MINI DENTAL IMPLANTS: ADVANTAGES, LIMITATIONS AND CLINICAL APPLICABILITY

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Abstract
Mini dental implants offer an effective and minimally invasive alternative for edentulous patients, especially those with advanced bone resorption, who are not ideal candidates for conventional implants. This review analyzes the advantages and limitations of mini-implants, emphasizing their clinical applicability in the stabilization of mobile prostheses and temporary fixed restorations. While mini-implants have many benefits, such as reduced costs, simplified procedure, and shorter recovery time, they also have important limitations, including their reduced ability to sustain high occlusal forces and inferior long-term durability. Advanced biomaterials, such as titanium alloys, are essential for the success of mini-implants, ensuring osseointegration and reducing the risk of inflammation. In addition, essential oils, with antimicrobial and anti-inflammatory properties, help maintain peri-implant health, preventing infections and peri-implant complications. The integrative approach, which combines the use of biomaterials and essential oils, can significantly improve the stability and success rate of dental mini implants, providing patients with a durable and functional solution for dental restoration. This analysis emphasizes the importance of the appropriate selection of treatment for each patient according to clinical needs and aesthetic requirements.
Keywords: dental mini-implants, oral implantology, biomaterials, titanium alloys, osseointegration, peri-implantitis.

Introduction

Mini dental implants are a relatively recent innovation in the field of oral implantology, designed to offer a less invasive and more affordable alternative for partially or totally edentulous patients, especially those with bone limitations. Unlike traditional implants, mini-implants are smaller, with a diameter between 1.8 and 3.3 mm, which allows them to be placed without requiring major surgery and, in many cases, without the need for bone augmentation. This small size and versatility make them a viable solution for a wide range of patients, including those with significant bone loss, who are not eligible for conventional implants without additional interventions [1-3].

The concept of mini-implants was initially introduced as a method of temporary stabilization of dentures, but their popularity and clinical success have led to their widespread use for permanent treatments [4-6].

Today, they are used both to stabilize prostheses and to support crowns and fixed bridges in selected cases. With their small size and minimally invasive insertion procedure, mini implants offer numerous advantages, from patient comfort to lower costs and reduced healing time. These aspects make mini-implants an attractive

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option for patients who are unwilling or unable to withstand the complexity and duration of conventional implant treatment [1-3].

A major advantage of mini implants lies in the less invasive insertion procedure. Because it does not require large incisions and often no sutures, the implantation procedure is faster and more comfortable for the patient [1-4].

At the same time, the small size of the mini-implants allows them to be inserted into areas with limited available bone, eliminating, in many cases, the need for bone augmentation interventions, such as grafts. This not only reduces the overall treatment time, but also considerably lowers costs, making it an attractive option for patients on a tight budget. In addition, healing time is often shorter, and the risks and complications associated with major surgeries are greatly diminished [1-4].

Although mini implants have many advantages, they are not without limitations. One of the main challenges is their ability to withstand high masticatory loads, given that the small diameter limits stability in certain clinical situations. This makes them more suitable for stabilizing removable dentures than for supporting extended fixed work. At the same time, there is a limitation in terms of the type of patients suitable for mini-implants; They are not recommended for patients with habits such as bruxism or those with high occlusal forces, as the risk of long-term loss of stability is higher. In addition, long-term studies are limited and data on the success rate compared to conventional implants are still being evaluated, although early results are promising [4-6].

The clinical applicability of mini-implants is varied, but their choice requires a careful evaluation of each patient's individual case. An essential factor in the success of mini-implant treatment is the selection of patients based on the available bone density, the position of the implants and the functional requirements [4-6].

In some cases, they can be used to provide stability to removable dentures, which tend to be more unstable in totally edentulous patients, improving comfort and functionality. In other cases, mini-implants can support fixed works for a limited period, but the selection of these cases must be done carefully, in order to avoid overloading them [4-6].

