

Mini Implants a Mega Solution to the Atrophied Edentulous Ridges

Ravi Shankar Krishna¹, Rashmi B. M. ², Anjum Afshan³ and * Shobhit Agarwal⁴

*Corresponding Author Email: dr.shobhit30@gmail.com

Contributors:

¹Professor, ²Reader, ^{3,4} Post Graduate Students, Department of Prosthodontics, Faculty of Dental Sciences, M.S. Ramaiah University of Applied Sciences, Bengaluru - 560054

Abstract

Clinicians and patients continue to enjoy the technological advances in implant dentistry that allow the least invasive and most economical approach to the best functional and esthetic result. Dental implants have markedly progressed from their original concept of subperiosteal implants in the 1940s and 1950s. Victor I. Sendax¹ expanded on Branemark's ideas when he learned that long-term denture stabilization could be similarly achieved with the use of small-diameter posts inserted directly into the alveolar ridge. Proposed advantages to the use of MDIs for single tooth and multi-tooth edentulous arch restoration include reduced bleeding, decreased postoperative discomfort, shortened healing time, placement into narrow ridges, and immediate loading. Survival rates reported range from 83.9% to 97.5%, depending on location and whether the implant is used for single-tooth or multi-tooth supported prosthesis. MDIs were originally used for transitional and provisional purposes, but it was observed that these implants appeared to osseointegrate. The advantages and scientific findings of the ultra-small-diameter (1.8 mm) commercially pure titanium threaded implant have provided the clinician with a predictable and financially feasible solution for loose denture.^{2, 3}

Keywords: Mini Implants, Mini Dental Implants, MDI, Narrow Diameter Implants, Atrophied Edentulous Ridges

Introduction

Completely edentulous patients frequently suffer from inadequate retention & stability of their mandibular dentures. Rehabilitation with traditional removable prostheses in case of edentulous lower jaws may create functional & psychological problems for the patients. However, atrophy of edentulous jaws may limit the conventional implant placement or require additional surgical interventions.⁴

Mini-dental implants used as a retentive aid for an overdenture showed high success and survival rate of 94.7% in 1-year interval with favorable prosthetic outcome, augmenting their use in definitive prosthodontic treatment. By placing implants that have a diameter of less than 3 mm, the surgical procedures can be minimal, less

traumatic, causing decreased post-operative discomfort, placement in narrow ridges & cost effective compared to conventional implant therapy.

The use of dental implants to replace natural teeth has become common place in contemporary restorative and surgical dental practices throughout the world. Substantiation of their efficacy has been well documented in the dental literature. There have been many advances in surgical techniques and implant design features, and the use of implants in edentulous sites can be successful and can have predictable, functional, and esthetic outcomes. A growing body of data suggests that mini dental implants can be used to retain removable complete and partial dentures in selected patients. Much of the research has been done on mini implants for orthodontic use.



Orthodontic forces applied, are much less than occlusal forces, and they are unidirectional and constant, unlike occlusal forces. Mini implants may be relatively easy to place and restore with appropriate preoperative data collection, such as osseous ridge contour and gingival quantity. Additionally, there is some evidence that in highly selected situations, mini dental implants can be used to support fixed partial or complete dentures. Mini implants may be immediately loaded in the appropriate osseous situations and may provide an alternative treatment if osseous conditions preclude a standard sized implant approach. In situations where there is an inadequate interdental space, reduced interocclusal space, convergent adjacent tooth roots or close proximity of adjacent tooth roots or narrow atrophic osseous contour, mini implants may be appropriate. These novel implants are consistent with the trend towards minimally invasive dentistry. Minimally invasive dentistry has been brought to the forefront by some practitioners and may be applied to implant dentistry where appropriate. Small diameter or mini implants may provide solutions in patients where there is severe osseous atrophy or systemic conditions that may contraindicate protracted standard sized implant treatment. For example, a severely debilitated patient may tolerate the placement of 4 mini dental implants with immediate loading to facilitate the retention of a removable mandibular complete denture, but are not able to tolerate the protracted treatment time required for standard sized implants.^{5, 6, 7}

Review of Literature

Mini-Dental Implants (MDIs) are biocompatible titanium screws conceived & designed by VICTOR I SENDAX. Mini-dental implants were originally used for temporary stabilization of overdentures. However, the implants appeared to osseointegrate into the bone proving to be much more than the intended purpose.

