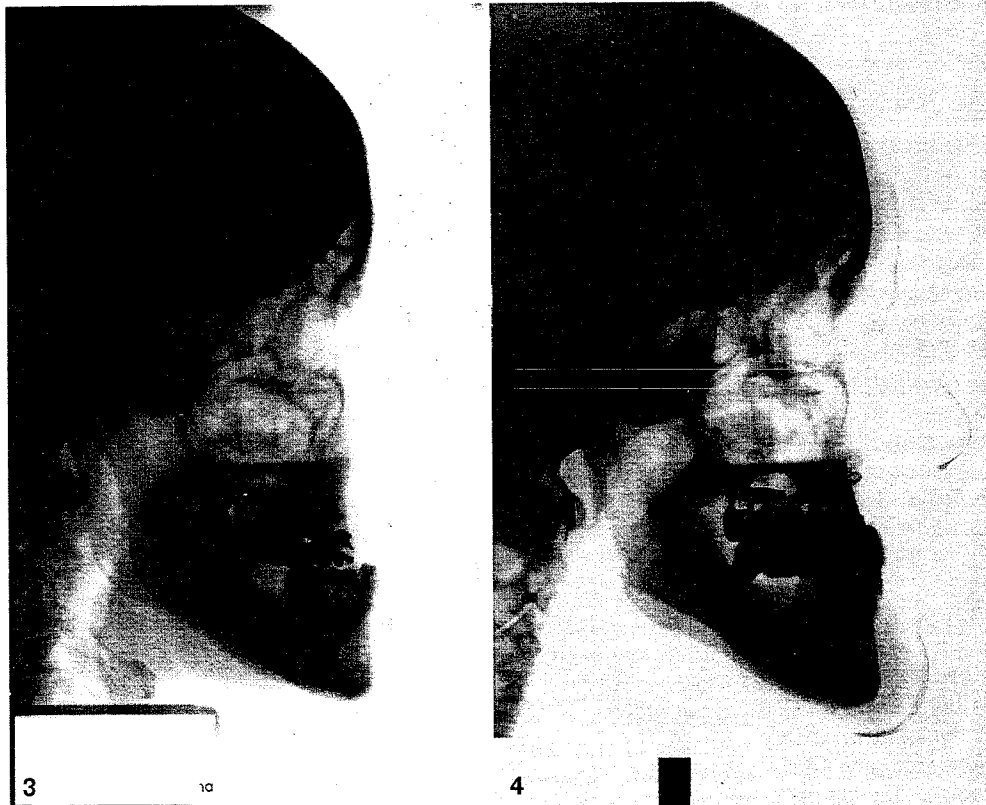
**Fig. 1.** Twenty-five years of implant development at a glance: T3D (Julliet, 1972), Diskimplant (Scortecci, Victory SA, Nice, France, 1986), and Diskos (S type, Dr. Ihde Dental GmbH, Eching, Germany, 1998).

**Fig. 2.** Diagram by M. P. Spahn of the correctly inserted implant. The disk is anchored bicortically. Blood supply is ensured without problems through the large perforations, even in the crestal aspect of the alveolar ridge.

use the resorption-resistant and stable nasal spine for load transmission and at the same time position the implant shaft within the prosthodontically desirable crestal aspect of the jaw.

Conversely, a large-disk balancing implant that is able to deflect anterior tilting forces far distally can be placed in the tuberosity region. This procedure has been described repeat-

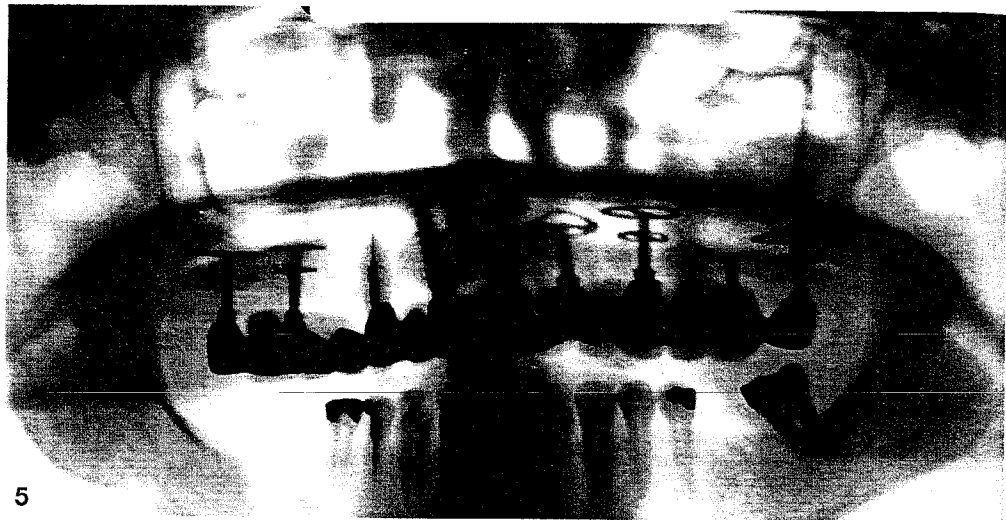
edly.<sup>8,13</sup> It becomes a problem with sagittal steps of more than 2.5 to 3 cm, because the occlusal table available for the masticatory process rarely permits more than three masti-



