

Mini Dental Implants: Applications in Prosthodontics and Orthodontics

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Abstract: Implants are considered as best treatment for replacement of missing tooth/teeth or to hold removable dentures in place because fixed prostheses are more preferred. To replace missing teeth, conventional dental implants are a popular alternative to more conventional ways of missing teeth replacement. However, various factors may make placement of conventionally sized (diameter of ≥ 3 mm) dental implants, contraindicated. Mini dental implants (diameter of ≤ 2.9 mm) have gained more popularity in dental practice nowadays. Since the mini dental implants introduced, they have been used in various clinical situations creating more dental treatment modalities for the good care of patients. This article reviews various applications of mini implants and their clinical efficiency, not only in prosthodontics, but also their applications in orthodontics.

Keywords: Mini Implants, Prosthodontics, Overdenture, Orthodontics, Orthodontic Anchorage.

INTRODUCTION

Dental implants are considered as a standard of care for prosthodontic teeth replacement when missed as a result of various reasons. Treatment using dental implants results in high patient's satisfaction with more success when compared to other alternatives. However, this treatment is not indicated in all cases. Some cases also are medically compromised, or have bone resorption in the site of missing tooth, hence, the implant choice is restricted. Furthermore, sites with reduced interdental space and atrophic ridges. Although volume of the bone at the edentulous area can be increased by grafting or surgical augmentation procedure to place a conventional implant, such interventions cannot be done in some cases because of financial reasons, medically compromised patient, more time consuming, or the prognosis of such procedures. In such cases, mini implants can be alternatively used [1].

Mini dental implants are traditionally used for patients who do not receive conventional implants due to medical, anatomical or financial reasons. They have similar structure to conventional implants, but are smaller in diameter. These mini implants constitute of two parts: a post made of titanium that has a ball on the top, and a socket that has a rubber O-ring to facilitate tooth-to-post attachment. The diameter of conventional implants is over 3 mm wide, while mini implants are less than 3 mm in diameter, with range of 10 - 15 mm long. Similar to the standard dental implants, mini implants are made of titanium [2].

Usually, a conventional implant comes in two separate pieces and has a thread inside the implant that is compatible with different types of prosthetic dentures. On the other hand, mini implants comes in one solid piece that screws into the bone. The ball on

the top is designed to support dentures, which have a rubber O-ring in order to slide over this ball [3].

Mini dental implants have been extensively used as temporary prosthesis or orthodontic anchorage; however there have been studies that proved their availability as a mean for long term prosthodontics [1].

In literature and practice, there is a controversy among dental professionals in recent years regarding the use of mini implants. Mini implants were first introduced for the purpose of temporary use to support an interim prosthesis that used while healing phase of conventional implant. Nowadays, the use of mini implants has been increased by many dental practitioners instead of conventional implants. The advantages include minimal invasive operating procedure, immediate placement and competitiveness.

They can fit seating of new dentures or existing ones, by securing the heads of the mini implants through the O-ring retention device, providing new levels of comfort and trust for edentulous patients [4].

The conventional implants may be contraindicated in some cases such as patients with chronic disease, heavy smokers, or following head and neck radiation therapy. In these circumstances, mini implants would be a valuable alternative treatment option to the conventional implants [5].

However, many dental professionals have significant doubts about the placement of mini dental implants as a permanent support structure for dental restorations.

MINI IMPLANTS IN PROSTHODONTICS

Mini dental implants are appropriate to retain removable prostheses and support fixed complete and partial dentures. Anatomic areas, quality of bone, esthetic considerations, and occlusion are important considerations for the treatment success [2].

Dentists can replace missing teeth with bridges, dentures or dental implants. Mini implants can support most prosthesis for teeth replacement; dentures, fixed bridges and crowns. However, they are used only in selected cases such as microdontia, and narrow space [5].

Conventional implants, when placed, they take few months and few dental appointments for the whole procedure, considering the extra appointments for bone grafting in cases with insufficient bone volume to support the implant. Moreover, certain patients cannot endure invasive surgery procedures and frequent dental visits, or have severe bone atrophy to receive the conventional implant with the regular diameter. In such cases, mini implants would be the best alternative option. Usually, Dentists can place mini implants in one visit under local anesthesia with lack of sutures need [6].

At first, mini implants were used mainly for temporary crown stabilization, or providing temporary bridge or denture for esthetic reasons while completing the healing phase of the surgical site. Nowadays, use of mini dental implants as the platform for a range of dental procedures is becoming more common. This means the use of mini implants for stabilizing removable dentures and permanent dentures, fixed bridges and crowns. The most common use of mini implants is for the lower denture, however, they can be placed any site into the oral cavity and can be used to replace single or multiple missing teeth. Mini dental implants showed a high effectiveness for stabilizing dentures [3].