In a clinical study conducted by Elsyad et al¹, the performance of MDI supporting mandibular overdenture was investigated prospectively as a

new treatment modality for mandibular edentulism, where a total of 112 mini dental implants were analyzed. Peri-implant crestal alveolar bone loss was measured along vertical and horizontal planes in traced radiographs. These investigations reported the cumulative survival & success rates of mini dental implants as 96.4% and 92.9% respectively after 3 years of prospective follow-up; thus concluding the clinical & radiographic peri-implant tissue responses of immediately loaded mini dental implants supporting the mandibular overdentures, which were favorable after 3 years of function.

Elena et al³ stated that for a mini dental implant supported overdenture, implants are placed without extensive augmentation procedures & with less invasive surgical technique considering the anatomical limitations. In mandible, the mini implants are placed in interforaminal region (7mm anterior to mental foramen) to prevent damage to the inferior alveolar neurovascular bundle. Biomechanical studies supporting the use of mini implants, stated that decrease in implant diameter does not affect the implant osseointegration.

Block et al analyzed the effect of implant diameter on the pullout force required to extract the implant and proved that after 15 weeks of osseointegration. No correlation was found to its diameter but only with its length. Clinical studies confirm that short implants were often accompanied by failure, but mini implants had good prognosis. Therefore, the mini implants used for overdentures should not only have at least 10mm length in relation to their diameter, but also to its bone height. Given good results obtained in vivo & in-vitro, narrow and mini implants seem to be the successors of conventional diameter implants in overdenture.

As stated by Preoteasa et al in case of mini dental implant supported overdenture for immediate loading, a good primary stability of implants was required which is related to the implant insertion torque (minimum 30-35Ncm); bone compression



and adequate anchorage in cortical bone.³ Mini dental implant crestal emergence profiles through small islands of keratinized gingival soft tissues attached to crestal bone significantly improve the prognosis for the peri-implant environment of the mini dental implants & by extension, enhance the predictability of the entire prosthesis. “Auto advancement of MDI”, driven slowly into the medullary bone with finger and thumb wrench rotations & compressive pressure until biting into denser bone apically, helps stabilize the mini dental implant but does not require overt penetration of any cortical wall.

Additional gradual force can be marshaled by using a ratchet wrench or an adjustable torque wrench (in Ncm) to improve the mechanical advantage. However, care should be taken not to apply excessive force that might snap the implant or fracture very dense type 1 basal cortical bone typically found in mandibular symphysis region.⁴

Dr Balkin demonstrated bone stability with mini implants inserted via the auto advancement technique & immediately loaded the MDIs. Supportive information was obtained from histologic study and human subtractive radiography. To further test the validity of clinical protocol, the mini implants were obtained at 4 months & 6 months after insertion & placement into immediate function. The histological samples indicated that osseointegration of these MIDs showed close adaptation of the bone to the surface of the implants without interposition of soft tissues.^{4,5} Higher magnification of the same area clearly shows the concentric lamellae of the formed osteon & the interstitial lamellae. Such an image suggests the intimate association of the remodeled bone to the implant & the osseointegration of the mini dental implant. Higher magnifications also reveal osteocytes within their lacunae. This remodeled bone is closely placed into the implant surface. Vascular elements within this remodeled bone are apparent, providing the nutritional requirement for healthy appearing remodeled bone interfacing the mini dental implant. In three systemically

healthy adults requiring multiple tooth replacement, a total of 14 mini titanium screw dental implants were surgically inserted with auto-advance technique and then immediately loaded with fixed prosthetic bridges and followed for at least 3 years after the treatment. Conventional periapical radiographs were taken at the time of placement and 3 years post function of the 14 implants with 27 of their proximal surfaces. Changes in crestal alveolar bone mass between the serial radiographic pairs were assessed using computer assisted digital subtraction radiography program (DSRTM, electro medical systems, Richardson Tex.)^{4,5}