**Fig. 3.** Remote x-ray before treatment. The maxillary teeth from the right lateral incisor to the left lateral incisors had been extracted years before and replaced by a partial denture with clasps. The crossbite, which had been of the telescoping type, had been overlaid by a class I situation. This promoted the periodontal defects visible in the posterior region. All teeth were loosened at least to the 1+ level. The right maxillary canine appeared salvageable after endodontic treatment and was not extracted. Tunneling defects were present on all molars. Orthodontic pretreatment for combined orthodontic/surgical therapy appeared both impossible and uneconomical. The patient's prognathic facial profile, clearly visible on the x-ray image, did not actually concern the patient. The ANB angle (subspinale [A], nasion [N], and supramentale [B]) was -4.

**Fig. 4.** Remote x-ray showing the continuing ledge in the soft-tissue profile and the position of the bridge relative to the implants. The large-disk counterbalancing implants located distally to the masticatory loading zones are clearly visible.

**Fig. 5.** Orthopantomogram, taken 6 months after surgery, confirming uneventful healing of the implants. For structural reasons, the mandible should be restored soon.



cating units of bicuspid length. In addition, tilting forces frequently prevent the creation of a true overbite relationship in the maxillary anterior region in these cases.

#### CLINICAL CASE REPORT

The following example illustrates the treatment options in a pronounced dysgnathic situation. A patient (Figs. 3–5) was referred to the surgeon after a thorough examination. The surgeon suggested retruding the mandible using an Obwegeser-Dal Pont procedure and inserting a complete denture, possibly using telescopes or stud attachments. The patient refused the operation because of the risk of possible damage to the inferior alveolar nerve. The maxillary surgeon did not propose a long-term fixed prosthodontic solution.

Pending treatment of the right maxillary canine and a cost decision by the patient's insurance company, the residual maxillary dentition, with the exception of the right maxillary canine, second bicuspid, and first molar, was extracted. The canine was endodontically treated. The two other teeth served the sole purpose of improving the retention of the immediate denture. After 6 weeks and extraction of the right maxillary second bicuspid and first molar, a total of seven BOI implants (Diskimplant, Victory SA, Nice, France; Diskos, Dr. Ihde Dental GmbH, Eching,

Germany) and a compression screw were inserted in the maxilla. A temporary resin bridge was inserted on the third day after surgery and monitored regularly. A slight retrusion of the mandible was noted. This was supported by adjusting the occlusion in the maxilla. Six weeks after surgery, the temporary bridge was replaced by the definitive metallo-ceramic restoration. Emphasis is placed on the fact that the procedure with the immediate denture was performed in this way because the results of the endodontic treatment of the right maxillary canine needed to be awaited and because the patient requested removal of the remaining maxillary teeth as quickly as possible. Under normal circumstances, the entire treatment would have been performed in one step.

Beyond the fact that a comparable result could not have been obtained by traditional methods of dental surgery, it is interesting to compare how long the patient will have to stay away from work. When it is not necessary to use a fixed temporary restoration, the definitive metallo-ceramic restoration is inserted, on average, on the seventh day after surgery but never later than the 11th day after surgery. In these cases, patients are advised to inform their employers that they will be absent from work for about 2 weeks.

#### DISCUSSION

In cases in which patients are provided with temporary restorations (such as when several teeth, especially anterior teeth, have to be removed concurrently with the insertion of the implants), these restorations are usually inserted on the first day after surgery; in fact, they are often inserted intraoperatively. In these cases, patients can return to their normal lives almost immediately after surgery.