Advantages of mini dental implants

Mini dental implants have a number of significant advantages over conventional implants, making them a preferable option for many patients and clinicians. One of the main advantages of mini-implants is their small size, which allows them to be inserted into areas with limited available bone, without the need for bone augmentation or other complex interventions. This is a beneficial solution for patients who have suffered significant bone loss, saving time and resources associated with additional procedures [6-8].

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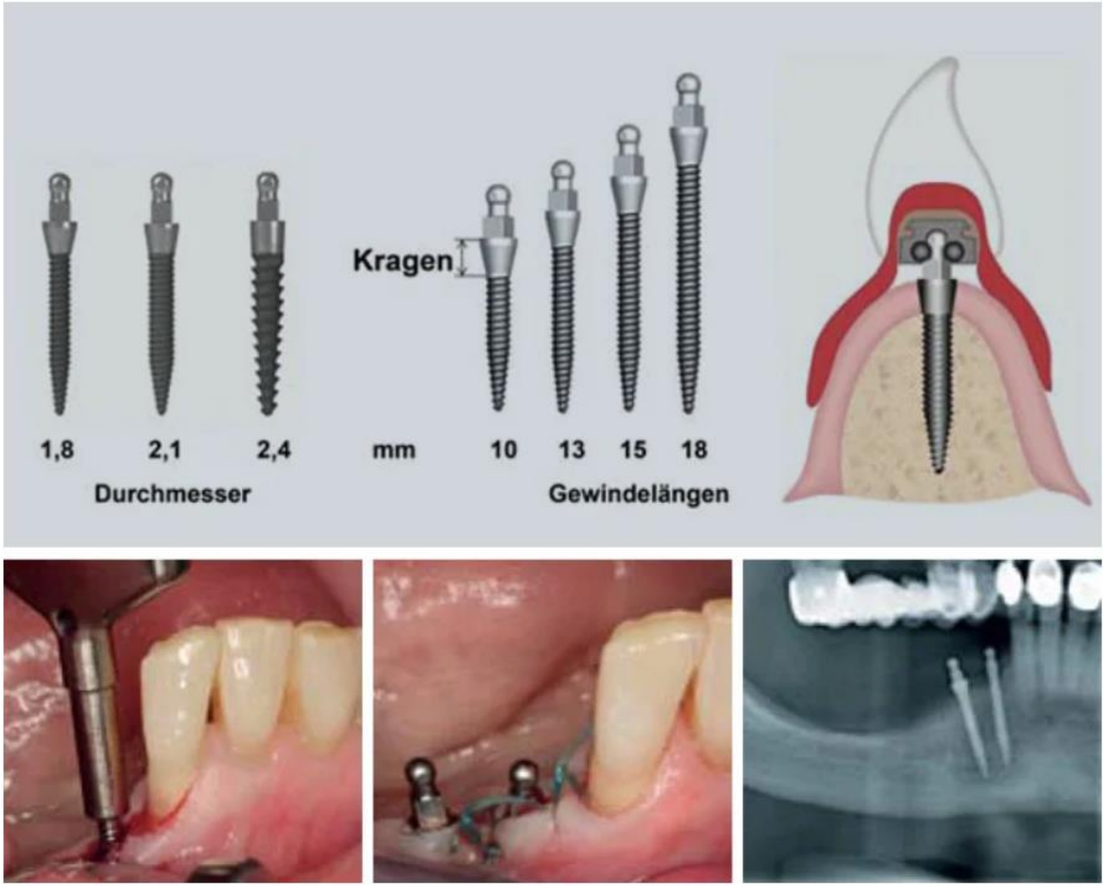

Figure 1. Miniature dental implants (MDIs) from 3M ESPE Dental GmbH are designed to adapt to different mucosal thicknesses. For patients with thick mucosa, polished collar MDI is used, as this design ensures proper emergence through the tissue and supports healing. In contrast, MDI without a collar are intended for cases with thin mucosa, providing a better fit and functionality in such situations. Following the placement of a 13 mm long collared MDI with a 1.8 mm diameter in the region of the first premolar, positioned 8 mm apart from another MDI, the mini flap was closed using individual 4-0 sutures [8].

