

# Critical Appraisal

## MINI IMPLANTS: GOOD OR BAD FOR LONG-TERM SERVICE?

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*This critical appraisal deviates from our standard format to address a topic of great clinical interest but with relatively few published research studies.*

Over 40 years ago, root-form dental implants made their major entry into clinical dentistry. The Swedish Branemark system, consisting of root-form titanium implants about 3.75 mm in diameter, made a major impact as dentists worldwide investigated and began to use these implants to support fixed/detachable prostheses for edentulous patients. The significance of implant placement and seating of a fixed/detachable prosthesis on the implants for edentulous patients was enormous.

The original technique for use of this system involved placement of preferably six implants anterior to the mental foramen in the mandible or anterior to the maxillary sinus in the maxillary arch. Subsequently, after an “osseointegration” period of several months,

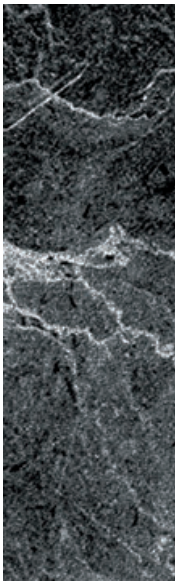
a casting was made to connect the implants and to serve as a substructure for a fixed/detachable prosthesis, usually consisting of acrylic resin denture base material supporting resin denture teeth. The prosthesis was screwed onto the implants, thus allowing removal by the practitioner for cleaning or repair.

Acceptance of this Swedish technique was very positive. The commercial originators of the technique encouraged only oral surgeons to place the implants, followed later by acceptance of periodontists. Subsequently, other surgically oriented dentists were allowed to take the surgical courses. As a prosthodontist, I originally took only the prosthodontic portion of the courses, but a short time later, I took the

surgical courses and began both placement and restoration of the root-form implants.

After a few years of observing the clinical success of implant-supported edentulous restorations, dentists began to use the implants for support of short-span fixed prostheses and for replacement of single teeth. Many other implant companies designed and produced their own varieties of root-form implants, and a high level of competition among companies was present. New alloys were used in the implants instead of the original pure titanium. Various coatings for the titanium were introduced. The coatings were placed on the surface of the titanium implants to encourage the integration of bone into the implants. New shapes and designs of implants

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evolved, including tapered implants; cylinder; various screw designs; short, wide implants; and many others. With a few exceptions, all of these designs seemed to serve very well.

About 20 years ago, the root-form implant concept had enough research support that it became an accepted and respected procedure in the profession, and root-form dental implants were requested by patients. In 1976, the U.S. Food and Drug Administration (FDA) cleared root-form implants 3 mm in diameter and larger for long-term use. Root-form implants smaller than 3 mm in diameter were not included in this clearance.

I have placed and restored many conventional 3-mm and larger-diameter root-form implants, and have watched these implants and restorations serve for 20 and more years. The following are several observations and conclusions that have become very clear to me and have led me to recognize the need for and to accept the use of implants smaller than 3 mm in diameter:

1. Many patients cannot afford or are not candidates for conventional root-form implants 3 mm and larger in diameter.
2. Nevertheless, root-form implants are the most significant innovation that has come

into dentistry over my career of several decades. In my opinion, the only invention of equal significance has been the air rotor and high-speed tooth cutting.

3. It is unfortunate that this service has largely been restricted to affluent patients with adequate bone present or with the financial resources and health to allow grafting.
4. Implants provide the ability to serve patients in clinical situations that are nearly unrestorable before their advent.
5. When treating healthy patients with adequate quantity and quality of bone present, the placement and restoration of root-form implants is not a complex or particularly threatening procedure for dentists or patients. There are many procedures in dentistry that I find to be more difficult. I feel that this procedure is well within the capability of surgically oriented dentists in all areas of dentistry who will take the time to attend adequate graduate or postgraduate education (i.e., continuing education).
6. In my experience, the majority of patients needing implant support for fixed or removable prostheses do not have adequate bone present to comfortably place implants 3 mm in diameter and wider without time-consuming, painful, and expensive grafting.

7. Additionally, the majority of patients who did not have enough bone and who were presented with the option of grafting bone into the deficient sites either denied the grafting, could not afford it, or did not want to wait long enough for the grafting to heal into their deficient sites.
8. Some patients accept grafting, and although it is successful for a significant portion of the time, I have observed some disappointing and expensive grafting failures.
9. Narrow body, small diameter, or the now-named "mini" implants (under 3 mm in diameter) for long-term use were not available until several years ago. Dentatus (Spanga, Sweden) provided to the profession small-diameter implants for "transitional" use to be placed at the time of conventional implant placement and to be removed after the conventional-diameter implants had integrated into the bone and before final implant restoration. They deserve the credit for this innovation for the profession.
10. In this same time period, small-diameter implants became widely used in orthodontics as temporary anchorage for tooth movement. They were removed after the orthodontic procedures were completed.

