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Even though modern concepts of prevention and conservative dentistry lead to longer preservation of the patient’s teeth, the treatment of edentulous patients will remain a central issue in dentistry. Many of those people desire fixed dentures, since tissue-borne prostheses offer limited stability and functionality – especially in patients with atrophic mandibular ridges. An adequate cost-effective solution to this problem is the use of small-diameter implants for denture stabilization. This option is more comfortable for the patient than conventional implant placement, since a minimally invasive, flap-less surgical protocol is possible in most cases.

The placement of mini dental implants is particularly suited for medically or anatomically compromised patients who cannot be treated with conventional implants. Moreover, mini implants are a solution often preferred by patients with financial limitations. The implants are usually inserted in a 90-minute treatment procedure. Augmentation prior to implant placement is usually not required and, due to the minimally invasive treatment protocol, complications as well as soft tissue trauma are less likely to occur compared to conventional implants.

Under the umbrella of the product family of MDI Mini Dental Implants, 3M ESPE offers a whole range of implants suited for denture stabilization. They combine implant and abutment in one piece and are available in diameters between 1.8 mm and 2.9 mm (Fig. 1). Implants with diameters of 1.8 mm and 2.1 mm are predominantly used in the mandible, the 2.4 mm option is recommended for insertion in the maxilla and the implants with the largest diameter (2.9 mm) are used mainly for soft bone in the upper jaw and are also suited for long-term fixation of single crowns. Collared and Classic O-Ball as well as Collared Square Head Implants are available. The lengths of the threaded portion of the implant vary between 10 mm and 18 mm (Fig. 2).

In the following, a patient case is used to illustrate the procedure for the insertion of MDI Mini Dental Implants.

Initial situation
An edentulous male patient in his mid 40s came to our dental practice in Berlin since he had problems with his mandibular denture. He reported that he used denture adhesives for fixation. Nevertheless, functionality and stability of this prosthesis were insufficient – it was so loose that he even had difficulty chewing. Since he was not able to carry the financial burden of a conventional implant treatment and desired a quick, comfortable solution, it was decided to place four MDI Mini Dental Implants in the anterior mandible for denture stabilization. Since the old prosthesis was in poor condition, the dentist, dental technician and patient agreed that a new denture should be fabricated in the dental laboratory.

Preparations
After having evaluated the anatomy of the jaw, local anaesthesia was delivered and the mucosal thickness determined with a periodontal probe (Fig. 3). Since a soft tissue depth of less than 2.5 mm was determined, implants with classic design were selected. Due to the small width of the patient’s alveolar ridge, the implants of choice had a diameter of 1.8 mm. The length of 15 mm was chosen on the basis of the bone height visible in the initial X-ray.

After implant selection, the distal implant positions were planned extraorally and a labside guide was used to transfer the desired positions into the patient’s mouth (Fig. 4). At this, care should be taken to plan the implant locations in safe distance – at least 7 mm mesially – from the mental foramina and neurovascular bundle. Between the implants, a minimum space of 5 mm is required due to the size of the metal housings used to fix the denture base. The planned locations of the distal mini implants were marked with the probe and became visible through slight bleeding (Fig. 5).
Surgical procedure

Subsequently, transgingival placement for the four single-piece implants followed in accordance with the surgical protocol for MDI recommended by 3M ESPE: with a pilot drill, the entry point for the first distal implant was prepared (Fig. 6). The depth of the pilot hole should be one third to one half of the implant length and the diameter of the drill should always be smaller than that of the implant (in this case, 1.1 mm). This is because the primary stability of the mini dental implants is established through bone condensation and bone compression. This self-tapping insertion technique makes immediate loading possible.