The procedure of inserting mini-implants is also minimally invasive and less traumatic. Unlike traditional implants, the insertion of mini-implants requires small or no incisions, and the procedure can usually be performed without sutures. This contributes to a shorter recovery time and a high level of comfort for the patient, significantly reducing postoperative pain and the risk of complications. Patients can resume daily activities in a short time and experience rapid improvement in masticatory function and overall comfort [6-8].

Another notable advantage of mini implants is the lower cost compared to conventional implants. Their smaller size and lack of need for bone augmentation procedures help reduce costs, making treatment more accessible to a larger number of patients. This can be an ideal solution for patients on a budget, providing them with a viable and effective alternative for restoring their smile and dental functionality [6-8].

In addition, mini implants are versatile and adaptable in various clinical situations. They are often used to stabilize removable dentures in totally edentulous

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patients, greatly improving the stability and comfort of the prosthesis. This increased stability is crucial for patients with difficulty adapting to traditional dentures, providing them with a more stable and effective restorative solution. Also, mini-implants can be used in certain cases to support temporary fixed works, offering an intermediate solution until the final treatment is achieved [6-9].

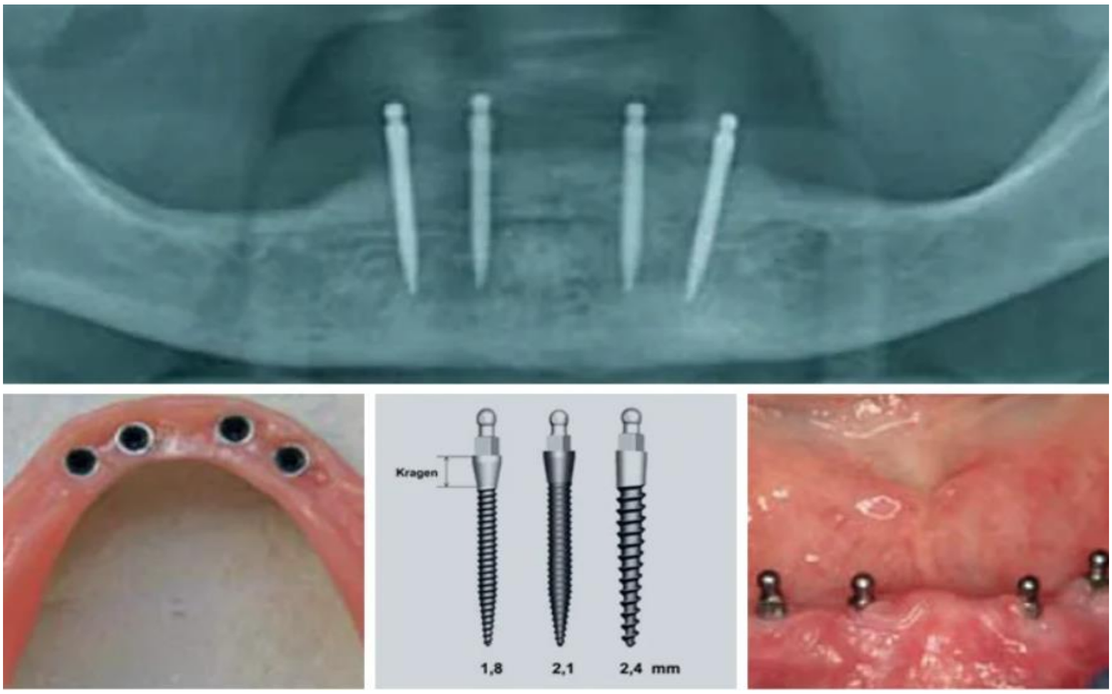

Figure 2. A panoramic X-ray showing the positioning of three MDI implants inserted into the mandibular bone, ostensibly to stabilize a denture. The implants are positioned in the frontal area of the mandible, and the structure of the bone and the positioning of the implants are clearly visible. Dental prosthesis with four implant supports. These supports are holes created in the prosthesis, which fit on the implants inserted in the mandible, providing stability and support to the prosthesis. A chart illustrating two types of MDI implants, each of which has a different size. The implant on the left has a diameter of 1.8 mm, and the one on the right has a diameter of 2.4 mm, both having a collar ("Kragen") that facilitates insertion into the thick mucosa. Clinical photograph of the gingival mucosa after the insertion of several MDI implants. The implants are visible at the gum level, each having a small rounded end that facilitates the attachment of the prosthesis [9].

