Success factors for treatment with mini-implants and their importance in practice

Prospective study of patient cases over one year

The clinical success of mini-implants depends on a variety of parameters that are also related to each other. The present study investigated whether there is a correlation between the diameter of the placed implants and primary stability. In addition, different bone densities specified by the respective patient case were taken into account. Moreover, the osseointegration and the depth of any peri-implant pocket were documented over a period of one year after implantation. In addition, the influence of the implant diameter and the type of implant structure on the success rate were determined.

If a tooth is lost, the bone also regresses. According to Christensen, the loss is usually from 20 to 30%. Already in the first six months, it is about 15%, and in the following period about 1% per year (Fig. from 1 to 3).

This has particular consequences for the treatment of patients with edentulous jaws. Patients who have been edentulous for many years (more than 10 years) have a jaw ridge width of 5 millimetres or less in 80% of cases. With such compromised oral conditions, a classic implantation is often ruled out. Therefore, especially for many older patients, the mucosa-supported prosthesis is still the standard treatment for the edentulous lower jaw. The bar-supported prosthesis with conventional implants is often not feasible for cost reasons, advanced jaw atrophy or other medical reasons. As an alternative, mini-implants have proven to be interesting for stabilization; in the upper jaw, a prosthesis supported in this way can, in many cases, even be designed without a palate. As a rule of thumb: With a jaw ridge width of 3.5 mm and generally medically impaired patients, mini-implants are the first choice.

In terms of costs, such restorations are located somewhere between the mucosa-supported prosthesis and a bar-supported restoration. Due to the advantages mentioned, mini-implants are experiencing a real boom in some cases. Since its introduction, over 1,000,000 mini dental implants have been sold worldwide.

Material and method

Patients and type of inserted implants

As part of the present study, a total of 187 mini-implants (Sendax MDI or MDI Hybrid, IMTEC, a 3M Company [hereafter briefly: IMTEC], Oberursel) have been inserted in 42 patients. These were between 30 and 92 years old, 8 of them under 60 years. The average age was 68 years. 16 patients were male, 26 female.

One-piece implants with different diameters (Sendax MDI: from 1.8 to 2.4 mm; MDI Hybrid: 2.9 mm) and with different structures (conical, spherical head, square) were introduced (Tab. 1 and Tab. 2). The ball head variant as the standard for stabilizing a prosthesis was used most frequently.

Patients were followed up for a period of at least 12 months, at intervals of three months, i.e. 3, 6, 9, 12 months after implantation. An X-ray control image was then taken, an occlusion check and the degree of osseointegration determined. The periotest used for this purpose was applied analogously to the procedure for classic implants (although the results have to be interpreted somewhat differently due to the different scale). The pocket depth on all four sides was measured with a periodontal probe. A classic curettage was performed for prophylaxis, and the mini-implants were thoroughly cleaned with a specially designed brush (Access, IMTEC, Oberursel). This was also recommended to patients for oral care at home.

Insertion protocol

The mini-implants used here (Fig. 1) have a significantly smaller diameter (1.8-2.9 mm) than classic implants and have a one-piece, conical-cylindrical compression screw with a self-cutting threading (Fig. 2). Due to this special design, the MDI Sendax implants can be easily inserted transgingivally into the bone after perforating the cortical bone with a 1.1 mm pilot cutter and drilling the bone to a length of one third of the implant thread length. The following applies to the larger Hybrid mini-implant with a diameter of 2.9 mm: A 1.8 mm pilot bur is used; in the case of a D3 or D4 bone quality (Fig. 3, 4), a length of one third of the implant thread length is drilled out, but in the case of D1 or D2 bone with a pilot drilling of 2.0 mm is used in a length of two thirds of the implant thread length (Fig. 5-9).

In general, the patient‘s existing prosthesis can continue to be used. Metal housings with a semi-elastic rubber ring are inserted into these. They then rest with a certain degree of flexibility on the mini-implants screwed into the jaw, so that the masticatory forces acting on them are introduced optimally (“soft loading”). In this way, among other things, over-stressing of the implants and of the bone bed directly after insertion is avoided and the load is dampened over the entire period of wear. At the same time, the bony layer remains protected from further resorption.

If a primary stability of 35 Newton centimetres (Ncm) or more is achieved after insertion, the total prosthesis can be loaded immediately. Otherwise, this is provided with soft relining (here Fig. 10-13).