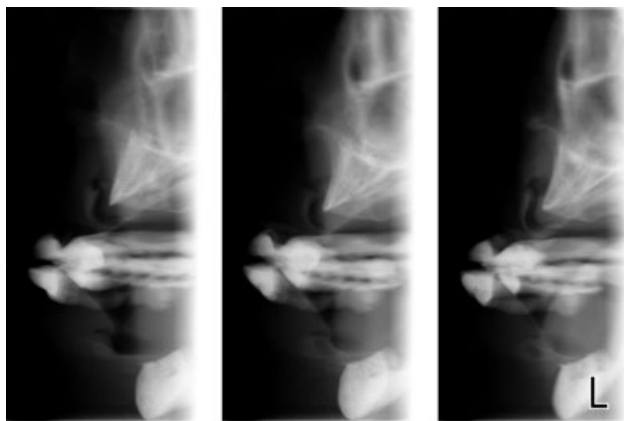


Figure 1. Radiograph showing minimal bone present not allowing placement of conventional-diameter implants without grafting.

11. An interesting fact was observed: the orthodontic “mini” implants were often difficult or nearly impossible to remove after the orthodontic procedures, unless the orthodontic practitioner had “tweaked” (slightly rotated) the implant frequently during the orthodontic procedure. Many of us found the same difficulty on removal of small-diameter implants when used for transitional prostheses support. The next logical question was to investigate small-diameter implants for long-term use.
12. The rest of the story is history; the small-diameter implants have been serving in long-term use situations (references are noted later in the article).
13. There are controversies on what to call these implants

when comparing them with implants over 3 mm in diameter. To make interpretation of my text easier, I will call them small-diameter implants, abbreviated as SDIs.

In 1997, 1999, and 2003, various forms of the IMTEC “mini” (under 3 mm in diameter) were cleared by the FDA for “long-term” use. IMTEC’s “mini” titanium alloy root-form implant, named the IMTEC Sendax MDI implant, of about 1.8 or 2.3 mm in diameter, was a reality. For historical purposes, the following quote from the FDA clearance follows:

*The MDI and MDI PLUS are self-tapping titanium threaded screws indicated for long-term intra-bony applications. Additionally, the MDI may also be used for inter-radicular transitional applications.*

*These devices will permit immediate splinting stability and long-term fixation of new or existing crown and bridge installations, for full or partial edentulism, and employing minimally invasive surgical intervention.*

Subsequently, numerous other companies have been cleared for long-term use of SDIs, including at least the following: Dentatus USA, Ltd. (New York, NY, USA), Dental Implant Technologies (Scottsdale, AZ, USA), IMTEC Corporation (Ardmore, OK, USA), Intra-Lock International, Inc. (Boca Raton, FL, USA), and Sterngold Dental, LLC (Attleboro, MA, USA).

The following information identifies the need for SDIs, justifies their use, and provides research support relative to the current clinical state of the art in this important area of dentistry.

#### NEED FOR SDIs

The following situations are the most significant clinical indications for SDIs:

1. Inadequate bone present for root-form implants 3 mm in diameter and over (Figure 1). Root-form implants 3 mm and larger in diameter need at least 6 mm of bone in a facial-lingual orientation and 10 mm of bone in a crestal-apical orientation.



Figure 2. Small-diameter implants (SDIs) assisting to support and to retain a removable partial denture for 4 years. Usually, two SDIs are placed in locations where one root-form implant over 3 mm in diameter would have been indicated.

2. Patient lack of acceptance of grafting for reasons previously stated.
3. Health challenges precluding extensive surgical procedures.
4. Inadequate funds for comprehensive conventional implant placement and extensive restorative restoration.

I find these indications on a daily basis, and I am thankful that alternatives other than conventional-diameter (3 mm and over) implants are now available.

**RESULTS OF A RECENT SURVEY ON SDIs**

Clinical Research Associates (now CLINICIANS REPORT) has recently published a survey of SDI users.<sup>1</sup> A brief summary of that survey follows:

1. Number of respondents: 200
2. Years as a dentist: mean 27
3. Nature of practice: general, 95%; prosthodontists, 4%; periodontists, 1%
4. Years doing implant dentistry: mean 15
5. Surgery or prosthodontics: surgery and prosthodontics, 74%; prosthodontics only, 24%; surgery only, 2%
6. Brand used most: IMTEC 91.5% with a few other brands
7. Number of SDIs placed: mean 43, range 1 to 700
8. Flap or no flap: 80% no flap, 20% flap
9. Amount of bone necessary: 4-mm facial-lingual, 10- to 12-mm crestal-apical
10. Difficulty of placement: no flap—"simple," flap—"moderately difficult"

11. Failure in service: mean number of years in service 3.4 with 9% failure
12. Almost no breakage of implants
13. Mostly used in edentulous locations
14. Fees for single implants were less than one-half of the fees for conventional over 3-mm implant placement. However, usually, two SDIs are used in locations where one implant over 3 mm in diameter would be used.
15. Attitude about SDI use: 95% of respondents indicated they would continue to use SDIs, and 91% felt positive or highly positive about the SDI concept.