Thus, mini dental implants offer numerous benefits, from lower costs and a less invasive procedure, to fast recovery and extended versatility. These advantages make mini-implants a preferred option for patients and an effective technique for clinicians, expanding treatment options for modern oral rehabilitation [9-12].

Limitations of mini dental implants

Although mini dental implants offer a number of remarkable advantages, they also have certain limitations that can affect their applicability in certain clinical situations. One of the most obvious disadvantages is the reduced ability to sustain masticatory forces. Due to their smaller size compared to conventional implants, mini-implants may be less stable and more susceptible to the high forces

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generated by chewing. This limits their use in certain cases, especially in patients who experience bruxism (teeth grinding) or have high occlusal forces, such as in the case of lateral teeth (molars). In such cases, mini-implants may not provide the necessary structural support for a long period of time [9-12].

In addition, the long-term durability of mini-implants is often inferior to traditional implants. Because they are smaller and have a smaller contact area with the maxillary bone, their integration into the bone can be less robust, which can lead to losses of stability over time [10-12].

Long-term studies are still limited, and preliminary results suggest that while mini-implants may have a satisfactory success rate for certain applications, they cannot provide the same long-lasting results as full-diameter implants. This aspect can influence the doctor's decision to recommend them or not according to the patient's needs [10-12].

Another notable limitation is the specific indication and anatomical restrictions of mini-implants. Although they are useful for patients with significant bone loss, there are certain situations in which they are not a viable solution. For example, in patients with very thin jaws or mandibles, even mini-implants may require a certain minimum amount of bone to ensure stability. In the absence of adequate bone density, the risk of mini-implant failure increases considerably. This means that patients with extreme bone resorption may still require bone augmentation procedures, thus reducing one of the major advantages of mini-implants [9-13].

Another disadvantage is the limitation of use in support of extended fixed works. Mini implants are more often used for stabilizing mobile dentures or for temporary work. Although they can be used in small fixed jobs, they are not recommended for extended dental bridges or for supporting complex fixed dentures, as the forces distributed on these structures may be too great for mini implants. This limitation makes them less versatile compared to traditional implants, which can support a wide range of long-term fixed dental work [10-13].

As for the insertion and integration process, although mini-implants are considered minimally invasive, there are still risks. Because they are thinner, they may be more susceptible to fractures or displacement during insertion, especially in low-density bone. Also, because mini-implants are less stable initially, they require a stabilization period and a carefully selected loading protocol to avoid premature failure [11-14].

Financial limitations can also occur in certain cases. Although the cost of an individual mini-implant is lower, sometimes multiple mini-implants are required to ensure the stability of a removable denture, which can increase the overall cost [11-14].

In addition, if a mini-implant fails, redoing the process may involve additional expenses, and the patient may lose the benefits of lower upfront costs [11-14].

In conclusion, although mini dental implants offer significant benefits for certain categories of patients, they are not suitable for all cases. Their reduced capacity to sustain masticatory forces, limited long-term durability, specific anatomical requirements, and restricted use in extensive fixed works are factors to be considered. [11-14].

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The choice of mini-implants must be preceded by a rigorous assessment of the patient's needs, bone structure and long-term expectations. The dentist must weigh these limitations to ensure an optimal and stable result over time for patients [11-14].