The author followed this exact protocol for the treatments in the present study. The following special features are pointed out (Tab. 3): vertical relief incisions were made in 80 cases (around 43%), and augmentation with a collagen membrane of equine origin (Tissue Fleece, Baxter, Heidelberg) in 85 cases (around 45%). These were patients with severely atrophied bone and a small amount of keratinized gingiva. The membrane also has a haemostatic effect. In this way, a better quality of the peri-implant tissue was achieved, which, according to the literature, can be attributed to the stimulation of the production of growth hormones. Immediate loading was performed in 24 cases (around 13%) and a soft relining in 163 cases (around 87%).

New prostheses were also made in 90% of the cases in the

Fig. 1: Mini-implants in different diameters and alternatively in the version with ball ("O-ball") or square head ("square head").

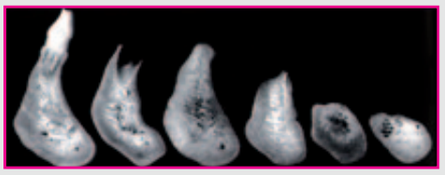

Fig. 4: Resorption classes (RKL) of the lower jaw (from left to right): RKL 1 = toothed lower jaw, no resorption; RKL 2 = alveolus after extraction; RKL 3 = high alveolar ridge (healed alveolar process); RKL 4 = high and narrow jaw ridge; RKL 5 = rounded and flat jaw ridge (vertically absorbed); RKL 6 = concave and severely atrophied jaw ridge.

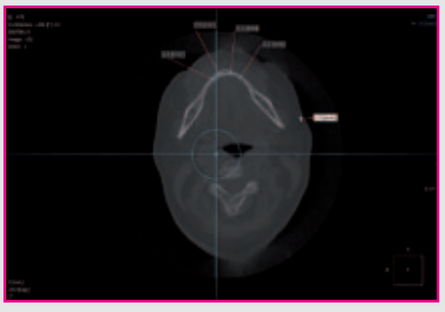

Fig. 6: The jaw ridge width is measured using a computer tomogram (Iluma, IMTEC, Oberursel).

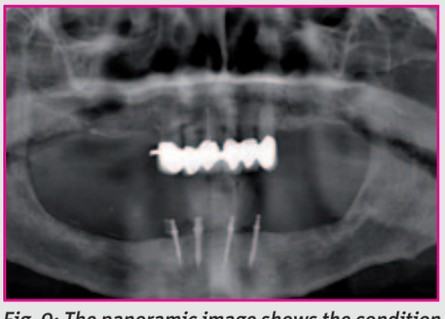

Fig. 9: The panoramic image shows the condition immediately after the insertion of mini-implants with a diameter of 1.8 mm and a length of 13 mm.

Fig. 12: The bite check is carried out before and after polymerizing the housings, paying attention to the correspondence of the occlusion points.

Fig. 2: 2.1 mm mini dental implant from IMTEC, a 3M Company, with ball head for easy insertion even in very dense bone. Small picture: an innovative micro-thread supports healing and stability of soft tissue and of the cortical bone during the healing process.

Fig. 7: The further implantological procedure is planned using radio-opaque marking points.

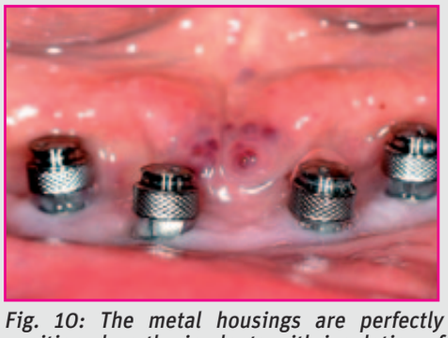

Fig. 10: The metal housings are perfectly positioned on the implants with insulation of about 2 mm high spacer sleeves.

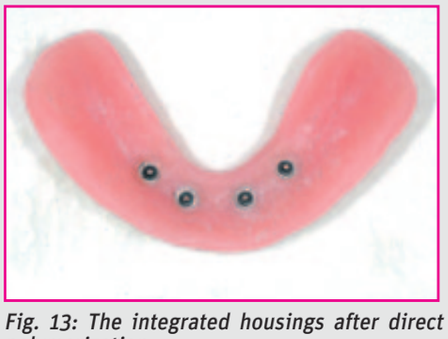

Fig. 13: The integrated housings after direct polymerization.