After transgingival perforation of the cortical bone and preparation of the pilot hole, the single-piece implant was removed from the sterile packaging and placed into the pilot opening with the silicone cap (Fig. 7). It was inserted until sufficient friction was felt and the silicone cap was removed. Using a finger driver, the mini implant with self-tapping design was advanced further into the bone under slight downward pressure and clockwise rotation (Fig. 8). When resistance was felt, the process was continued with a winged thumb driver that offers mechanical advantages over the finger driver, because force transmission is improved (Fig. 9). With increasing resistance, it became difficult to turn the implant with the winged thumb driver and the instrument was replaced by a torque wrench. This tool is used to insert the MDI carefully into its final position (Fig. 10). When a force of 35 to 45 Ncm is reached, the implant is stable enough to be loaded immediately. The other implants were placed in the same fashion. In this case, a parallelization aid was used for correct angulation of the implants (Fig. 11). Figure 12 shows the four mini implants in place.
When all implants were inserted, the implant positions were indexed on the denture base (Fig. 13) using a thin layer of SECURE Soft Reline Material and openings of the size needed for the metal housings drilled into it (Fig. 14). Metal housings were then placed on the O-balls, pushing the shims in contact to the gingiva (Figs. 15 and 16).

In the following step, SECURE Hard Pick-Up Material was applied into the openings of the denture base as well as onto the metal housings and the prosthesis was seated in the patient’s mouth (Fig. 17). The patient was asked to bite down and remain in occlusion under regular pressure for six to eight minutes (Fig. 18). This time is sufficient for the acrylic material to polymerize. Afterwards, the denture was removed and the fit of the metal housings checked (Fig. 19). Then, the denture was finalized, polished and tried in again.
Chewing function was immediately improved. Since the denture is now supported by the soft tissue as well as stabilized through the rubber O-rings (Fig. 20), the stability of the whole denture is ensured right from the beginning. At the same time there is no immediate contact between the metal housing and the O-ball, which prevents an overload of the implant body. The patient is still highly satisfied with the functionality of his new mandibular denture.

Figure 19: Metal housings fixed in the openings of the denture base.

Figure 20: The mechanical load is not carried by the implants alone.

Conclusion

The present case shows that MDI Mini Dental Implants present a favourable option for denture stabilization, even if financial capacity is limited. The minimally invasive protocol and reduced treatment time lead to improved patient comfort—during as well as after the surgery.

Dr. med. dent. Winfried Walzer

Dr. Walzer is a certified specialist in implant dentistry and looks back on 30 years of experience in placing implants. In 2004, he earned a degree as “Certified Implantologist” from the Deutsche Gesellschaft für Zahnärztliche Implantologie (German Society of Dental Implantology). Dr. Winfried Walzer is an internationally renowned speaker focusing on the topic of mini dental implants. In his seminars and trainings, an innovative treatment concept of denture stabilization with direct loading is presented. His private practice at the Litzensee, an exclusive location in Berlin Charlottenburg, is devoted to implant dentistry and implant-prosthetic concepts which are implemented by highly qualified dental technicians working in the practice laboratory. In his second practice in the center of Berlin (Kantstraße 15a), he is conducting seminars for colleagues as well as educational lectures for patients.

1975 State examination at the Johannes Gutenberg University Mainz
1976 Doctorate “Cryochirurgie von Leukoplakien der Mundschleimhaut” (Cryosurgery of leukoplakia in the oral mucosa)
1979-1980 Director of a dental clinic in Jamaica (development aid)
1984-1985 Sabbatical and musical studies in Boston, USA
1986-1997 Owner of a practice in Berlin (near Wittenbergplatz)
1994-1997 Lectures and seminars on the topic of implantology
1998-2001 Freelancer (consulting) for Friadent North America
Since 2001 Owner of a practice in Berlin Charlottenburg (private practice)
Since 2005 Lectures and publications focusing on mini dental implants
Since February 2009 Second practice in Charlottenburg “Praxis am Stilwerk”
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Mini implants: a useful complement to conventional implants?!

PD Dr. Friedhelm Heinemann, PD Dr. Torsten Mundt, Greifswald, Germany, and Prof. Dr. Dipl.-Phys. Christoph Bourauel, Bonn, Germany

Mini dental implants with a diameter of less than 3 mm are increasingly often used in dental implantology. Several years ago, they were typically placed in combination with conventional implants and served as provisional solutions for the stabilization of dentures during the healing phase\[5\]. Today, they are also approved for long-term use. On the one hand, mini dental implants are placed to fix complete or partial dentures and contribute to increased stability. On the other, they are used as abutments for fixed bridges in specific situations – e.g. in small gaps\[12\].