Clinical applicability and importance of biomaterials and essential oils for mini-implant patients

The clinical applicability of dental mini-implants has expanded significantly, being used today in a wide range of treatments for partially or totally edentulous patients. Mini implants are ideal for patients with significant bone loss, as their small size allows insertion without requiring complex bone augmentation. Also, mini implants are effective in stabilizing mobile prostheses, significantly improving their comfort and functionality for patients. In the case of removable dentures, mini-implants provide better fixation and stabilize the denture, preventing it from moving during chewing and speaking. This applicability is particularly valuable for totally edentulous patients who have difficulty adapting to unstable conventional dentures [14-18, 50-55].

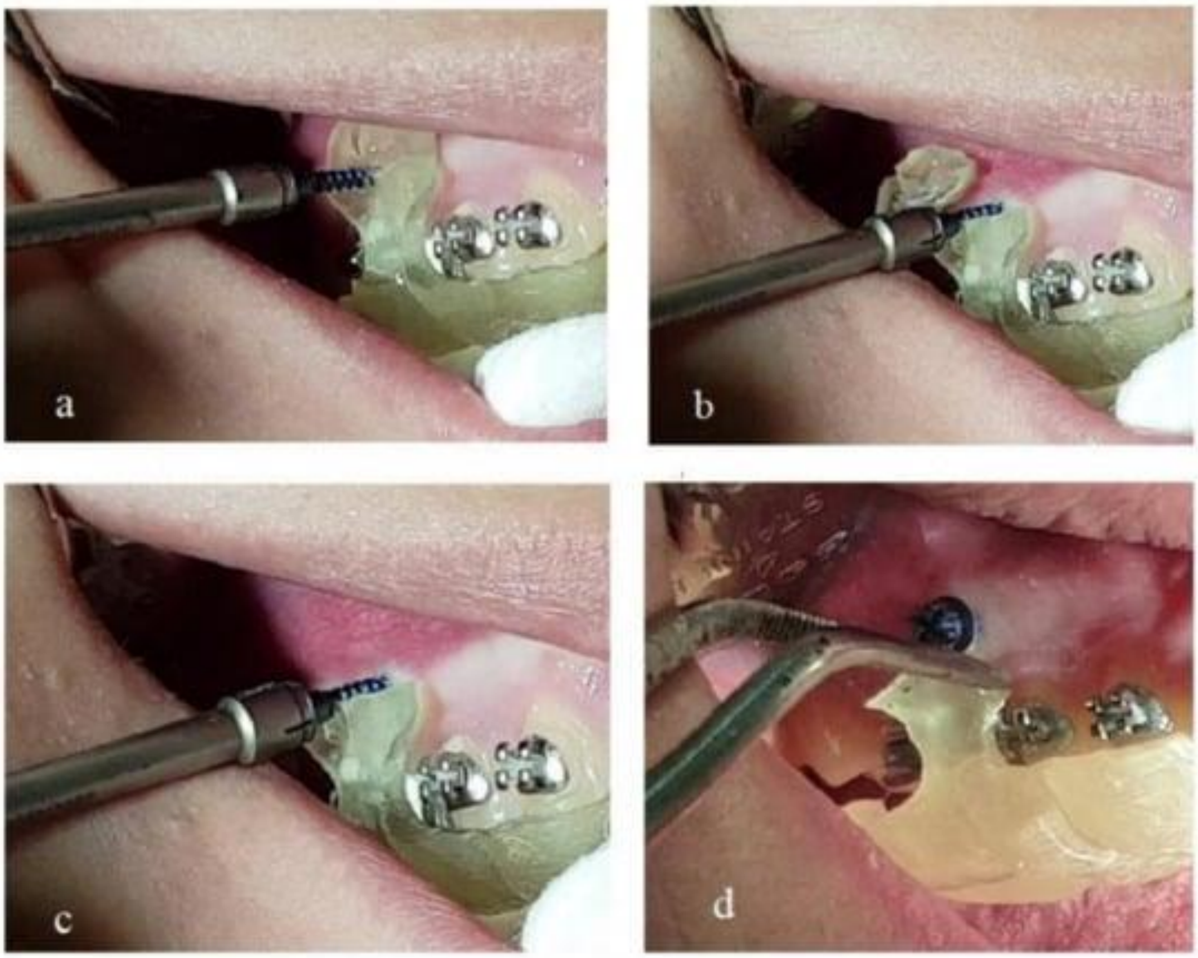

Figure 3. (a) Mini-implant positioned through the guiding hole in the surgical template. (b) A small section of the guide beyond the mini-implant fractured under pressure from screwing. (c) Fragments of the broken guide were removed. (d) The guide was then detached from the mouth [18].