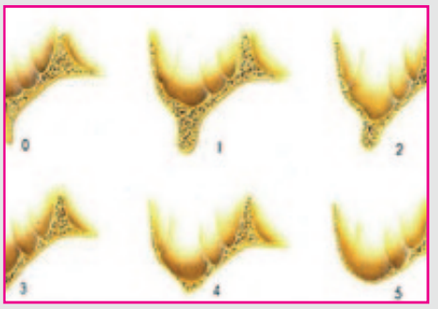

Fig. 3: Classification of the atrophied upper jaw according to Cawood and Howell.

Fig. 5: When inserting the implant in the direction of the opposite cortex, the bone height is used to the maximum.

Fig. 8: Clinical situation immediately after transgingival insertion of four mini-implants in the lower jaw.

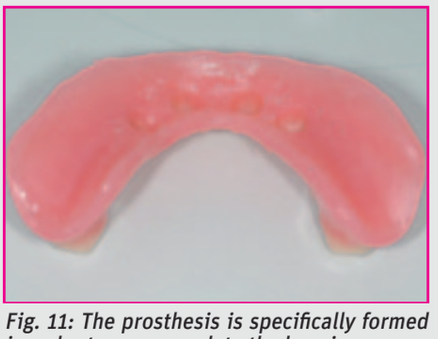

Fig. 11: The prosthesis is specifically formed in order to accommodate the housing.

Fig. 14: 2.9 mm diameter mini-implant design (MDI Hybrid, IMTEC, Oberursel): it can also be used for single tooth replacement.

Fig. 15: Initial situation in the lower jaw: teeth 32-42 have a degree of loosening of 2 and are not worth preserving.

Fig. 16: At the beginning of the minimally invasive procedure, there is the pilot drilling in the alveolar region 32.

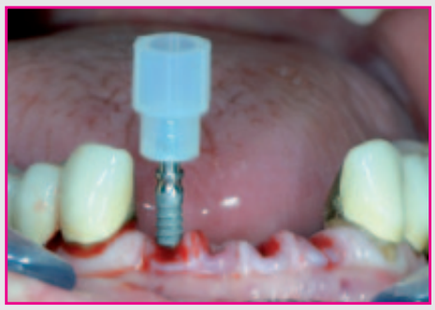

Fig. 17: The mini-implant is grasped by its plastic handle, removed from the sterile packaging and screwed into the extraction socket with a few turns.

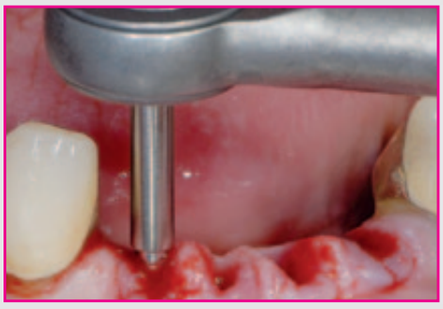

Fig. 18: The final stage of insertion is performed using the torque ratchet. In the case shown here, a good primary stability of around 50 Ncm was achieved (minimum stability for immediate load: 35 Ncm).

Fig. 19: After insertion, the mini-implants regions 42 32 are fitted with snap-on caps.

Fig. 20: For the temporary restoration, a deep-drawn splint is made using a mock-up.

Fig. 21: Temporary manufacturing

Fig. 22-24: The completed temporary bridge on snap-on-caps for the non-cemented provisional restoration.

Fig. 24

Fig. 25: The temporary in situ in non-occlusion.

present study. Aesthetic reasons and/or a crown height space (i.e. the distance between the bone and the incisal or occlusal level) of less than 15 mm spoke in favour of this. It is not atypical for old, badly worn full dentures to fall well short of this value intended by nature. In this case, an aesthetic rehabilitation can only be achieved by making a new one. Sometimes full dentures no longer offer enough space for the metal housing after they have been worn for a long time. This represents another possible reason for the manufacturing of a new prosthesis.

In addition, as an extension of the classic indication and after careful consideration of the risk-benefit ratio and comprehensive advice to the patient, mini-implants were also used in individual cases for later treatment with single-tooth crowns or bridges (here the example single-crowns: Fig. 14-25).

Results

Primary stability with different implant diameters

In order to determine whether different implant diameters affect the primary stability, implants that had been inserted with the same bone density and position were compared. In each case, a smaller implant diameter was compared with the next higher one, for example 1.8 mm versus 2.1 mm or 2.1 mm versus 2.4.