The results showed that none of the 14 mini dental implants were lost the 3 year observation period of the 27 proximal implant surfaces examined with digital subtraction radiography 8 (29.6%). These mini implant surfaces exhibited a gain in crestal bone mass; 18 (66.7%) showed no change & 1 (3.7%) surface revealed a loss in crestal alveolar bone mass. This pilot study demonstrated that mini implants subjected to immediate fixed prosthetic loading & function for at least 3 years survived & exhibited a remarkably high degree of stability in crestal bone mass using digital subtraction radiographic analysis.^{4,5}

Bruce Lish stated that patients who have had radiation therapy directed at the mandible or maxilla due to oral or head and neck cancers or metastasis to the head & neck region, are particularly fragile. These patients are often faced with few options for improvement of quality of life in the area of their oral health, both in form & function.^{4,7}

Often, radiations to head & neck regions result in destruction of salivary glands (both major & minor). Complete denture retention relies heavily on oral moisture to develop “suction”, without which denture function is severely impaired. With concurrent loss of stability, denture sores are common & heal poorly due to decreased tissue vascularity. The “minimally invasive protocols” of mini dental implants are great benefit to such cases to stabilize complete



dentures. These implants can be self-threaded into pilot osteotomies reducing the post-surgical complications. In doing so, compromised vascularity will not adversely affect the healing. However, for placing mini implants in irradiated patients, several factors like the type, dose & field of radiation must be considered. The dose of 5500 cGy is often quoted as a cut off presenting a relative low risk for development of osteoradionecrosis for implant placement procedures. For patients with developmental disabilities, Bruce Lish stated that in a large segment of the developmentally disabled population, the only treatment for advanced caries is extraction. As one would expect, this would leave a large portion of the population either partially or completely edentulous. This leads to the next great challenge of restoring the patient to function with prosthetics. Mini dental implants greatly increase the success of these prostheses by increasing stability and retention. Once again, simple and minimally invasive non-surgical protocol for mini dental implants makes them the solution of choice. In this vein, because there are fewer post-operative problems that are much harder to manage in these cases can be avoided.

As stated by Harold Sussman & Authur Volker,⁴ the deleterious effects of diabetes on the body are numerous & well known. This includes retinopathy, neuropathy, nephropathy, microvascular changes, polyuria & polydipsia. Of interest to the dental clinician, is high incidence of residual ridge resorption & periodontal disease. This co-morbidity maybe a strong contributing factor in compromised edentulous nature of many patients.

The use & reliability of mini dental implants have shown to have similar success rate to other implant systems when used in edentulous patients of Coler Goldwater Speciality Hospital (Roosevelt), having co-morbidity of diabetes of type II & taking supplemental insulin. As the mini dental implant placements do not require the use of a surgical flap ideally, with the use of a small diameter fixture, it is anticipated that wound

healing for patients with diabetes will proceed with less sequelae than would have been seen with conventional standard implant placements, provided proper protocol is followed. Peckitt⁴ reviewed that mini dental implant system has a pivotal role in complex orofacial reconstruction. This treatment option permits end osseous stabilization of a prosthetic device by:

- Having an advantage of flapless technique & minimal trauma
- In cases of compromised osseous width &/or bone volume
- Used as single stage or immediate technique
- Available at low cost

