Early development of oral implants in Gothenburg Sweden under the leadership of P-I Brånemark built on the hypothesis that the titanium devices were directly anchored in bone without any interposed soft tissue. However, first with the advent of Donath’s cutting and grinding technique was it possible to demonstrate that what was now named osseointegration really occurred around oral implants. The original discovery of osseointegration happened in 1962 and the first patient was treated 3 years later in 1965. Brånemark’s first oral implant paper was published in 1969. Clinical results were initially rather poor, but started improving during the 1970s. We were not aware of the works by Schulte and by Schroeder on similarly bone anchored oral implants until 1981, about 5 years after their first publications.

In 1975 W. Schulte and G. Heimke developed the concept of the Tuebingen immediate implant. The design was a polycrystalline aluminum oxide stepped ceramic cylinder, which was inserted immediately after tooth extraction and preparation of the bone cavity. In a series of animal experiments this concept was successfully tested and then introduced into clinical practice. In the 80’s hundreds of patients were successfully treated and under regular maintenance followed for many years in order to demonstrate the strengths but also the weaknesses of this implant type. Many basic investigations demonstrated the unique properties of endosseal implants in the oral cavity. As a consequence out of the previous investigations and experiences the Frialit-II implant design was developed and then also successfully introduced into clinical practice. Willi Schulte’s visionary ideas contributed considerably to our current understanding and development in oral implantology.

Research on dental implants has traditionally focused on a single outcome: implant survival. More recently, other parameters such as patient-reported outcome measures and the occurrence of biological and technical complications have moved into focus. Our understanding, however, is still limited and based on reports from small and selected patient samples. This presentation will report findings from a large, nationwide project evaluating the effectiveness of implant therapy. Results on patient-reported outcomes, implant loss, and peri-implantitis will be discussed.
EAO Consensus Conference 2015 – Main
Conclusions and Clinical Recommendations
Christoph Hämmerle,1 Thomas Flemmig,2 Mariano Sanz,3 Alberto Sicilia,4 Marc Quirynen5
1University of Zurich, Zurich, Switzerland, 2The University of Hong Kong, Hong Kong, 3University Complutense of Madrid, Spain, 4University of Oviedo, Oviedo, Spain, 5Faculty of Medicine of the Catholic University, Leuven, Belgium

- Opening of session
- What is a consensus conference?
- Digital technologies to support planning, treatment and fabrication processes and outcome assessments in implant dentistry
- Long-term stability of peri-implant tissues after bone or soft tissue augmentation. Effect of zirconia or titanium abutments on periimplant soft tissues
- Therapeutic concepts and methods for improving dental implant outcomes
- The patient undergoing implant therapy
In February 2015, four groups of experts in implant dentistry met to debate four key topics. These topics were selected because they represent areas where there is currently a lack of clarity on best practice.

By the end of the meeting, experts reached a consensus based on their combined expertise. The main conclusions and clinical recommendations will be presented during this session and also published in a supplement of Clinical Oral Implants Research.

The relevance of implant materials for periimplantitis
Andrea Mombelli
University of Geneva School of Dental Medicine, Geneva, Switzerland

The prevalence of peri-implantitis at titanium implants is estimated in the order of 10% implants and 20% patients during 5 to 10 years after implant placement. To what extent peri-implant infections could be lowered by choosing another implant material is unknown. Zirconia ceramics have been proposed as an alternative. Some authors have suggested adverse immune reactions to titanium oxide as a possible contributing factor to biological complications. Others have pointed to the importance not only of the implant-material but also of the structure of its surface. To obtain the full picture, host-to-implant interactions have to be studied at three levels: the interface with the oral microbiota, the soft peri-implant tissues, and the bone.

Pro-inflammatory cytokines in peri-implant crevice fluid may be markers for early peri-implant infections and may have value in indicating patients at risk for biological complications. However, factors other than the properties of the implant itself undoubtedly also play a role. They include the material, the surface and the macroscopic design of the abutment and the crown, and their position relative to the soft and hard peri-implant tissues. Currently, comparative data from long-term monitoring of implants made of different materials are incomplete, thus definitive conclusions cannot be drawn.

The patient and the problem awaits Monday morning; what do I do?
Stefan Renvert
Kristianstad University, Kristianstad, Sweden

After diagnosing peri-implantitis, the first decision is to either treat or remove the implant. If you decide to treat the implant it is recommended to always start with non-surgical therapy although it may not be sufficient to obtain complete healing. This allows you as a clinician to evaluate healing response and the patient’s cooperation. In case healing do not occur access to the infected area is needed and both resective and regenerative surgical approaches have been employed for the treatment of peri-implantitis. In the aesthetic area and in situations with crater like defects at implants, regenerative surgical approaches have been evaluated for the treatment of peri-implantitis. It has been demonstrated that it is possible to obtain re-osseointegration after surgical cleansing of the infected implant surface. Although defect fill have been demonstrated after regenerative surgical treatment modalities, the long-term prognosis for such therapies has only been evaluated in a few studies. It has however been demonstrated that stable results can be maintained over at least a 5 year period provided an adequate maintenance program is employed. This presentation will focus on treatment planning and alternatives for the treatment of peri-implantitis.