Dental professionals who support the use of mini implants emphasize that the procedure is faster and less invasive than conventional implant placement, and can be done in cases with decreased bone volume or interdental spaces. These factors make reconstruction with mini implants a less costly option than standard implants, and both the procedure and recovery times are shorter. Additionally, these implants are less expensive than standard implants, further reducing the costs of treatment [6].

Mandibular overdentures retained by 2 conventional implants have been considered the standard of care for complete edentulous patients. However, certain patients decline this treatment option because of the high costs and discomfort associated with the procedure. Mini implants would overcome these disadvantages because of their feasibly lower costs and adequately uncomplicated placement procedure [7].

Mini implant retained overdentures are less costly than overdenture treatment on 2 standard-sized implants. Treatment with 2 mini implants is an efficacious and cost-effective technique, while treatment with 4 mini implants would result in better outcomes with marginally less costs compared to the treatment with 2 conventional implants. Therefore, overdentures supported with mini implants would be more effective and more feasible than overdentures supported with 2 standard-size implants for patients with limited incomes [7,8].

In cases with lack of adequate bone mass; as a result of aging, and patients with reduced income along with medically compromised patients, treatment with conventional implants would be not the preferred option. Thus, those patients would be more suited for the use of mini dental implants [5].

In a retrospective study analyzed mini implants placed over a 12-year period supported removable and fixed prostheses, with mean length of follow-up of 3.5 years, the overall implant survival was 92.1%. Failures of implants were accredited to the implant mobility and the average implant failure period was 14.4 months [9].

In a systematic review evaluated complete overdentures that retained by mini implants, authors found higher survival rate of mini implants (92.32%). More frequent failures for maxillary (31.71%) compared with mandibular arches (4.89%). Most of studies showed slight bone loss values close to those of conventional implants (<1.5mm). Upon treatment with mini dental implants, all studies confirmed an improvement in satisfaction and quality of life [10].

The mini implants performed well on all sites with limited bone loss and high patient satisfaction. In certain cases, mini implants can serve as an alternative

to conventional diameter implants. These would ideally be used in multiples to maintain fixed dental prostheses and could serve in selected cases as an effective, low-cost solution to retain overdentures. Mini implant aided overdentures had greater patient satisfaction than standard implant overdenture [1].

Two and four mini dental implants can be used to maintain lower full dentures instantly, as shown in another study after one year of follow-up [11].

Survival rates are similar to those recorded for standard implants for mini implants. Such rates of survival did not seem to vary between experiments using flapless reflective techniques and flap reflections. In studies where the length of the failed implants was recorded, the failure rate appeared to be higher in shorter mini implants than in longer ones. Mini implants could be considered for use with fixed prosthesis and mandibular overdentures, as their success rate seems to be equivalent to conventional diameter implants. They could also be a reliable, low-cost solution for elderly people who want to reduce dental dysfunction problems [12].

Regular and mini implants each have their own advantages and drawbacks.

PROS OF MINI IMPLANTS

One main advantage of mini implants is that, unlike standard implants, they can be used for patients who have lost a significant amount of jaw bone structure. For cases where a patient has severe bone loss to make standard implants viable and wants to avoid a grafting operation, mini implants can be the only alternative [13].

Another benefit is that they minimize the need for major surgery; during a relatively non-invasive operation, anchors are positioned in the jaw with reduced discomfort. Mini implants are intended to avoid bone grafting, complex flap surgery and accelerate the implant procedure, i.e. less invasive procedure with shorter healing time. Healing process is much faster and healing time is reduced from months to days [5].

Mini implants are less costly too. Standard implants can be costly, especially if patients need several visits to the dentist [2].

CONS OF MINI IMPLANTS

Since mini implants are about half the size of traditional implants, it means two mini implants to replace a single traditional implant, which can bring a little more pressure on the jaw bone which contribute to slower recovery period due to the different weight distribution [10].

Standard implants provide such a longer-term solution when compared to mini implants, primarily

because they enhance weight distribution and minimize long-term pressure on the jaw bone. Conventional implants also provide a greater chewing force with their larger surface area. Because mini dental implant applications are relatively new in the implant dentistry community, there is no clinical evidence for long-term outcomes from these procedures. [8].

Short-term efficacy studies suggest that failure rates with these mini implants are significantly higher than with conventional implant placement, ranging from 6% to 13% in different studies, compared with 3% to 5% in conventional implants. Research has also shown that mini implants have a significantly lower tolerance to bite force than traditional implants, which can make them more susceptible to bend or break over time [9].

While there is plenty of evidence behind these claims that mini implants produce results comparable to conventional implants, a various studies suggest that treatment with mini implants may be less efficient than conventional implant-based prosthesis. Although mini implants are less costly, still it should be considered that conventional dental implants have been in use for decades, have plenty of scientific evidence that support safety and efficacy, and have an average lifespan of 25 years. Moreover, although the expense per mini implant is lower, two or three mini implants are sometimes required to securely anchor bigger teeth, such as molars, while only one conventional implant can secure them [6].