Trevor McClain et al examined the success of mini dental implants by assessing four subjective measures of patient satisfaction for mini dental implants in edentulous mandible in terms of comfort, retention, chewing ability & speaking ability. They stated that mini dental implants supported overdentures are highly successful implant options for patients with poor tolerance to maxilla & mandibular removable complete denture prosthesis. Also, MDIs once thought of as transitional implants but with success rates of 97.4%, certainly proved to be more than temporary implants. The implants are relatively affordable & overall patient satisfaction is excellent.⁸

AHN et al (2004) investigated mini implant as retentive aid for the overdenture. Their study revealed a high success rate & a favorable prosthetic outcome that augment their use in edentulous arches. They also emphasized that mini implants could be a good solution for those patients suffering from discomfort & less functional dentures. As confirmed by FEA studies, another proposed reason for reduced bone loss around mini dental implants could be claimed by the load transferred to the bone-implant interface by minimal nondestructive horizontal forces.⁹



Additionally, as quoted by Himmlova et al (2004) and Balaji et al (2010), the single piece mini implants provide gap free connection (bacteria proof) and therefore get the optimal effect of the barrier and protect the per-implant soft tissue. This allows the establishment of a tissue collar overlapping the bone implant interface.⁹

Bidra et al (2013) compiled a systematic review & stated evidence for short term survival of mini implants when used exclusively for definitive prosthodontic treatment. These had an encouraging first year interval survival rate of 94.7%.⁹

In a study conducted by Sang Choon et al, full mandibular dentures supported by non-splinted dome shaped narrow diameter implants provided with immediate occlusal loading & function, showed high survival rates of implants as 94.1% & prostheses 100%.¹¹

Park et al reported on the long term survival of narrow diameter implants with an overall survival rate of 85.9%. The survival rate in mandible was greater (93.4%) than that of maxilla (79.4%), 36 months following immediate loading. The study subjects were evaluated and the narrow diameter supporting the overdentures were compared with that of conventional complete dentures. They were reported with an increase in comfort, function, stability, fit, occlusion, satisfaction, phonetics & social life over an average of 22.8 months. To date, the use of immediately placed narrow diameter implants to support overdentures in mandible has shown excellent results.¹¹

Maryod et al evaluated and compared clinical outcomes of immediate and early loaded four interforaminal mandibular overdentures with cumulative survival rates of 91.7% and 96.7% respectively, concluding that immediate and early loading protocols showed clinical results with favorable peri-implant tissue response 3 years after implant insertion and function. However, early loading of mini implant supported

overdenture appears to be preferable to immediate loading.¹²

Discussion

Using mini-implants supported overdenture as a definitive method for treating the edentulous is relatively recent and therefore the literature present is comparatively less. This therapeutic alternative is seen by a large group of authors as indicated especially for mandibular complete edentulism. Treatment with MDI supported overdenture has been frequently done in the mandible.¹¹ The largest number of implants was applied in the interforaminal area. Regarding the indicated number of implants that should be used, specialists' opinions vary. Some believe 1-2 to be sufficient, whereas according to others a minimum of 4 mini implants in the lower jaw and 6 in the maxilla are needed. The main advantage of these implants which has been commonly identified in literature, is that they can be placed in compromised ridge conditions where conventional implants cannot be placed due to the poor availability of bone width. The necessary ridge width in order to apply a conventional implant must be bigger than 5 mm. MDI may also be inserted where the ridge width is 3–4 mm. According to some studies, D4 bone density is a contraindication for implant placement. Usually D3 bone density is found mostly in the anterior and posterior region of maxilla. D4 bone density is usually seen typically in posterior maxilla. The insertion torque is correlated with bone density during implant insertion. Most authors agree that immediate loading can be performed in MDI's. Immediate loading is recommended in D1 and D2 bone densities. The full edentulism is frequently associated with elderly persons, who generally have a lower income. In this context, overdenture on mini implants becomes an advantageous treatment solution, being generally perceived as having lower costs.¹³

Advantages of Mini Dental Implants⁴

- Atraumatic surgical procedures
- Flapless surgeries & minimal bleeding operative procedures