Risks of mini implants

Although the one-piece implants have been used for retention of definitive restorations for several years – the first approval was granted in 1997 by the U.S. Food and Drug Administration (FDA) for today’s 3M™ ESPE™ MDI Mini Dental Implants – there are still reservations in many practices regarding their suitability for permanent use. This is due to study results which reveal that implants with a reduced diameter might have a higher failure rate than conventional implants\[9, 13\]. In an investigation analyzing biomechanics (FEM analysis) of mini implants, it was shown that – in comparison with conventional implants – those with a small diameter cause a significantly increased stress on the bone\[7\].

Figure 1 shows the FE model of an experimental implant. In this investigation, the implants were surrounded by a thin bone segment representing bone loss in analogy with the clinical situation. The corticais was modeled with a relatively high thickness and the turn of the thread stood in contact with the corticais. The presumed load was a force transmission of 150 N with an angle of 30° to the implant axis. Under these conditions the load on the implant and the bone was the one represented in figure 1. While the strains in the implant are 600 MPa and thus below the flow limit of the material, a load on the oral corticais of up to 200 MPa was measured. This is twice the permissible limit stress for the bone (100 MPa) from which damage is to be expected. The investigation was based on the assumption that the same prosthetic concept was used as for conventional implants, i.e. causing a direct load distribution on the implant.

The observed higher load might be an explanation for the partly increased failure rates. However, a current literature survey shows that the survival rate of implants with a reduced diameter is indeed comparable to the ones obtained for conventional implants\[10, 2, 3\]. In addition, there are references pointing towards a lower stability of mini implants and those indicating the risk that these might fracture due to their reduced diameter\[6\]. However, these fractures also do not seem to be a frequent problem associated with mini implants\[4, 8\].

Alternative solution with reduced bone volume

Mini implants prove their worth in the clinical long-term use, provided that they are placed in accordance with the protocol recommended by the manufacturer and inserted by trained dentists or implantologists\[10, 2, 3\]. Under these conditions, they present a sensible supplement to implants with a conventional diameter in many cases.

For example, mini implants are indicated in cases where the horizontal bone volume is not sufficient for conventional implant placement and where bone quality is not impaired. In many cases, augmentative measures or bone splitting would be necessary in order to create sufficient space for the implant. By use of a mini dental implant, a complex augmentation procedure can be avoided and in particular cases – e.g. in medically compromised patients – implant treatment is only possible with implants with a small diameter, since the surgical risk can be reduced in this way.

In the following, two patient cases are described in which mini dental implants were used for denture stabilization in the mandible.

Patient case I

Originally, the male patient had received a partial mandibular denture which was supported by the remaining natural teeth. The remaining premolar
(Fig. 2) was not considered to be worth preserving. Since the anxious patient also asked for a treatment with a reasonable price, the placement of four one-piece Mini Dental Implants (3M ESPE MDI) with a diameter of 1.8 mm and an O-ball head was planned. Within the context of the implant procedure the premolar should be extracted. Due to the low thickness of the gingiva, it was not necessary to create a flap: the location of the bone could be identified exactly. Initially, the desired implant positions were determined. The positions should be chosen in a way that the mesial distance from the mental foramen and the neurovascular bundle is at least 7 mm. In addition, a gap of minimally 5 mm between the implants is required. In this way it is ensured that sufficient space is left between the metal housings which are placed on the implants later on and are used for fixation of the denture base.

In the first step, two implants were inserted in the anterior region following the protocol which is recommended by the manufacturer (Fig. 3). For the preparation of the pilot hole, a drill with a diameter that is smaller than that of the selected implant was used. Moreover, the drilling depth should be one half to one third of the implant length in order to cause bone compression and condensation during implant insertion. This contributes to an increased primary stability of the implants and is possible due to the self-tapping design of MDI. For turning of the implant, a silicone cap, a finger driver, a winged thumb driver and a torque wrench were used one after the other. All instruments — with the exception of the torque wrench — were used until clear resistance was felt. The insertion of the distal implants followed in the same manner after extraction of the premolar (Figs. 4 to 6). With the aid of the torque wrench an insertion torque of 35 Ncm was obtained in order to ensure sufficient stability of the implant (Fig. 7). Figure 8 shows the final situation. On the control radiograph it became clear that the implants were placed in the desired positions (Fig. 9).