With development, new mini implants are self-tapping titanium threaded screws for immediate and long-term uses. Such devices allow the immediate fitting and long-term retention of dentures in the existence of primary stability and suitable occlusal loading [3].

MINI IMPLANTS IN ORTHODONTICS

Currently, a variety of clinical aspects were analyzed by orthodontists to individualize treatment options. Innovations in the field such as skeletal anchorage, digital radiography, bracket device enhancements and aligner therapy have encouraged orthodontists to provide more services and better treatment for patients than ever before. Skeletal anchorage gives an opportunity to make possible further dental changes. Mini implants, commonly known as Temporary Anchorage Devices and mini plates are often used today to make teeth more manageable and even help change growth patterns. One example is the application of a mini implant in the retromolar pad for distalizing the first permanent molar to reduce the crowing in premolar area [14].

Mini implants have guided the treatment plan of orthodontic treatment by handling complex inconsistencies with traditional biomechanics. Force can be transferred directly to the bone-borne anchor unit

by means of mini implants. Therefore, mini implants not only resolved anchorage-related problems, but also allowed patients to manage three-dimensional tooth movement. In addition adjunctive orthodontic therapies in adults and management for impacted teeth are another example of mini implant therapy. Clinical applications include anchorage reinforcements, intrusion, extrusion, bodily movements, and treatments of rare dento-skeletal disorders [15].

The mini implant, temporary anchorage devices (TADs), is now a widely known treatment modality in orthodontics with adaptability, minimal invasiveness and the cost-benefit engagement they still offer today. Skeletal anchorage has replaced traditional anchorage to a large extent in cases where anchorage is found either crucial, inadequate or likely to cause undesirable side effects like those of vertical displacements caused by inter-maxillary force schemes. The effectiveness of mini implant orthodontic anchorage relies on the reliability of the mini fastening screws used. The application site must provide a good quantity and consistency bone for good stability. We may reasonably conclude that the strength of the mini implants ' anchorage could be improved by choosing a position with specific characteristics of bone quality and quantity in comparison to the cortical and overall mandibular and jaw thickness. These expected information are important because it shows that bone quality and quantity are important when considering an implant insertion location, but also that there are other conflicting factors that influence the rate of success [14].

Orthodontic mini implants are important tools for effective orthodontic anchorage treatment, but the longevity of these systems depends on several biomedical factors. In one study [16], the overall success rate of mini implants was shown to be adequate, but screw volatility in the buccal fold demonstrated a high incidence, indicating that the immediate fitting by buccal mini implants was carefully considered [16].

In another study evaluated the long-term durability of orthodontic mini implants (self-tapping and self-drilling mini implants), they found a significant decrease in the content of titanium and a deterioration in the surface properties of all parts of mini implants after being used in oral cavities of patients for more than 6 months. They concluded that mini implant orthodontic treatment should not exceed 6 months in the oral cavities of patients [17].

In another study aimed to evaluate failure rates and variables associated with the stability of mini implants used for orthodontic anchorage, found that the use of mini implants for orthodontic anchorage is reliable. The overall rate of success was 89.9%. A careful selection of diameters is important for different locations. It is advised to have an implant size equal to

or less than 1.4 mm in the maxilla. For a proper orthodontic anchorage, an implant size greater than 1.4 mm is proposed in the mandible [18].

The fracture torque resistance of mini implants used for orthodontic anchorage was assessed in another study [19]. Larger mini implant diameter has been associated with higher torque resistance to fracture. Detailed information on maximum torque values in the fracture of different commercial mini implant brands might improve the success rate of this orthodontic anchoring system [19].

In another study, for both the neck and the tip of the five types evaluated, the fracture torques were different. Namely, NEO and SIN mini implants used in that study demonstrated the greatest resistance to neck and tip fracturing. Both the tip and neck fracture torques were higher than the torque needed to insert mini implants [20].

Treatment of malocclusion and orthodontic or orthopedic movements in three dimensions has recently become achievable with the use of mini implants for skeletal anchorage. Mini orthodontic implants and direct anchorage can achieve maximum retraction; nevertheless, the optimal implant placement (palate versus alveolar ridge) and the positive impact of direct or indirect anchorage need to be further studied [21].

The steadiness of orthodontic mini implants counts on the type of mini implant, patient age, site and location of implantation, and mini implant healing time. Mini-plate anchorage scheme is more feasible if mini-screws fail repeatedly [13].

CONCLUSIONS

Despite widespread concern about the ability of these mini implants to sustain occlusal load, mini dental implants are successfully used to assist fixed prosthesis.

The use of mini implants in areas with poor ridge width and/or interdental space can be a viable alternative treatment option that can minimize the cost of rehabilitation and provide the advantages of implant-supported prosthesis.

Due to the reduced diameter of the mini implant, their clinical effectiveness for supporting fixed prosthesis demands occlusal load management by adequate case evaluation and clinical diagnostic and laboratory techniques.

Further long-term studies need to be done to evolve clinical protocols based on evidence for predictable outcomes.

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