- Simple insertion protocols to place implants
- Minimal armamentarium
- Reduced post-operative discomfort
- Immediate loading protocol
- High degree of patient satisfaction
- Easy to maintain the cleanliness of the exposed ball abutments
- No bone grafting or additional ridge augmentation procedures required
- Reduced risk to medically compromised patients
- MDIs with low ball top profile, decrease the risk for lateral overloading forces
- Able to maintain the vertical dimension of occlusion by using patients pre-existing dentures
- Cost effective compared to conventional implants
- For stabilization of any overdenture system
- Obturator retention
- Craniofacial applications
- Fixed & removable prostheses in compromised situations

It is a hope and presumption that the advent and acceptance of MDI technology with its exceptional affordability will pave way to a much wider accessibility for the needy patients who have heretofore been written off within on the presumed basis of non-affordability. Broader access to implant therapy is now envisaged as being far more achievable by the generous application of MDI principle globally.

But, with India being the second most populous and socio-economically developing country in the world and having 70% inhabitants affected by edentulism, this alarms for the need for an implication of a feasible treatment modality like that of mini dental implant supported overdenture that will fit into the economic pocket and compensate to perform good function.

Conclusion

Mini-dental implant supported overdenture can be recommended as a treatment alternative for either conventional denture or conventional implant retained overdenture. The advantages of

this type of treatment derives from the characteristics of the implant (small diameter, variable length, O-ring retention system), which adapts better to the particular morphological conditions present in full edentulous patients. Also, the implant insertion requires less surgical trauma, this being a beneficial aspect in the context of usually poor general status. Proceeding and achieving the treatment requires careful evaluation through clinical, imagistic and laboratory methods. This type of treatment has a lower cost compared to conventional implant supported overdenture method. Also, by eliminating some surgical intervention, we make the procedure more affordable to the patient. On the other hand, the benefits related to an improved stability, better functionality and adaptation are quickly noticed by the patient which increases their level of satisfaction. Due to the relatively simpler technique and benefits that are quickly perceived, mini implant supported overdentures may be the elective treatment alternative for completely edentulous patients.

References

1. M.A.Elysad, A.A Gabreel, M.M Fouad, A.H Elshoukoui. The clinical and radiographic outcome of immediately loaded mini implants supporting a mandibular overdenture. A 3-year prospective study. J of Oral Rehab. 2011; 38:827-834.
2. Elena Preoteasa, Marina Imre, Henriette Lerner, Ana Maria Tancu and Cristina Teodora Preoteasa. Narrow Diameter and Mini Dental Implant Overdentures, Emerging Trends in Oral Health Sciences and Dentistry, Prof. Mandeep Viridi (Ed.), InTech.2015.
3. Laney W R (ed) Glossary of oral and maxillofacial implants. Chicago: Quintessence Publishing Co 2007, p.40, 102, 103, 113, 133.
4. Victor Sendax. Mini dental implants: principles and practices. *Elsevier - Health Sciences* Division, United States (2012).



5. Dubey RK, Gupta DK, Shetty P. Current status of edentulousness in India: Systematic review. *Chhattisgarh J Health Sci.* 2013;1:72–6.
6. Balkin B E, Stefik D E, Navel F. Minidental implant insertion with autoadvance technique for ongoing applications. *J Oral Implantol.* 2001; 27:32.
7. K. Aitasalo. Bone tissue response to irradiation treatment modality of mandibular irradiation injury. An experimental and clinical study. *Acta Otolaryngol suppl.* 1986; 428:1-54.
8. Griffitts TM, Collins CP, Collins PC. Mini dental implants: an adjunct for retention, stability, and comfort for the edentulous patient. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005; 100(5):e81-e84.
9. Mostafa Omran, Alaa Abdelhamid, Amr Ekarargy, Mahmoud Sallom. Mini-implant overdenture versus conventional implant overdenture (A radiographic and clinical assessment). *Journal of American Science* 2013; 9(9).