**Patient case II**

In this case, the female patient, approximately 65 years old, was not happy with the stability of her denture. Moreover, she reported that she fre-
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Frequently had sore spots which could be explained by a very narrow and pointed alveolar ridge after the initial clinical examination. The patient obtained detailed information about the situation and the available treatment options and finally settled for three-dimensional radiographic diagnosis in order to lay the foundation for a simplified decision making regarding different prosthetic concepts.

The radiograph (Fig. 10) confirmed a high and entirely small alveolar bone. Without complex augmentative measures, implant placement was not possible. Moreover, it was revealed that, in accordance with the small ridge, the bone was dense and thus ideally suited for the use of mini dental implants – judged by the results of the FEM analysis. Since the patient did not desire complex augmentation procedures, she opted for fixation of a complete denture with MDI Mini Dental Implants.

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Four mini implants with a diameter of 2.1 mm and a length of 13 mm were inserted in the mandible following the procedure described above. Their position was checked on the OPG (Fig. 11). Afterwards, SECURE Soft Reline Material (3M ESPE) was applied into the denture base, which was cautiously placed into the mouth of the patient. In this way, the implant positions were marked in the material (Fig. 12). Subsequently, the metal housings were embedded in the denture base using SECURE Hard Pick-Up Material (3M ESPE). The housings are pressed into the denture intraorally during occlusion. When the cold cure resin was polymerized, the denture was removed from the mouth and finished (Fig. 13). Since the metal housings enable highly elastic anchorage via rubber O-rings, the denture is still supported by the soft tissue and the load on the implants is reduced. Thus, immediate loading is possible if the required primary stability is obtained, as is usually the case in the mandible. The resilient connection concept without contact of metal to metal (soft loading) should also reduce the risk of overload of the implant or the surrounding bone bed as observed in the FEM analysis described above. However, a scientific verification of the interface remains to be done.

Conclusion

As shown by both patient cases, mini dental implants are a useful alternative or complement to implants with a conventional diameter. The patient is often spared complex augmentative measures which are time-consuming and invasive. In addition, new treatment options are created for medically compromised as well as anxious patients.

After a thorough evaluation of the risks and benefits of a treatment involving mini implants and provided that they are placed by an implantologically experienced dentist who follows the insertion protocol, excellent clinical results can be obtained.

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Fig. 10: CBCT scan for analysis of the anatomical situation.
Fig. 11: Checking of the implant positions on the OPG.
Fig. 12: Marking of the implant positions on the denture base.
Fig. 13: Basal view of the denture after embedding of the metal housings.
Fig. 14: Clinical situation in the mandible after placement of four mini implants.
Dr. med. dent. Friedhelm Heinemann
Since 1990 dentist in Morsbach, Germany | Certified Specialist in Oral Implantology of BDIZ | Active Member and Specialist in Oral Implantology | Certified lecturer of the Consensus Conference Implantology | Consultant for Implantology of the Consensus Conference Implantology | 2004 to 2010 President of the DGZI | External employee and lecturer at the Department of Prosthodontics, Gerodontology and Dental Materials, Center of Oral Health, University of Greifswald, Germany (Director: Prof. Dr. Reiner Biffar) | Lecturer, course instructor and publications in the fields of implantology, augmentative surgery and implant prosthetics.

PD Dr. med. dent. Torsten Mundt
1984-89 Studies of dentistry in Greifswald | 1989-94 Assistant at the Center for Dental and Oral Medicine Greifswald at the Department of Periodontics and the Department of Prosthodontics | 1994 Conferral of a doctorate and appointment as senior physician at the Department of Prosthodontics, Gerodontology and Dental Materials (Director: Prof. Dr. R. Biffar) | 2007 Appointment as a Specialist in Prosthodontics DGPPro | 2011 Habilitation | Working areas: Implant-based restorations, function-oriented prosthetic diagnostics, planning and therapy, build-up of endodontically treated teeth, telescopic crowns, community dentistry.

Univ.-Prof. Dr. rer. nat. Dipl.-Phys. Christoph Bourauel
1987 Studies of physics and receiving a diploma in Bonn, Germany | since September 1987 employed as a scientist at the Dental Clinic of the University of Bonn | 1992 Doctorate and title Dr. rer. nat. with an interdisciplinary dissertation about nickel-titanium alloys in orthodontics | 1998 Habilitation and venia legenda in experimental dentistry / biomechanics | 2005 Appointment as Adjunct Professor | 2006 Head, Endowed Chair of Oral Technology, University of Bonn | Research fields: Dental biomechanics in orthodontics, implantology and prosthetics, finite element methods, experimental biomechanics | President-designate of the German Society of Biomechanics | Reviewer of diverse scientific journals | Lecturer, course instructor and publications in the fields of biomechanics, orthodontics, implantology and materials science.