When observing that most of the dentists in this survey were general dentists and not specialists, the success rate is impressive. The optimism about the concept is also indicative of its success.

**CLINICAL LOCATIONS IN WHICH SDIs ARE BEING USED**

Figures 2 to 6 show SDIs placed by me that have served for 4 to 7 years. The preceding survey showed that the major areas of use were from most to least<sup>1</sup>:

1. Augmentation of retention and support for edentulous jaws of both arches



Figure 3. Small-diameter implants supporting a complete denture for 7 years.

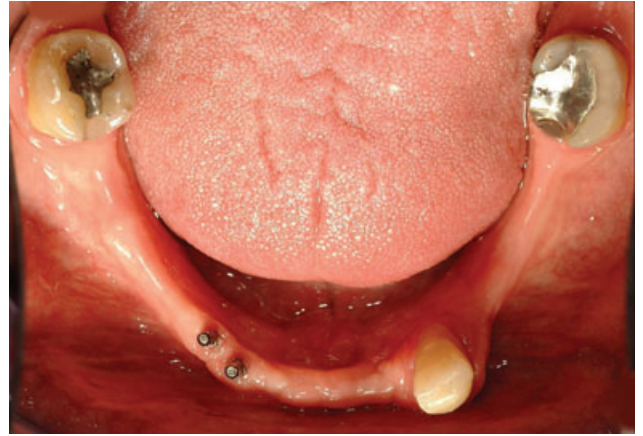


Figure 4. Extremely small amount of bone supporting a removable partial denture for 4 years.



Figure 5. Small-diameter implants supporting a minimal-retention removable partial denture for 4 years.



Figure 6. Small-diameter implants combined with natural teeth supporting a fixed prosthesis for 4 years.

2. Augmentation of retention and support for removable partial dentures
3. Augmentation of retention and support for fixed partial dentures with both natural teeth also supporting the fixed prosthesis, and also as sole support for fixed partial dentures
4. Sole support for single-tooth replacements

5. Transitional use
6. Orthodontic anchorage

My opinion, after using SDIs for over 7 years, is that I have no question about the use of SDIs in appropriate edentulous arches or for augmentation of retention and support for removable partial dentures. I have had success using SDIs for fixed partial dentures

supported by teeth and SDIs as well as sole support for fixed partial dentures. In certain situations, I can support the use of SDIs for sole support of single crowns. Maxillary lateral incisors and lower anterior teeth are excellent examples for single-tooth support.<sup>2</sup> My failure rate has been far below that reported in the previous reported survey.



### RESEARCH ON SERVICE LONGEVITY AND SUCCESS OF SDIs

A few of the studies on the service potential and success of SDIs are discussed in the following information. Shatkin and colleagues<sup>3</sup> reported that 2,514 implants from 1.8 to 2.3 mm in diameter in 531 patients had a 94.2% survival rate at 2.9 years. Mean failure time in the Shatkin study was 6.4 months.

Griffiths and colleagues<sup>4</sup> showed that when observing 116 SDIs placed in the anterior mandible in 13 months, 113 remained in service for a success rate of 97.4%. Patients reported improved comfort, chewing ability, speech, and retention. Mazor and colleagues<sup>5</sup> reported on 5 years of service with 32 SDIs, which they state “demonstrate the benefit of this treatment modality.” Vigolo

and colleagues<sup>6</sup> concluded the results of a retrospective 5-year study placing 52 SDIs for single-tooth replacement in 44 patients from 1992 to 1994. The study showed a 94.2% survival rate. Many other studies are present in the orthodontic literature. My own personal experience has been highly positive, having had failure of only a few SDIs over the last 7 years.

#### THE BOTTOM LINE

The “mini” or small-diameter or narrow-diameter implant (<3 mm in diameter) concept is making an impact on the profession amid controversy and debate. However, there is no question that these small implants, placed and restored properly, are serving patients well. This concept provides highly needed service for many patients who do not have enough bone present for conventional over 3-mm-diameter implants and cannot have or cannot afford bone grafting. More research is needed to find the best alloys for the implants, the most appropriate abutments, and the service potential of these small implants over many years.

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