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Possibilities of Dental Implants Installation "Bypassing" Inferior Alveolar Nerve: Results of CBCT Analysis and own Experience

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The "Experience Factor" – an Alternative to "Peer Reviews" and "Impact Factors" in Oral Implantology and a Method to Assess the Experience of Court Experts and Authors in the Medical Field

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The Foundation of Knowledge

Possibilities of Dental Implants Installation “bypassing” Inferior Alveolar Nerve: Results of CBCT analysis and own experience

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Key Words

cone-beam computed tomography; distal mandibular aspects; implantation; inferior alveolar nerve.

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Abstract

The problem of installation of dental implants in atrophied distal mandibular aspects is extremely relevant. From the point of view of classical two-stage implantation, the height deficiency of the alveolar process, due to the topographic proximity of the inferior alveolar nerve, requires the use of so called short or ultra-short implants or vertical augmentation of bone tissue using autologous, allogeneic, xenogeneic materials. Moreover, the installation of classical cylindrical or bullet-shaped implants is possible only in the presence of sufficient width of the alveolar process laterally or medially to the mandibular canal. The invention of single-piece cone-shaped implants of different lengths and diameters has allowed to realize the idea of their installation "bypassing" the inferior alveolar nerve, minimizing or avoiding the need for additional surgery to increase bone volume. This work demonstrates our own approach to the rehabilitation of patients with dentition defects in the distal mandible by precise analysis of computed tomography scans of patients and the installation of implants "bypassing" the inferior alveolar nerve.

Introduction

It is known that in cases of atrophy of the distal mandibular aspects, the possibility of dental implantation is often limited by the lack of required height of the alveolar ridge due to the proximity of the mandibular canal, which requires short or ultra-short implants or vertical augmentation [12]. In the first case, the question of the unfavorable relation between the height of the implant and the prosthetic structure, as well as the proximity of the latter to the mobile vestibular mucosa remains debatable, which complicates, in particular, the necessary hygienic measures in peri-implant areas. In the second case, despite the presence of well-documented results of various vertical augmentation techniques using autologous, allogeneic, xenogeneic materials, etc., their disadvantage will always be an increase in the number of surgeries with additional trauma and higher risk of surgical complications, as well as increasing the overall rehabilitation time. [8].

The invention of single-piece cone-shaped implants of different lengths and diameters has allowed to realize the idea of their installation "bypassing" the inferior alveolar nerve, minimizing or avoiding the need for additional surgery to increase bone volume.

The aim of the study is to find out the features of the morphology of the edentulous distal parts of the mandible on the basis of analysis of computed tomography of patients, to propose a technique for dental implants installation "bypassing" the inferior alveolar nerve.

Materials and methods

In accordance with the Agreement on Scientific Cooperation between the Department of Surgical Dentistry of Danylo Halytsky National Medical University (LNMU) and the Center for Medi-

cal 3D Diagnostics and after approval of the research protocol by the Comission of Bioethics of LNMU, 30 computed tomography scans of the mandible of patients (12 women, 18 men aged 36–68 years) who applied for the study during 2018–2020 were selected. Criteria for inclusion in the study were free-end defects of the mandible (at least - the absence of three lower molars) with varying degrees of atrophy of the alveolar process in this area. Exclusion criteria were the presence of mandibular molars, acquired defects of the alveolar process due to previous surgery (removal of jaw cysts, tumors, etc.), which could distort the clarity of visualization of certain anatomical structures and the necessary measurements. If the patient has bilateral free-end defects, measurements were performed on only one of them, which was selected by randomization. Criteria such as the distance from the apex of the alveolar ridge to the upper edge of the mandibular canal (A) and the distance from the lateral walls of the mandibular canal to the vestibular (B) and lingual (C) cortical plates of the mandible were taken into account (Fig. 1).

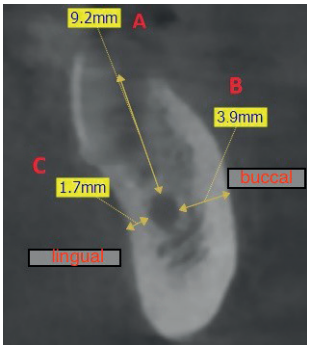

Fig. 1. *Schematic representation of the method of measuring the distance from the mandibular canal to the lingual (C), vestibular (B) cortical plates and the top of the alveolar ridge (A).*

Patients were examined on a Vatech Pax-i3D Green cone-beam computed tomography scanner (South Korea). The scan was performed in 9x12 cm mode, with a voxel size of 0.2 mm, which allowed to obtain maximum visualization of small anatomical elements of the jaws. Computed tomography results were processed using the Ez3D2009 and Xelis Dental (South Korea) imaging software.