Literature
In the edentulous mandible with limited anatomical conditions, i.e. severe vertical or horizontal atrophy, implant therapy is usually contraindicated or would involve extensive augmentation procedures. However, in these patients, complete dentures often cause problems as well, since sufficient retention is missing and poor stability of the solution is obtained. This may lead to discomfort e.g. during talking and chewing. At the Department of Prosthodontics of the University of Bern in Switzerland, we became aware of an alternative treatment option in 2009: the placement of mini dental implants with a diameter of 1.8 to 2.4 mm for denture stabilization.

The clinical procedure of implant planning, placement and fixation of the prosthesis is explained using the following patient case.

Case report

An 82-year-old non-smoking female patient with good general health complained about frequent sore spots and insufficient stability of her lower denture during mastication. Two attempts to place standard diameter implants had led to implant failure. Therefore, it was decided to place four 3M™ ESPE™ MDI Mini Dental Implants. At first, a radiograph was taken to analyze the spatial conditions. On the basis of this data, single-piece implants with 1.8 mm diameter and 15 mm length – equipped with an o-ball head for anchorage of the denture – were chosen.

Subsequently, pilot holes were drilled with 1.1 mm surgical drills. This size is sufficient because the implants have a self-tapping design. The bone condensation and compression during insertion is important for the primary stability of the implants. With the burs, the parallel position of the holes was checked.

Then, the mini implants were inserted and an impression was taken with the existing denture to mark the implant positions.

Afterwards, radiographs were taken to check the implant positions and metal housings were integrated in the denture base.

The mini implants were immediately loaded, which was possible due to sufficient primary stability and the fact that the denture is also supported by the soft tissue.

In regular recalls, the clinical situation was checked and the healthy soft tissue conditions were observed. The radiograph after twelve months showed no signs of periimplant bone resorption.

Parallel position of the drilling holes.

Impression showing the position of the implants.
Due to the positive results of the treatments with mini dental implants at the university, a study was planned and initiated in early 2011. Its aim was to find out how the mini dental implants prove itself in the clinical environment and to study the tribological behaviour of the o-balls and metal housings. In addition, the investigation should include data on peri-implant bone resorption and the level of patient satisfaction.

80 implants were placed in the lower jaws of 20 patients participating in this prospective controlled clinical trial for stabilization of complete mandibular dentures with four MDI from 3M ESPE. Contrary to the first impression that the tiny implant bodies might break after loading, the preliminary results are highly convincing: there was no incident of implant failure over the past year. The study will be completed in mid 2013, so that definitive conclusions cannot be drawn to date. However, the use of mini dental implants seems to be especially suitable for patients with compromised anatomical and medical conditions. The patients are very satisfied with the treatment as well as the result, since an improvement of the denture stability led to optimized chewing ability. Due to the minimally invasive procedure, only minor postoperative discomfort was reported.

**Future research**

In order to gain additional knowledge about the clinical use of mini dental implants, it would be interesting to investigate the required insertion torque and its impact on immediate loading. By now, 3M ESPE recommends immediate loading only when a torque of 35 Ncm is obtained. A research question would be if a lower torque – e.g. 25 Ncm – would also lead to sufficient primary stability to allow for successful loading directly after implant placement. The benefits of a lower torque: The surgical procedure is simplified since fewer instruments are required.

**Conclusion**

Mini dental implants are a relatively new treatment option for edentulous patients. Although there are only few long-term clinical study results available, first experience shows that the implants with minimal diameter are a suitable solution in several cases. Medically compromised patients and those with unfavourable anatomical conditions who are not willing or unable to face complex bone grafting procedures are offered an alternative to interforaminal standard diameter implants.