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Another area of clinical applicability is in temporary fixed restorations. In the case of complex interventions, mini-implants can be used to support temporary works until the definitive treatment is completed. This solution provides patients with increased comfort and allows them to have temporary aesthetic functionality, until conventional implants can be fully integrated. However, it is essential that these works are carefully selected and not subjected to high occlusal forces, in order to prevent the risk of premature failure of mini-implants [19-28].

Recently, studies have shown that essential oils can bring additional benefits in maintaining peri-implant health. They are used for their antimicrobial, anti-inflammatory, and antioxidant properties, helping to prevent peri-implantitis, a condition that can compromise the stability of the implant. Essential oils such as tea tree oil, peppermint oil or clove oil have demonstrated effective antimicrobial effects against oral bacteria. By applying them to the implant area in the form of mouthwash or gel, essential oils can help reduce the bacterial load and maintain optimal oral hygiene [29-38].

For patients with mini-implants, essential oils can be used as part of their daily oral hygiene regimen to prevent gum inflammation around the implants. For example, peppermint oil has a calming effect and provides a feeling of freshness, while tea tree oil is known for its antifungal and antibacterial action. These oils can help create a healthy oral environment and help prevent bacteria buildup, thereby reducing the risk of peri-implant complications [39-42].

The importance of biomaterials in mini-implant treatments is crucial for their success and longevity[46-52]. The biomaterials used for mini-implants are usually titanium alloys, known for their high biocompatibility and osseointegration capacity, a process by which the implant becomes an integral part of the bone structure. Modern titanium alloys have been developed to ensure rapid integration and increased resistance to masticatory forces. An important aspect in the use of biomaterials for mini-implants is the reduction of the risk of inflammation and rejection of the implant by the body, which is essential to ensure their long-term stability. At the same time, the innovative materials used for mini-implants are specifically treated to stimulate bone regeneration and reduce the risk of infections, thus increasing the success rate of treatment [39-45].

The combined use of advanced biomaterials and essential oils can significantly improve the success rate and longevity of mini-implants. Modern biomaterials contribute to the rapid integration and long-term stability of implants, while essential oils provide additional support for oral hygiene, preventing inflammatory complications. This integrative approach is beneficial for patients, providing them with a functional and durable dental restoration solution [39-45].

Conclusions

Mini dental implants are a versatile and effective solution for patients who cannot benefit from conventional implants due to anatomical conditions or financial constraints. They offer an attractive alternative due to their minimally invasive procedure, lower costs and fast recovery time, although their clinical applicability

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must be carefully evaluated for each individual patient. The study of their advantages and limitations is essential to understand how mini implants can be effectively integrated into modern treatment plans, contributing to increasing the quality of life of patients through functional and aesthetic restoration solutions.

Although mini dental implants offer significant benefits for certain categories of patients, they are not suitable for all cases. Their reduced capacity to sustain masticatory forces, limited long-term durability, specific anatomical requirements, and restricted use in extensive fixed works are factors to be considered.

The choice of mini-implants must be preceded by a rigorous assessment of the patient's needs, bone structure and long-term expectations. The dentist must weigh these limitations to ensure an optimal and stable result over time for patients.

The clinical applicability of mini-implants is extensive and adaptable to various patient needs, and the role of biomaterials and essential oils is essential in maintaining peri-implant health. Through the correct selection of oral care materials and products, patients can benefit from effective and stable mini-implants, which improve their quality of life by restoring dental function and aesthetics.

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