In the clinic of the Department of Surgical Dentistry and Maxillofacial Surgery of LNMU 16 patients (men - 7, women - 9) aged 45-66 years with uni-, bilateral free-end defects or complete absence of mandibular teeth were examined and treated. All patients gave written consent to participate in the study. After finding out the location of the mandibular canal based on the analysis of CBCTs in coronal projection, single-piece dental implants (Ihde Dental AG, Switzerland) were installed in the distal parts of the mandible, "bypassing" the inferior alveolar nerve with immediate loading of the prosthetic structure within 3-4 days after implantation. Follow-up CT scans were performed 1-4 days after implantation. The effects of hypoesthesia or anesthesia in the area of distribution of the alveolar inferior or mental nerves, which could indicate their mechanical damage or compression, were also taken into account.

Statistical evaluation of the obtained results was performed using the IBM SPSS v.25.0 statistics software (IBM Corp., Armonk, NY, USA).

Research results

Based on the study of 30 computed tomography scans of the mandible of patients with unilateral and bilateral free-end defects of the mandible (women - 12, men – 18, aged 36-68 years), who applied for research during 2018-2020 to the Center for Medical 3D diagnostics (Lviv) we found that the average distance from the mandibular canal to the vestibular cortical plate is 5.12 ± 1.04 mm, to the lingual cortical plate - 2.95 ± 0.89 mm, to the top of the alveolar process - 6, 18 ± 1.9 mm ($p<0.001$).

Our results, as well as information from similar studies conducted earlier by other specialists [1,6,9,13], allowed us to implement the idea of installation of single-piece cone-shaped implants "bypassing" the inferior alveolar nerve.

In the clinic of the Department of Surgical Dentistry and Maxillofacial Surgery of LNMU, 16 patients (men - 7, women - 9) aged 45-66 years with uni-, bilateral free-end defects or complete absence of mandibular teeth were treated using 42 single-stage cone-shaped dental implants (KOS®, KOS® X, KOS® Micro, Ihde Dental AG, Switzerland) "bypassing" the inferior alveolar nerve on the lingual side. It is important that in some cases, depending on the clinical and radiological situation, single-stage implants with a bendable neck were used, which allowed to place the abutment head in the most correct prosthetic position by manual bending of the implant neck even under conditions of angular insertion of the implant body into the bone tissue. For 4-5 days, all implants were loaded with a temporary metal-acrylic prosthetic structure. In a follow-up CT scan, the position of the implants in relation to the location of the mandibular canal, lingual, or vestibular cortical plates was assessed. In cases of patients complaining about postoperative hypoesthesia or anesthesia in the area of distribution of the inferior alveolar or mental nerves, which could indicate their mechanical damage or compression, glucocorticoids (Dexamethasone - 8-12 mg / d.) and vitamins (Neurorubine-Forte Lactab - 1 t. / 2t a day) were administered.

According to the results of follow-up computed tomography scans of patients performed 1-4 days after implantation, no complications in the form of direct mechanical damage to the walls of the mandibular canal or cortical plates with surgical tools (drills) or directly by the implant body were found. In some cases, CBCT scans showed contact of the lateral surface of the implant body to the mandibular canal wall, which caused compression of the inferior alveolar nerve and was clinically manifested by temporary hypoesthesia or anesthesia in the innervation zone of the respective nerves and required the use of aforementioned medication. These complaints disappeared within a month after implantation. None of the patients complained of decreased or lost sensitivity in the alveolar process and soft tissues of the mandible.

As an example, we introduce the following clinical case.