The only incident that occurred during the trial – fracture of a denture – can be prevented by addition and polymerization of a metal band into the denture base.
Denture stabilization and its effect on patient satisfaction

Expert discussion with Dr. Miodrag Scepanovic, Belgrade, Serbia

Lack of stability is a well-known drawback of complete lower dentures. Their movement limits the patient’s ability to chew and speak properly and thus leads to discomfort in various situations. In order to find more functional solutions he may offer to his edentulous patients, Dr. Miodrag Scepanovic from the University of Belgrade, School of Dentistry, decided to conduct a study on mini dental implants in 2008. In an interview, he provides insights into the design and outcomes of his investigations.

Dr. Scepanovic, why did you decide to conduct research with 3M™ ESPE™ MDI Mini Dental Implants in 2008?

At that time, I had many patients who were not satisfied with the stability of their mandibular dentures. In the literature, evidence was found that mini dental implants might offer some help in improving the retention and stability of complete dentures. Moreover, a flapless procedure and immediate loading is possible in many cases in the mandibular jaw. However, there were different views in the literature regarding secondary stability and the ability of mini implants to osseointegrate with the bone.

Together with my mentors Prof. Dr. Aleksandar Todorovic and Prof. Dr. Aleka Markovic, I decided to conduct a study to find out if mini dental implants are indeed a suitable solution to improve denture stabilization. We aimed at evaluating the changes in the quality of life, chewing efficiency and patient satisfaction and analysed the success of implant therapy.

Please describe the design of the study.

We had a total of 30 patients participating in the study, all of whom had an edentulous mandible. First, a new complete denture was fabricated by a single dental technician. After several weeks, four 3M™ ESPE™ MDI Mini Dental Implants with 13 mm length and 1.8 mm diameter were placed in the lower jaw of all patients. In most cases, a flapless surgical procedure followed by immediate loading was performed. After the surgery, the existing denture was modified to fit over the implants. Objective and subjective criteria were used for evaluation. The subjective assessment focused on quality of life, chewing efficiency and patient satisfaction. For the objective analysis, measurements of peri-implant bone resorption and primary and secondary stability, data about soft tissue healing and the overall success of implant therapy were taken into account.

Could you please summarize the results of the subjective patient assessment?

The findings of this part of the study show that patient satisfaction is indeed increased by the use of mini implants.
of mini dental implants for denture stabilization. Since chewing efficiency and patient satisfaction were evaluated twice during the study – once while the patients were wearing traditional complete dentures and once 15 weeks after implant placement with implant-retained dentures – a comparison was possible. All patients had the same denture prior to and after implant placement, so that the difference they felt was definitely due to the stabilization of their denture, and not its design. The answers of the 30 participants revealed a significant improvement in the quality of life after implant placement.

What are the results of the objective measurements of implant stability and bone resorption?

The primary stability, which is important for immediate loading, turned out to be very good. The secondary stability decreased in the period of six weeks to four months after implant placement, a phenomenon that is found in standard diameter implants as well and is a sign of bone remodelling around the implant. After six months, the stability increased again. This is also similar to standard diameter implants and might be associated with osseointegration. To prove this, however, a histological analysis would be necessary. Bone resorption was measured using radiographs with a uniform geometry. The highest registered level of peri-implant bone resorption was 0.64 mm after one year. According to scientific data, values under 2 mm are clinically acceptable. Soft tissue healing was found to be good and completely correlates to the results obtained for standard diameter implants. The success of implant therapy was 98.3%.

What conclusion may be drawn from your study?

Our study shows that denture stabilization with mini dental implants in the mandible may be a suitable treatment option for edentulous patients. Especially for medically or anatomically compromised patients, the simple surgical procedure and the chance of avoiding augmentation are arguments in favour of this therapy. The feedback I received from my patients was very positive, they are happy because the treatment changed their lives. In everyday clinical practice, MDI Mini Dental Implants have become one of the treatment options I regularly offer my edentulous patients. And for many of them, it turns out to be the best solution.

Are you planning to conduct further research in this field?

Yes, under the direction of Prof. Dr. Aleksa Markovic, a second study was started a month ago at the University of Belgrade to evaluate the rise of bone temperature during implant placement. The working hypothesis is that the surgical technique and insertion torque may have an impact on heat generation in the bone surrounding the implant. Moreover, the second year investigation of the 30 patients participating in the first study will be finished soon. I really look forward to receiving information about the stability of the mini implants two years after their placement.