Longer time periods away from work can result from excessive and protracted postoperative swelling and if concurrent massive discoloration of the facial skin is seen. This contrasts sharply with the situation after sagittal osteotomy: In 1994, Biermann and Schettler<sup>14</sup> reported that time away from work after mandibular osteotomy averaged a total of 11 weeks (including orthodontic pretreatment). It is true that this period is considerably shortened today because of the increasing use of stable screw fixation and immediate, careful functional loading. Nevertheless, even today the total time away from work will be at least 4 weeks for this procedure. The callus distraction method, which is also used occasionally, is also much less advantageous than BOI with

regard to treatment times and patient comfort.<sup>15</sup>

## CONCLUSION

BOI implants provide several advantages for the implant practitioner, including (1) very little need for available vertical bone, which reduces the risk of inferior alveolar nerve and maxillary sinus intrusion and reduces the need for augmentation procedures except for esthetic reasons; (2) ease of circumventing skeletal limitations by strategic implant placement; (3) the ability to provide immediate loading that does not depend on special surface properties of the implant; (4) an area of load transmission that is separate from the area of bacterial invasion; (5) the ability to combine implants with implants or with natural remaining teeth; (6) the ability to treat regardless of spongiosa bone quality, because only the optimal compact bone is used; and (7) rather quick results because of the low lead time. In essence, use of BOI allows for immediate load and creates immediate patient satisfaction.

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## Abstract Translations [German, Spanish, Portuguese, Japanese]

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**ABSTRACT:** Die Prognathie im teilweise oder vollständig zahnlosen Kiefer kann heute mit endostalen Implantaten und festen Prothesen behandelt werden. Die bevorzugte Methode ist dabei die basaleosseo integration. Bei Vorliegen einer günstigen strukturellen Diagnose können die prothetischen Überbauten unter Berücksichtigung der verschiedenen Phasen der Knochenneubildung zu einem frühen Zeitpunkt eingesetzt werden. Invasivere chirurgische Eingriffe – besonders die Transplantation aus dem Beckenkamm – sind dabei selten angezeigt und lassen sich in den meisten Fällen vermeiden. Die Patienten können schon nach wenigen Tagen wieder in den normalen Alltag entlassen werden.

**SCHLÜSSELWÖRTER:** Basaleosseo integration (BOI), Bißstellung nach Angle Klasse III, Heilung mit minimalem Eingriff

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**ABSTRACTO:** Hoy se puede tratar el prognatismo en la mandíbula parcial o totalmente edentulosa con implantes endosteales y prótesis fijas hoy. El procedimiento preferido usa la oseointegración basal. Si la situación estructural es favorable, las supraestructuras prostodónticas pueden cargarse temprano, teniendo en cuenta las distintas fases de regeneración del hueso. Intervención quirúrgica invasiva—específicamente trasplantes de la cúspide ilíaca—están indicados raramente y pueden evitarse en la mayoría de los casos. Los pacientes pueden volver a su vida diaria en pocos días.

**PALABRAS CLAVES:** Oseointegración basal, (BOI), mordida de ángulo clase III, restauración mínimamente invasiva

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**SINOPSE:** o prognatismo em mandíbula parcial ou completamente edêntula pode ser tratado atualmente com implantes endosteais e próteses fixas. O procedimento preferido é aquele que usa a integração óssea basal. Se as condições da estrutura forem favoráveis, as supra-estruturas protodônticas podem ser carregadas cedo, levando em consideração as várias fases da regeneração óssea. A intervenção cirúrgica invasiva – mais especificamente os transplantes de crista ilíaca – são raramente indicados e podem ser evitados na maioria dos casos. Os pacientes podem retornar às atividades normais cotidianas em poucos dias.

**PALAVRAS-CHAVES:** integração óssea basal (BOI), mordida em ângulo classe III, restauração invasiva mínima

**顎の部分的歯喪失と年齢関連の上顎前出を症状とする骨分類IIIの患者の固定補綴 : Basal Osseointegration法**

**著者 :** ステファン・K・A・イーデ、Dr. med. dent.

**概要 :**

部分的または完全に歯を喪失した上顎前出は、今日、骨内インプラントと固定補綴による処置が可能になった。その最良の処置法には、Basal Osseointegrationが使われる。患部の状態が構造的に良好な場合は、骨再生の各フェーズを利用した、補綴によるsuprastructureの早期設置が可能である。侵襲的な外科処置 – 特に腸骨綾部移植 – はまれに適用されるが、ほとんどの場合に避けられる。患者は数日後日常生活に戻ることができる。

**キーワード :**

Basal Osseointegration (BOI)、アングル不正咬合分類III、最小限に侵襲的な修復法

\* (肩書き挿入)

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### In the Next Issue

In recognition of the critical roles of various members of the "implant team," there will be a position paper by a knowledgeable, seasoned clinician on the uses of antibiotics and antiinflammatories at the surgical stages of dental implant insertions.

At the other end of the implant-restorative-prosthetic spectrum, there will be articles by seasoned and knowledgeable laboratory technicians.