Patient S., born in 1972, came to the clinic of the Department of Surgical Dentistry of LNMU with complaints of tooth pain located in the lower jaw on the left, mobility of the bridgework in the area of teeth 44-47. During the radiological examination, the presence of periapical inflammation in the area of the root apex of 44, 47, 48 teeth was revealed (Fig. 2). After a thorough analysis of CBCT scans with schematic visualization of anatomical formations of the distal lower jaw on the left, the conduction of necessary measurements and explanation of alternative therapeutic options, the patient was offered a treatment plan that included removal of teeth 44, 47, 48, bone curettage and installation of 3 single-piece implants in the area of teeth 44, 45, 46 "bypassing" the inferior alveolar nerve. After obtaining written consent for treatment under local anesthesia with premedication, teeth 44, 47, 48 were removed, thorough mechanical and medical curettage of the inflammation area was performed, and 3 single-piece cone-shaped implants KOS®, KOS® Micro (Ihde Dental AG, Switzerland) were installed in the area of teeth 44, 45, 46 (size 3.7/12 mm; 4.1/8 mm; 4.1/8 mm, respectively) "bypassing" the inferior alveolar nerve on the lingual side. At the follow-up CBCT 2 days after implantation, the presence of all 3 implants from the lingual side of the mandible without involvement or damage to the walls of the mandibular canal or lingual cortical plate (Fig. 3) was ascertained. Moreover, the implant in the area of tooth 44 was inserted with mesial angulation considering the location of the loop of the mental nerve, and the head of the abutment was subsequently paralleled to the others by manual bending of the flexible neck of the implant. 3 days after the operation, the temporary metal-acrylic bridge structure was fixed on the implants under full occlusal loading.