Dr. Scepanovic, thank you for providing such valuable information to us.
A perfect alternative to treat edentulous patients?

Expert discussion with Prof. Dr. Shahrokh Esfandiari, Montreal, Canada

The increasing popularity of mini dental implants (implants with a reduced diameter of less than 3 mm) has led to a growing number of research projects and studies being conducted by universities. One such example is McGill University in Montreal, Canada, which is currently carrying out a study on 3M™ ESPE™ MDI Mini Dental Implants. During the ICOI (International Congress of Oral Implantologists) in Florida in October 2012, results of a pilot study were shown in a poster presentation by Prof. Dr. Shahrokh Esfandiari, Patricia Oliveira and Prof. Jocelyne Feine. Insights into current and future projects at the University, and the potential of mini implants, are given by Prof. Dr. Shahrokh Esfandiari, Associate Professor at the Faculty of Dentistry of McGill University in the following interview.

Prof. Dr. Esfandiari, why did your team decide to initiate a study with 3M ESPE MDI Mini Dental Implants?

At the Oral Health and Society Research Division of McGill University, we have been focusing on various topics including conventional implant-retained overdentures that involve two standard sized implants in the mandible placed for purposes of denture stabilization. We have been able to show in studies that this solution enhances the patient’s quality of life tremendously, however, the costs for this kind of treatment are relatively high. Therefore, we started looking for a more cost effective solution and finally were confronted with mini dental implants. These one-piece implants with a self-tapping screw design are usually inserted with a minimally invasive procedure. For stabilization of complete dentures, the manufacturer 3M ESPE currently recommends placement of at least four MDI’s in the edentulous mandible and six in the maxilla. The implants are available with diameters of 1.8 mm, 2.1 mm and 2.4 mm, the latter being recommended for use in the maxilla.

Please describe the aim of your pilot study and its design.

There is already data available on the survival rate of mini dental implants placed in the edentulous mandible. According to various studies, the results are similar to those obtained with conventional implants. In order to assess if mini implants are indeed a suitable alternative to conventional implants for this specific indication, however, it is important to know the patients’ preferences. Today, patients get information at their fingertips and are well-informed. They want and should contribute to decision making about the treatments they would receive, so that a dentist has to know what they want.

Therefore, we decided to set up a study that investigated enhancements in oral health related quality of life of edentulous patients who received mandibular overdentures that were retained by four mini implants. An OHIP-20E questionnaire which is a validated known instrument for these kinds of assessments was used for this purpose. In our pilot study, 40 implants were inserted in a flapless procedure, the dentures were relined chairside and the implants loaded immediately. The questionnaire was completed by each patient prior to and six months after the implant placement.

The quality of life of the patients participating in this study was tremendously improved. Due to the minimally invasive insertion technique, the patients were not only comfortable with the treatment result, but with the whole procedure. The success rate in our study was within the usual range (92.5%), but we can learn something from the failures as well: firstly, there seems to be a
typical learning curve as it was noticed always one of the operator’s first cases where implant loss had occurred. Secondly, a flapless insertion technique was used in all cases and there may be some situations in which a small flap would be advantageous for proper positioning of the implants. When one of the four mini implants was lost, this did not have a negative effect on patients’ comfort, and we even found that three implants might be sufficient for denture stabilization in the mandible. This would be an interesting topic to investigate in further studies.

What are your personal conclusions?

The presented pilot study involved only a small number of patients and further research in this field will be required to provide sufficient evidence for our findings. Therefore, a larger group of patients will be investigated in the same manner very soon. Research focusing on other aspects such as a reduced number of implants or additional patient groups would be interesting as well.

Nevertheless, from the results of the pilot study and my own experience in placing 3M ESPE MDI Mini Dental Implants, I can conclude that use of these implants is efficacious and cost-effective. Although the predominantly flapless insertion technique is apparently easier to adopt than other placement methods, experience with implants and specific further training are absolutely necessary in order to ensure a proper and secure use of MDI. Overall, I personally feel very confident that the presented approach is a perfect alternative to treat edentulous patients, since their level of satisfaction is very high. And I do care about patients’ preference very much …

Prof. Dr. Esfandiari, thank you very much for the insightful conversation.