The primary stability was determined with a torque ratchet.

Anzahl der eingesetzten Mini-Implantate nach Durchmesser

Durchmesser [mm]	Gesamtzahl	Art des Aufbaus	Anzahl
1,8	39	Kugelkopf	36
		Vierkant	3
2,1	24	Kugelkopf	24
2,4	69	Kugelkopf	68
		Vierkant	1
2,9	55	Kugelkopf	37
		Vierkant	3
		konisch	15

Tab. 1

Anzahl der eingesetzten Mini-Implantate nach Aufbau

Durchmesser [mm]	Aufbau	Anzahl	Aufbau
1,8	Kugelkopf	36	
2,1	Kugelkopf	24	
2,4	Kugelkopf	68	
2,9	Kugelkopf	37	Kugelkopf
2,9	konisch	15	konisch
1,8	Vierkant	3	
2,4	Vierkant	1	
2,9	Vierkant	3	Vierkant

Tab. 2

Besonderheiten der im Rahmen der vorliegenden Studie vorgenommenen Eingriffe

Besonderheit	Anzahl der Implantate (bei insgesamt 187)	Anzahl der Patienten
Insertion mit vertikalen Entlastungsschnitten	80	
Insertion nach Augmentation	85	
Sofortbelastung nach Implantation	24	12
zunächst weiche Unterfütterung	163	30

Tab. 3

Nach Implantatdurchmessern aufgeschlüsselte Erfolgsraten

Implantatdurchmesser [mm]	Erfolge	Anzahl der damit vorgenommenen Insertionen	Erfolgsrate (in Prozent)
1,8	32	39	82,05%
2,1	24	24	100,00%
2,4	67	69	97,10%
2,9	52	55	94,55%

Tab. 4

Nach festsitzend bzw. herausnehmbar aufgeschlüsselte Erfolgsraten

Art der Restauration	Implantatdurchmesser [mm]	Erfolge	Gesamtzahl der Behandlungen	Erfolgsrate
festsitzend	1,8 bis 2,4	21	22	95,45%
herausnehmbar	1,8 bis 2,4	154	165	93,33%
festsitzend	2,9	17	18	94,44%
herausnehmbar	2,9	35	37	94,59%

Tab. 5

Significant differences were found for the pairs "1.8 vs. 2.1" and "2.4 vs. 2.9". On average, the 2.1 mm mini-implants showed a primary stability that was approximately 10 Newton centimetres (Ncm) higher than the 1.8 mm mini-implants, while the corresponding value for the "2.4 vs. 2.9" was at 15 Nm.

Clinical success parameters

No bone loss was detected over the entire study period. The mini-implants healed in the jaw over the entire observation period, with osseointegration improving significantly between the 6th and 12th month. There was also no new formation or deepening of gum pockets during the entire period, especially not in the peri-implant area of the freshly inserted mini-implants.

Success rates

Overall, the success rates were in a range that is comparable to the equally high level of success with classic implants (Tab. 4). For "larger" diameters (from 2.1 to 2.9 mm), the values were well over 90 percent, only for the mini-implants with a diameter of 1.8 mm below.

The following correlation resulted: high primary stability also leads to high success rates. The breakdown by "fixed" or "removable" and by implant diameter revealed barely any differences (Table 5). With the classic Sendax MDI implants (from 1.8 to 2.4 mm), the fixed restorations showed slightly higher success rates.

Conclusion

Based on the results determined in the present study, a success rate similar to that of classic implants can be expected when mini-implants are used to stabilize prostheses. Since the success correlates with the primary stability, it can already be well estimated after determining it with the torque ratchet directly after the insertion. If the determined figures are in the borderline range (≈ 35 Ncm), soft relining should be used, if in doubt. Depending on the individual case, it should also be checked whether another mini-implant can be inserted for better stabilization. If you have a choice, you should choose a slightly larger one, i.e. instead of the 1.8 mm implant, prefer the 2.1 one or instead of the 2.4 mm implant, prefer the MDI Hybrid with a 2.9 mm diameter.

It goes without saying that recall dates scheduled closely to each other are advisable, especially in order to be able to follow the scheduled osseointegration in a timely manner. It is by no means complete after six months, but it usually experiences a significant improvement again in the following six months.

Literature by the authors

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