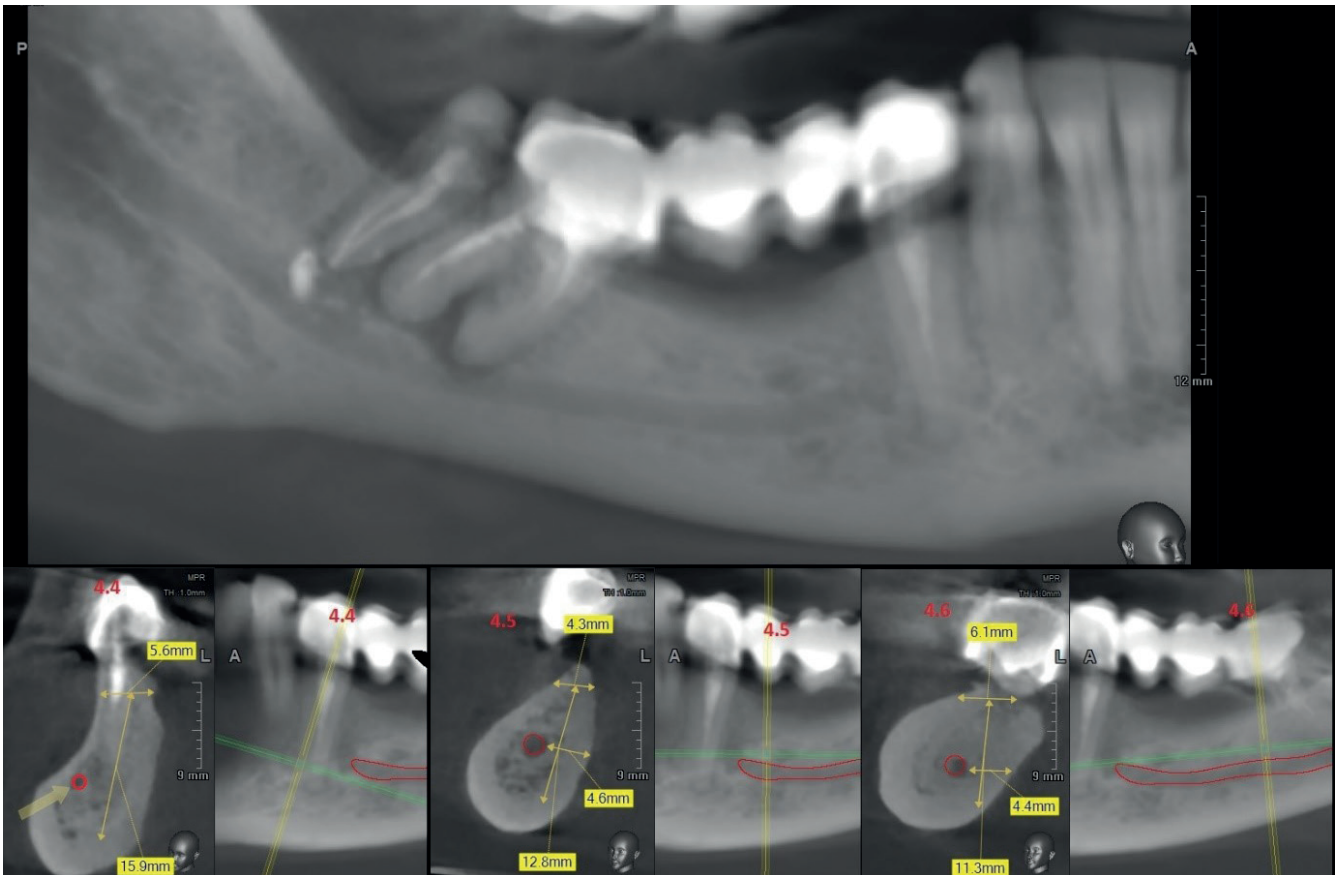

Fig. 2. *Reformatted CBCT scan, panoramic view. Patient S., born in 1972, before implantation. Chronical periodontitis of teeth 44, 47, 48. Graphic visualization of the mandibular canal with measurements of the height of the mandible and the distance from the mandibular canal to the lingual cortical plate.*