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Mini implants with a reduced diameter (of less than 3 mm), smaller than that of conventional implants, are increasingly arousing the interest of implantologists and researchers, since they have meanwhile proven their worth, especially when used for denture stabilization in edentulous patients. Studies show that in this indication, the success rates obtained with mini dental implants are similar to those achieved with conventional implants. Other factors that have an impact on their success are currently being investigated at different universities. Among those is the University of Greifswald Medical School in Germany, where a study was initiated in order to learn more about the impact of mini dental implants on the patients’ quality of life and the maintenance of the dentures.

In an interview, PD Dr. Torsten Mundt, Senior Physician at the University of Greifswald Medical School, provides information about this study and possible further investigations. In addition, he assesses the suitability of implant systems with a reduced diameter for clinical use.

**Dr. Mundt, why did you decide to initiate a study focusing on mini dental implants?**

In 2009, an article authored by me with the title "Implantatprothetische Behandlungen bei Senioren – Eine versorgungsepidemiologische Betrachtung" ("Implant-prosthetic treatment of senior citizens – a view from health care epidemiology") was published. It contained an estimation that the number of edentulous patients is not likely to decrease due to demographic change, and that many senior patients may decide against implants due to financial reasons and fear of the intervention. Consequently, the article demanded more cost-efficient and less invasive forms of care with a clear benefit for the patient and the chance of improving the quality of life.

As a result, we were contacted by an implantologist who had been using 3M™ ESPE™ MDI Mini Dental Implants successfully for denture stabilization in the maxilla and mandible. He called attention to the fact that this system of mini implants offers what we requested in this article. Thus, I started to acquaint myself with the system that is composed of one-piece implants with diameters of 1.8 mm and 2.1 mm (for the mandible) as well as 2.4 mm (for the maxilla). I also concentrated on available studies on this topic. Finally, I decided to investigate the suitability of the system for practical use within the framework of a retrospective study in nine dental practices. The focus should be on the acquisition of data about improvements in the oral-health related quality of life after insertion of at least four mini implants in the mandible and six MDIs in the maxilla. Survival rates and information about the prosthetic maintenance were gathered as well.

**Would you please summarize the results of the study?**

Against the background that the mini implants were inserted in different dental practices by different dentists and there were no exclusions of patients due to previously determined criteria, the results reflect what may be expected for a typical dental practice. Moreover, every one of the more than 130 patients was investigated by an independent, experienced dentist after the MDIs had been in place for up to five years. When questioning the patients, it became clear that their perceived quality of life had been improved due to stabilization of their complete dentures with mini implants. The survival rates were similar to those obtained with conventional implants, even though the mini implants were directly integrated into the existing denture – either by using soft reliner (usually in the maxilla) or opting for direct loading via the metal housings (often in the mandible). This is possible due to the so-called soft-loading concept: the dentures are mainly tissue-based and implant-retained via an O-ring in the matrix. Chewing forces in vertical direction cannot completely affect the implant, since they are absorbed in part by the O-ring.

**What is your conclusion from these results?**

Due to the results of the study, the team of the University of Greifswald Medical School and the
independent investigator feel confident that the MDI system is suitable for clinical use. Therefore, the mini implants are now being used for several indications in the dental practice of the investigator and at the university. What should be respected is that experience with implants and specific further training are necessary in order to ensure a secure use of the implant system. In the seminars, the participants learn which anatomical requirements have to be fulfilled by a patient to qualify for the insertion of mini implants. In general, MDIs present a useful complementation of the conventional implant portfolio – the solutions with a reduced diameter are primarily suited for senior patients and patients with general diseases. In these cases, the risk of the intervention can be reduced thanks to the less invasive procedure. Together with the possibility of immediate restoration, this also leads to shortened treatment times.

Are you planning to conduct further studies with mini implants?

At the moment, we are planning to initiate two investigations – a retrospective one and a prospective multi-center study – at the University of Greifswald to learn more about the suitability of mini implants as additional abutments in partial dentures (Figs. 1 to 3). Until now, scientific data on this concept is barely available: MDI are inserted in positions where they contribute to a relief of the strain on natural abutments and to a uniform distribution of forces that affect the partial denture.

Dr. Mundt, thank you very much for the conversation.

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For further study results, please see the MDI Technical Product Profile or check latest news on the local 3M ESPE website.