

# Immediate Loading of Small Diameter Implants in Severely Atrophic Mandibles

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“...dentures supported by dome shaped Dentatus Atlas implants provided immediate occlusal loading and function with a high survival rate of implants (94.1%) and prostheses (100%)....”

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Conventional mandibular dentures for patients with severely atrophic mandibles often times present problems with retention, phonetics, function, and pain due to instability (1). Endosseous implants have been successfully used to restore edentulous mandibles with implant-supported fixed bridges, hybrid prosthetic dentures and removable overdenture prostheses (2). However, oral rehabilitation utilizing two to four implants to support mandibular overdentures has been shown to have success rates of approximate 96% with implants placed in a one or two stage procedure (3-7). Numerous authors also have addressed patient satisfaction with the mandibular implant overdenture (8-12). Meijer et al. has reported that patients with two implant-supported mandibular overdentures had higher satisfaction scores than patients who had complete denture treatment (11).

However, atrophy of edentulous jaws may limit implant placement in the mandible. Anatomic limitations and resorbed alveolar ridges may compromise implant number, length, and inclination (13). The use of standard diameter implants to support an overdenture often requires ridge augmentation procedures in order to place the implant in bone of sufficient volume. On the other hand, in patients of advanced age, having serious medical problems or using anticoagulant therapy, placing more than one standard implant has been shown to have a statistically significant increased risk of surgical complications (14). Small diameter implants placed with flapless surgery to support pre-existing conventional dentures present a method of restoring patients with atrophic mandibles. Advantages of this procedure include implant placement without any bone augmentation surgery, minimally invasive surgery resulting in virtually no bleeding, decreased pain and a decreased cost of treatment.

Small diameter implants (SDI) (MTI Monorail; Dentatus USA, New York, NY) with 1.8mm diameters were originally introduced and used as transitional implants to support provisional restorations in a single-stage surgery and were designed to be immediately loaded (15-19). The transitional implants were usually removed at the end of the provisionalization period. However, these small diameter implants became osseointegrated with similar percentages of bone-to-implant contact achieved as compared to conventional machined surface implants (20, 21). Approximately 3 years ago (2004) a new line of SDI were introduced by one manufacturer (Anew, Atlas; Dentatus USA, New York, NY) and approved for use as conventional implants. These implants are made of commercially pure titanium or titanium alloy and are designed as 1-piece implants composed of screw-retained, cement-retained or attachment superstructures. These implants have a self-threading tapered screw design with diameter of 1.8 to 2.4mm and embedment length between 7 and 14mm (22).

The purpose of the present study was to investigate the use of immediately loaded small diameter implants to support overdentures in severely atrophic mandibles and report on implant/prosthetic survival rates and patients satisfaction.

## MATERIALS AND METHODS

Clinical data in this study was obtained from an Implant Dentistry Database (IDD) at the Department of Periodontology and Implant Dentistry New York University College of Dentistry (NYUCD) Krises Dental Center. This data set was extracted as de-identified information from the clinical information started from the routine treatment of patients. The IDD was certified by the Office of Quality Assurance at NYUCD. This study is in compliance with the Health Insurance Portability and Accountability Act (HIPAA) requirements.

Between 2004 and 2006 ten patients (3 males and 7 females), mean age of 58.25 (range 30 to 83), received a total of 34 small diameter implants (2.4mm, Atlas Dome Keeper Implants System; Dentatus AB, Sweden, Jakobsdalsvagen 14-16 S-126 53 Hagersten, Sweden) (Fig1-10). The inclusion criteria consisted of patients who were not satisfied with their conventional mandibular dentures because of lack of stability in function. Two to four small diameter one piece dome-type implants made of titanium alloy were placed in the mandibular anterior area (between foramina) with flapless surgical procedures. Utilizing these SDIs avoided the need for bone augmentation.

Utilizing these SDIs avoided the need for bone augmentation. The patient's pre-existing mandibular denture was then relined with a resilient silicone material (Tuf-Link silicone liner material; Dentatus USA, Ltd.192 Lexington Ave. New York, NY. 10016) to establish adequate retention and allow immediate function. Two months after the surgery following delivery of the final implant-supported overdenture, a patient interview with subjective evaluation was performed. This interview also included the patients' evaluation of their previous dentures. In the present study, questionnaires were used to evaluate and compare the satisfaction of patients who previously wore complete dentures (CD) who now functioned with small diameter implant support overdentures (SDISO) (23) (Table 2).

Two months following the removal of this SDI, it was replaced with an additional SDI placed with flapless surgery and immediately loaded. Another failed SDI was placed into a fresh extraction socket. This might have resulted in implant micromovement and loss of initial stability during the first 3 weeks of socket bone remodeling. To date there has been a 100% prostheses survival rate in the 10 reported cases.