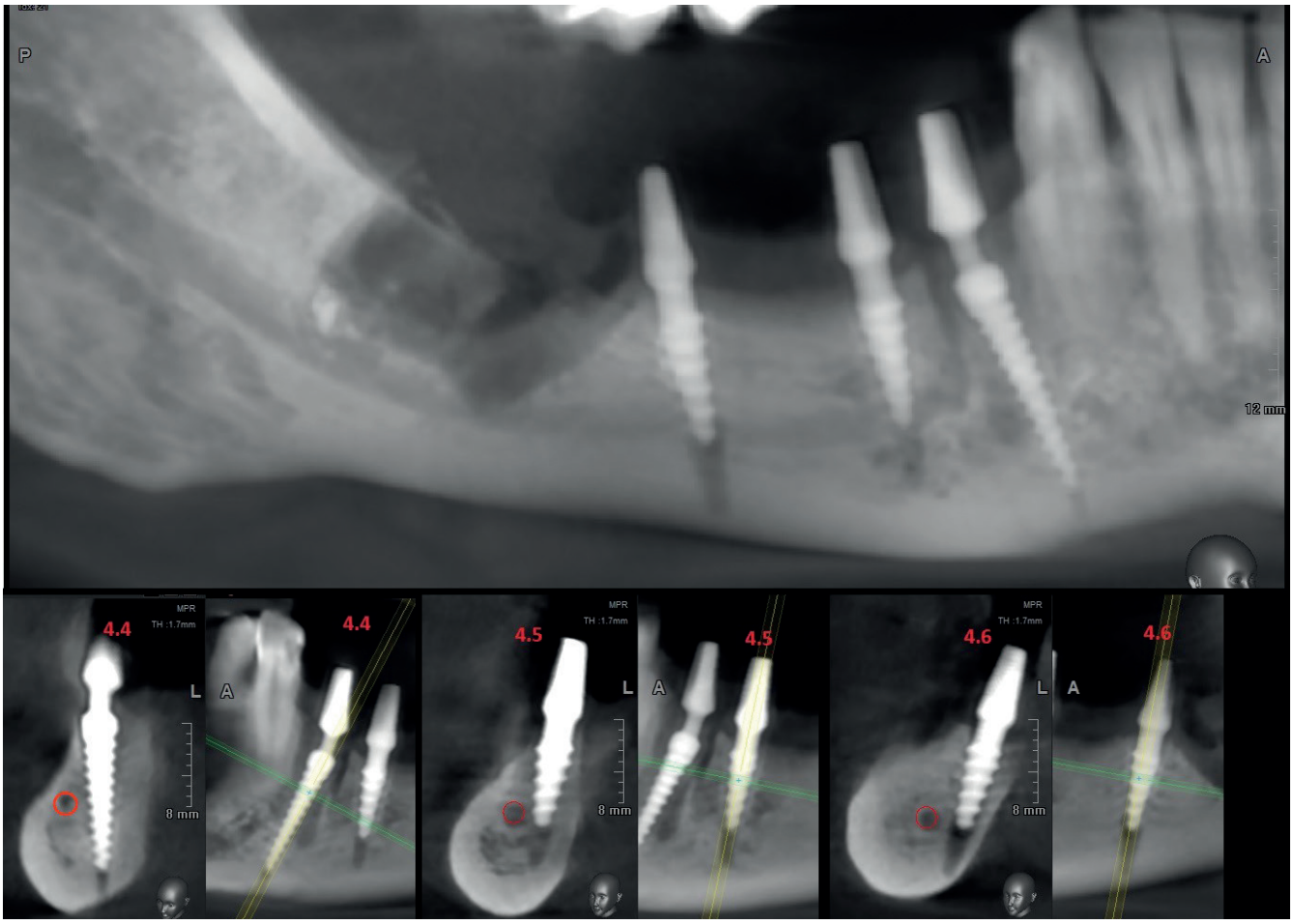

Fig. 3. *Reformatted CBCT scan, panoramic view. Patient S., born in 1972, 2 days after implantation. Teeth 44, 47, 48 extracted. Graphic visualization of the mandibular canal. Installation of 3 single-piece implants on the lingual side of the mandible "by-passing" the inferior alveolar nerve.*

Discussion

Many publications have been devoted to determining the size and morphology of the distal mandible as a necessary diagnostic measure at the stage of dental implant planning, which indicates the urgency of the problem of potential damage to the inferior alveolar nerve during implant placement [3,10].

In the work of Japanese scientists [13], which included the study of 79 computed tomograms of patients of different sexes, it was noted that the distance from the mandibular canal to the top of the alveolar ridge was 15.3–17.4 mm, but the authors did not provide information about the patient age and their dental status, which would allow to speak about certain atrophic changes of the distal parts of the mandible. A similar study, performed by L.A. de Souza et al. [11] indicates that only in 18.3% of the 100 patients examined, the height of the alveolar process (to the mandibular canal) allows the installation of standard (≈ 10 mm) implants, while the remaining cases require the use of short implants or bone augmentation. A more precise study of the morphology of the mandible in its distal aspects was conducted by S. Bayrak et al. [1] based on the analysis of 500 computed tomograph scans (1000 halves of the mandible) of patients aged 10–87 years. The authors found that the average distance from the mandibular canal to the vestibular cortical plate is 5.02 ± 1.32 mm, and to the lingual cortical plate - 1.4 ± 0.85 mm, and there are significant differences depending on gender and sides of the study (right or left). According to Brazilian scientists [6], who studied the topography of the mandibular canal in 50 people aged 25-75 years of different sexes, the average distance from the canal to the vestibular cortical plate is 6.1 ± 1.5 mm, to the lingual cortical plate - 3.9 ± 1.1 mm, to the top of the alveolar process - 16.9 ± 2.8 mm. Instead, in a study by M.G. Sghaireen et al. [9] indicates that the distance from the mandibular canal to the lingual cortical plate in edentulous patients is more than 6 mm regardless of age, sex or side of the jaw, which indicates the possibility of implants "bypassing" the mandibular canal on the lingual side.

According to C. de Oliveira-Santos et al. [8] an important factor that directly affects the distance from the canal to the lingual and vestibular cortical plates is the diameter of the canal itself, which can range from 2.1 to 4.0 mm.

Based on the study of CBCT 30 dried jaw models with complete or partial absence of teeth S.R. Daroz et al. [2] concluded that in 28.3% of cases it is possible to install standard implants with a diameter of 3.75 mm by lateral bypass of the mandibular canal, which makes this technique an alternative to more complex techniques, such as vertical augmentation.

Instead, according to other researchers, the procedure of implant placement bypassing the inferior alveolar nerve on the lingual side may be accompanied by perforation of the lingual cortical plate during dissection of the implant bed

and lead to serious complications in the form of massive bleeding followed by airway obstruction [4,5], which once again indicates the feasibility of careful planning of the procedure of implant placement in the atrophied distal parts of the mandible.

Conclusions

Undoubtedly, this study is preliminary and requires the processing of much more clinical material and analysis of long-term (up to 5-10 years) observations. However, the results of our own experience, which are fully consistent with the reports of other researchers, suggest that the installation of dental implants in the distal mandible "bypassing" the inferior alveolar nerve creates a serious alternative to traditional methods of vertical augmentation, allows the fast rehabilitation of the dental-maxillary system due to the implementation of the protocol of immediate loading of implants. At the same time, the procedure of implant placement "bypassing" the inferior alveolar nerve on the lingual side requires in-depth knowledge of the anatomy of the maxillofacial area and careful planning with use of CBCT.

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The Foundation of Knowledge

The "Experience Factor" – an alternative to "Peer Reviews" and "Impact Factors" in oral implantology and a method to assess the experience of court experts and authors in the medical field

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Key Words

Experience Factor; Impact Factor, Knowledge vs. experience

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EF: At the end of the year 2020 the cumulative **Experience Factor** of all authors compiles to more than 410.000 implant-observation-years with basal and Corticobasal® implants.

Abstract

The quality of a scientific publication is presently still evaluated by looking at impact factors or listings of the journal in databases. This process contains a number of flaws and allows massive third-party influences.

The authors propose a simple way of experience-rating for the authors of a publication, which is applicable in oral implantology. The pros and cons of this simple system are discussed. One of the main advantages of the process is that "Universities" can be excluded from the process of evaluation in the future.

The article also explains in detail how theoretical training leads to knowledge, and how practical work leads to experience, and what is the significance of re-training and that even treatment providers with a lot of experience have to update their knowledge to fight the inevitable process of forgetting.

Introduction

The literature in the field of oral implantology is published in journals of various quality, financing and dependencies.

"High ranking" journals have an "Impact Factor" others are "Peer Reviewed" and listed in databases like Pubmed® Central and Scopus®. All these efforts have not prevented that an assumed 70% of the publications are today considered false, blended or at least far away from the clinical reality. As already university teaching in our field is fully controlled by dental implant manufacturers, practitioners have difficulties to get an independent view and orientation. If a believe-driven science (actually a funding-driven science) dominates the scientific writing the system runs towards a collapse. That is what we see today in the western world.

Richard Horton[1] wrote regarding fake publications in 2015: "The bad news is that nobody is ready to take the first step to clean up the system".

The opposite happened: due to stricter and stricter "rules" in scientific publishing (as set up by the insiders) those practitioners which have most experience gave up publishing, because they don't want to be disqualified by "reviewers" (with typically much less experience).

The authors suggest that scientific articles should not be reviewed until they have all the same homogenous content, but instead the authors should reveal openly the amount of experience which they have with the topic about which they

1 Horton R., TheLancet.com, Vol 385, April 15, 2015, p 1380

write. In practical fields like in oral implantology this is quite easy to do and we suggest here a simple method of calculating the proposed "Experience Factor" (EF).

Materials and methods

As practitioners in dental implantology gain experience over years, the number of implants placed and the observation time for these implants are decisive factors for their increase in experience. An **Experience Factor** (EF) can be calculated for the surgical work and for the prosthetic work. The following table shows a simplified example with only six timepoints:

Year (Timepoint)	Number of implants placed	Multiplication for years	Total
2000 (1)	100	20	2000
2005 (2)	100	15	1500
2010 (3)	100	10	1000
2015 (4)	100	5	500
2020 (5)	100	1	100
End of observation End of 2021 (6)	Total: 500		**Experience Factor: 5100**

Table 1 *A practitioner places (or equips prosthetically) 100 implants during the years 2000, 2005, 2010, 2015 and 2020. At the end of 2021 the observation years are multiplied with the implants placed per year and added up to the* ***experience factor****.*

Year (Timepoint)	Number of implants placed	Multiplication for years	Total
2000 (1)	1000	0	0
2001 (2)	1000	0	0
2002 (3)	1000	0	0
2019 (4)	100	2	200
2020 (5)	100	1	100
2021 (6)	100	0	0
End of observation End of 2021 (7)	Total: 3.300		**Experience Factor: 300**

Table 2 *A practitioner places (or equips prosthetically) 1000 implants per year during the years 2000, 2001, 2002, then interrupts his career, and then continues placing in 2019, 2020, and 2021 100 implants each. At the end of 2021 the uninterrupted observation years are multiplied with the implants placed per year and added up to the* ***Experience Factor****. Due to the large interruption in the work 3000 implants placed in the years 2000, 2001 and 2002 are not considered when it comes to calculate the* ***Experience Factor****.*

Results

It becomes evident, that the same number of implants placed per year counts more depending on when the implants were placed. Even 100 implants placed e.g. in the year 2020 and counted at the end of the year 2021 result in low experience, whereas the same number placed in the year 2000 yields higher experience.

Discussion

There are a number of shortcomings to this approach:

1. The calculation does not take into account how many implants have failed or are not fully successful, or if patients do not turn up for control, nor if they die. We have to accept that our approach is solely looking on the experience and the years, hence it is not a success-meter.