Reconstruction of a severely resorbed mandible with standard implant placement may require multiple grafting procedures prior to, or in conjunction with, implant placement. In the present study, SDIs placed with flapless surgery in severely atrophic mandibles had the following advantages:

| PI ID | Implants Placed | Survival Implants | Failed Implants | Survival Rate (%) | Prostheses Survival | Function Period (mo) |
|-------|-----------------|-------------------|-----------------|-------------------|---------------------|----------------------|
| 1     | 4               | 3                 | 1               | 75%               | 100%                | 12                   |
| 2     | 4               | 4                 | 0               | 100%              | 100%                | 24                   |
| 3     | 2               | 2                 | 0               | 100%              | 100%                | 15                   |
| 4     | 4               | 4                 | 0               | 100%              | 100%                | 11                   |
| 5     | 4               | 4                 | 0               | 100%              | 100%                | 17                   |
| 6     | 4               | 4                 | 0               | 100%              | 100%                | 3                    |
| 7     | 4               | 3                 | 1               | 75%               | 100%                | 3                    |
| 8     | 2               | 2                 | 0               | 100%              | 100%                | 18                   |
| 9     | 4               | 4                 | 0               | 100%              | 100%                | 3                    |
| 10    | 4               | 4                 | 0               | 100%              | 100%                | 2                    |
| Total | 34              | 32                | 2               | 94.1%             | 100%                | 10.8                 |

Table 1. Survival of implants placed in 10 patients

|       | Q1  | Q2  | Q3  | Q4  | Q5  | Q6  | Q7 | Q8  | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 |
|-------|-----|-----|-----|-----|-----|-----|----|-----|----|-----|-----|-----|-----|-----|
| CD    | 3.3 | 3.5 | 0.3 | 4.2 | 3   | 3.4 | 3  | 2.2 | 4  | 1.6 | 5.4 | 7.6 | 7.2 | 5.6 |
| SDISO | 3.1 | 5   | 0.5 | 1.4 | 7.8 | 8.1 | 0  | 8.6 | 9  | 8.2 | 9.3 | 8.4 | 8.4 | 8.4 |

Table 2. Patient satisfaction questionnaires and results



Fig 3. Surgical and prosthetic instruments



Fig 4. Flapless osteotomy using profile drill



Fig 7. Careful loading of reline material



Fig 8. After removal of excess material with scissors



Fig 1. Severely atrophied mandibular alveolar ridge



Fig 2. Radiographic view of edentulous ridge



Fig 5. Evenly distributed 4 implants between foramina



Fig 6. Create adequate space for reline material



Fig 9. Post-op panoramic view



Fig 10. Same day prosthesis delivery

## RESULTS

A total of 34 implants were placed in 10 patients. Two of these implants failed. This represents an overall implant survival rate of 94.1% and prosthetic survival rate of 100% (Table 1). Patient satisfaction questionnaire scores reported that SDISO resulted in improvement in pain control (Q4), function (Q5), stability (Q5), comfort (Q6), fitness (Q7, Q8), occlusion (Q9), satisfaction (Q10, Q13), speech (Q11, Q12) and social life (Q14) compared to the wearing of CD. (Table 2)

## DISCUSSION

Small diameter implants have demonstrated successful osseointegration with similar percentages of bone-to-implant contact as that achieved with conventional machined surface implants (20, 21). Park SH reported long term survival of small diameter implants (1.8mm) with an overall survival rate of 85.9%. The survival rate in the mandible (93.0%) was greater than that in the maxilla (79.4%) following a minimum time of 36 months (24) after immediate loading.

Simon and Caputo evaluated the removal torque of immediately loaded transitional endosseous implants in humans and reported that values were significantly higher in the mandible (24.0 ± 7.3Ncm) than in the maxilla (16.1 ± 4.8Ncm) (22). These studies showed stronger integration occurred in the mandible with higher survival rates of SDIs in comparison to the maxilla. In the present study, insertion of two to four SDIs in severely atrophic mandibles were used to support pre-existing dentures. The dentures, which were relined with a silicone material and immediately loaded, resulted in an implant survival rate of 94.1% which is slightly higher but similar to the Park study.

Two SDIs failure were reported in two patients. The first SDI failure occurred after two months of immediate loading. This may have been the result of misalignment, which induced excessive forces during the initial healing phase following immediate loading. However, by using the three remaining SDIs placed in this patient, the prosthesis still functioned well.

- (1) Patients had less bleeding during the surgery, and less post-operative discomfort and swelling.
- (2) The surgery required less time and avoided ridge augmentation procedures.
- (3) The procedures represented a reduced risk to patients who were advanced in age (3 of 10 patients), had serious medical problems (1 of 10 patients) or were using anticoagulant therapy (1 Of 10 patients).
- (4) Patients were able to maintain the same vertical dimension of occlusion by using the pre-existing denture with flapless surgery. Moreover flapless implant placement also decreased denture shifting after surgery caused by healing of the sutured flap.
- (5) Immediate loading in function was achieved with the patient's denture on the same day of implant surgery.
- (6) Use of low profile ball attachments (4mm) decreased the risk of lateral overloading forces in the initial healing phase of the loaded implants.
- (7) The procedure used less expensive implants with flapless surgery and therefore resulted in a reduced the cost of treatment.

The patient satisfaction questionnaires showed that after two months of immediate function with SDISO, patients cleaned very well three times a day and removed the dentures at night. Patients reported wearing the SDISO for longer periods of time than the CD during the day. There was also a significant increase in patient satisfaction with improved denture retention during function, improved patient comfort, and a decreased use of denture adhesives with SDISO compared to CD. There was a higher satisfaction level reported with the occlusion of the prostheses, as well as an improvement in reported ability to understand the patient's speech with SDISO. The data from the present study also showed that patients had a significant overall appreciation for increased comfort and confidence in social life with SDISO compared to complete dentures.

## CONCLUSION

In this study, the dentures supported by dome shaped SDIs provided immediate occlusal loading and function with a high survival rate of SDIs (94.1%) and prostheses (100%).

Patients wearing SDI supported dentures reported an increased in comfort, function, stability, fitness, occlusion, satisfaction, phonetics and social life over an average of 11.8 months (range 3 to 24 months) compared to the wearing of their CDs.

To date, the use of immediately placed small diameter implants to support removable overdentures in the mandible has shown excellent results. Further studies are required to determine long term success and predictability of this treatment modality.

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