2. The calculation does not take into account if the practitioner has changed the implant system or his personal method for patient/case selection, the methods of doing surgery, the methods of doing prosthetics and his scheme for maintenance and checkups. We can assume that if a practitioner changes the implant system or applies serval such systems parallel in the clinic, he does this as a result of (newer) education and the personal experience.

The advantages of calculating the EF of a treatment provider and mentioning it in e.g. publications can be summarized as follows:

1. The introduction of the EF into the profession would reduce the strong and not justified influence of universities on our profession. We all are aware, that the typical professor has long ago investigated deep into a very selected topic for his research and the necessary publications. Very few professors which teach in the field of oral implantology have actually done their PhD in this field. Many professors e.g. in the field of periodontology have matured to became professors teaching oral implantology, and they do this either because they are under contract with some implant manufacturer, or because they earn money with private teaching of post-graduates, or both. Both can lead to a good income, but not to experience.
2. Conventional oral implantology is a field in academic dentistry, where myths, rumors and beliefs prevail severely over real knowledge and experience. It has been rightfully named the "red light district" of dentistry. This problem could be eased, if all authors and teachers would self-reveal their (truthfully calculated) EF to the audience, together with conflicts of interest. This way the receiver of information would be able to evaluate how much they would trust the information.
3. We propose that the EF can be attained by surgeons and prosthetic treatment providers in the same way, whereby the prosthetic treatment provider will count the implants which were equipped with prosthetics for every year.
4. The EF as it is proposed here, can only be used if the practitioner does not interrupt his implant-work significantly. Any longer interruption e.g. for 4 years or more would lead to a situation where both the knowledge but also the experience would be partly forgotten.
5. It is true that the EF is not a success meter, however we have good reasons to assume that the practitioner has at least some successes and that patients have recommended the clinic, otherwise this treatment provider would have stopped placing implants. If a treatment provider places implants for e.g. 20 years uninterruptedly, we can assume that he does at least something right. And if this person decides to publish, the publication is based on both knowledge and on experience. We should not forget that patients chose their treatment providers because they assume that he/she has experience, and not

because of the exam marks nor the amount of scientific publications.

6. If a treatment provider does both surgery and prosthetics, every implant counts as one implant. If one treatment provider does surgery and another treatment provider does prosthetics on the same implant, one implant (placed and equipped) counts as one implant for each of the treatment providers. Nevertheless it makes no sense to distinguish a surgical EF from a prosthetic EF.

Knowledge is something that can be taught and learned, whereas experience requires practical work and observation of the work over time. Experience includes (automatically) that the treatment provider will do alterations to the standard procedures, if the subject is slightly different. Experience reaches far beyond the limits of knowledge and routines of work, Fig. 1. Knowledge must be kept available and topped up through regular re-training.

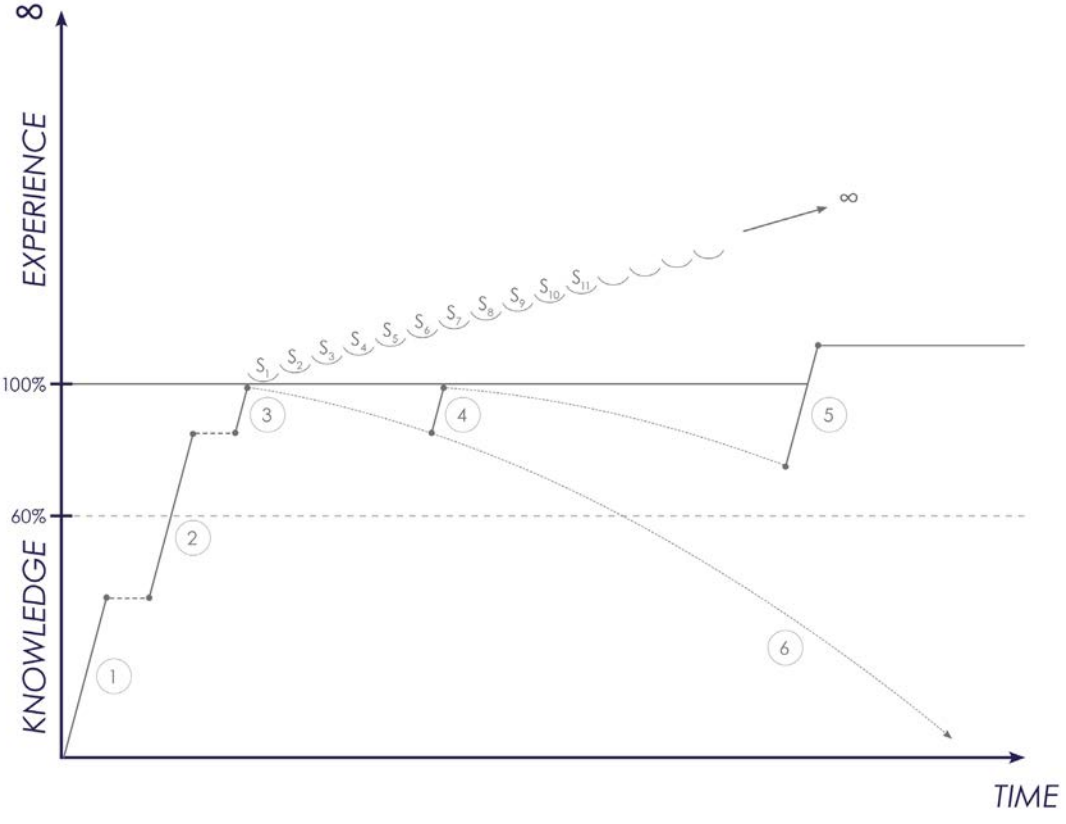

Fig. 1 *A treatment provider receives 100% of the available knowledge in the field, during three steps of education (1), (2), (3). Right after this this treatment providers starts with his/her own treatments S1 – Sx. With every treatment experience is gained. While this happens, the treatment provider forgets however some part of the knowledge which was aquired before and hence his picture on the field is not complete. In order to fill up the knowledge-gap more theoretical training is required (4). Would this not be done, the knowledge base would drop sooner or later below 60%, which must be considered as a minimal amount of knowledge (6). Without these 60% of the knowledge mistakes will happen even especially in critical situation even to experienced treatment providers. If knowledge should increased after the basic training had finished, new knowledge can be picked up in a well designed continuous education program (5). But even this will not replace missing experience.*

Conclusion

Access to join into university teaching is typically limited by the university itself: the "insiders" build up hard walls which have to be taken, just as "PhD-studies" and the demand for impact factor publications. This demand for impact factor publications is nothing else than a perfected system to exclude competition for teachers from the real dental world in the dental schools. Dental schools should first of all should create knowledgeable dentists (without experience): it is their job to create a dentist out of a high-school leaver. The insiders in these schools are afraid that if experienced practitioners would be allowed to enter their sacred institutions, they would be exposed every day and the practitioners would make them look ridiculous. They would show them permanently that the textbooks are wrong and quite useless, and they would ignite a change towards real life dentistry which the university doesn't want.

The situation as it is now, where a 30 year old "PhD" with five impact factor (IF) publication counts more than a practitioner with an EF of 200.000 is unacceptable for the general public, who pays the (to some extend useless university show) with his/her tax payers money.

At least the journals in dentistry, regardless of their fame must be liberated from the burden of the "Impact Factor" which is nothing else than a measure on how often the content of one article is copied into other articles, means: how many new authors have copied something out of old articles (instead of creating new knowledge which does not compare to old knowledge). And they are even proud of this.

If we want to involve experienced practitioners into the process of publishing and teaching we must think of defining means for their evaluation. The Experience Factor (EF) as it is proposed here could be one step into the right direction. An author with a high EF should be allowed (and even strongly motivated) to publish the views and experiences, and all obstacles should be removed out of such an author's way.

In other words: if members of the university teach high-school graduates, they have to base this on textbooks and existing knowledge. But everyone who publishes should not copy out of the textbooks, they should present real life experiences. A PhD or a professorship in a practical field like dentistry can hardly ever meet the true public expectations if the author is less than 50 years old and has performed thousands of relevant medical interventions. Regardless of the amount of their scientific publications.

The usage of the **Experience Factor** will also clarify to courts, how much experience an expert with a specific method of treatment has. It is clear, that for the work with different technologies, i.e. for the work with conventional dental implants (regardless of the brand and the manufacturer) and for Corticobasal® implants **sepa-**

rate Experience Factors must be calculated. Conventional implants and the Technology of the Strategic Implant® are not the same subject, although they are both working methods for fixating prosthetic constructions in the jaw bones.

Knowledge by itself is quite useless without experience. But even with a lot of experience knowledge must be revived and updated regularly.