Challenges in the treatment of periimplantitis
Olivier Carcuac
Institute of Odontology, Gothenburg, Sweden

Peri-implantitis is one of the major challenges in implant dentistry. Numerous protocols have been proposed for the treatment of the disease. This presentation will analyze the available literature on the treatment of peri-implantitis and discuss potential benefits of different procedures proposed. Results from a recently completed randomized controlled trial including 100 subjects will be presented.
A comparison between periodontitis and periimplantitis lesions

Tord Berglundh
Inst. of Odontology, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

Peri-implantitis is a disease affecting peri-implant tissues. It is characterized by bleeding/suppuration on probing together with loss of supporting bone. Recent evaluations on the prevalence of the disease indicate that about 20% of implant-carrying patients present with significant peri-implantitis problems and subjects with a history of severe periodontitis have higher risk for the disease. In the presentation results from recent studies on peri-implantitis and periodontitis using experimental and human sample protocols will be reported and important differences between the two conditions will be described. The understanding of disease onset and progression for peri-implantitis will be addressed from the comparison between periodontitis and peri-implantitis. Thus, peri-implant mucositis represents the obvious precursor of peri-implantitis, as does gingivitis for periodontitis. The presentation will also address the role of implant surface characteristics in relation to peri-implantitis. Results from pre-clinical in vivo studies will be presented and their clinical relevance will be discussed.

Osseointegration and brain controlled prostheses

Rickard Bränemark
Sahlgrenska University Hospital, Gothenburg, Sweden

Osseointegration has been used in the treatment of amputees for more than 20 years in different parts of the world. An overview of this work will be presented including indications for treatment, surgical technique, complications, benefits and future possibilities. More recently, osseointegration was used in conjunction with implanted electrodes to improve the control of a robotic arm in a transhumeral amputee.

What the dentist needs to know about tissue reconstruction/regeneration

Luca Cordaro
Eastman Dental Hospital, Roma, Italy

The implementation of the concept of prosthetic driven implant placement has enormously increased the need for tissue augmentation at implant sites. The implant-supported prosthesis should have the ideal esthetic and functional prerequisites and thus placed in the desired position with the required hard and soft tissue support. The dentist, responsible for the overall treatment plan of the patient, should be informed about all treatment options and of the risks connected with the various tissue augmentation modalities. The dentist should also be aware of the correct diagnostic pathway that based on a combination of prosthetic and radiological information will lead to an evaluation of the treatment steps needed to achieve the planned ideal restoration. Moreover the dentist should be aware of the possible prosthetic compromises to overcome suboptimal implant placement and the esthetic and functional risks connected with the possible prosthetic solutions.

The combination of these information will allow the dentist to drive the patient through an individualized treatment plan that considers the specific needs and expectations.
Aspects from the video “Cell to Cell communication”

Bernd Stadlinger
University of Zurich, Zurich, Switzerland

The vast spread of modern digital media strongly influenced our means of communication and gave new opportunities to university teaching and education. This presentation introduces the 3D-computer animated film series “Cell-to-Cell Communication”. This series of currently four computer animated films aims at the illustration of cell biological processes that occur prior, during and after dental therapies. The first film “Osseointegration” illustrates the biological processes of peri-implant bone formation. The second film “Inflammatory reaction” visualizes the role of the immune system in relation to periodontitis. The third film “Periodontal Regeneration” illustrates the embryological development of the teeth, cellular processes during orthodontic tooth movement and trauma or periodontitis induced changes in the cementum. The newest film “Oral Health and Systemic Health” leaves the oral cavity and describes processes leading to atherosclerosis and diabetes. In order to combine different imaging techniques, scanning electron microscopic images of relevant cells are integrated into the films. The camera perspective changes in between different image planes: - the macroscopic plane of the human eye, - the microscopic plane of cells, and the submicroscopic plane of proteins, functioning as mediators between cells. This enables a better understanding of three-dimensionality and the timeline of cellular processes. Modern dental medicine is influenced by various medical specialties and natural sciences, e.g. internal medicine, immunology, material science, pharmacology and many more. Aim of this interdisciplinary film project is integrate new media into teaching for the illustration of biological processes in order to facilitate understanding and create a fascination for science.

Reconstruction of periimplant soft tissues

Tomas Linkevicius
Institute of Odontology, Vilnius University, Vilnius, Lithuania

The role of soft tissue thickness is well established in aesthetic treatment. It is known that thin soft tissues present an unfavorable situation for implant placement, crestal bone stability and subsequent prosthetic treatment. Therefore, some guidelines how to successfully reconstruct soft tissue thickness in thin tissue biotype is a necessity for satisfactory clinical outcomes.

Tissue regeneration via the use of L-PRF

Marc Quirynen, Andy Temmerman
Faculty of Medicine of the Catholic University, Leuven, Belgium

The active search for natural, patient derived additives that can promote bone & soft tissue healing, and that can easily be applied during surgery remains a hot topic. The use of Platelet aggregates has been very controversial in the past (and the present). Especially the 1st generation [PRP - Platelet Rich Plasma] had major drawbacks: it was expensive, needed bovine trombin, and several difficult preparation protocols had to be applied. The latter had its impact on the inconsistent outcome. Most of these problems were overcome by the 2nd generation aggregates [PRF - Platelet Rich Fibrin], including an easy preparation, minimal costs and several inherent advantages. This lecture will give an overview of possible treatment options for L-PRF in oral surgery and implantology and include recent research.

Bis-phosphonates; a threat or an option?

Per Aspenberg
Department of Clinical and Experimental Medicine Orthopaedics, Linköping University, Sweden

Bisphosphonates either bind to bone mineral or are quickly excreted. Normally, they don’t enter cells and are therefore not toxic. When an osteoclast resorbs bone, it also ingests any bisphosphonate bound to it. This will inactivate the osteoclast, and thus reduce bone resorption. When bone is infected, quick resorption will demarcate the infected area. This protection mechanism can be impaired if resorption is reduced by any potent antiresorptive, leading to spread of infection and established osteomyelitis (ONJ). This is sufficient to explain ONJ. At implant insertion in bone, bisphosphonates reduce the resorptive response to the trauma without impairing the bone formation response, therefore acting as a “net anabolic”. Local and systemic bisphosphonates have been shown to improve the early fixation of both knee and hip replacements. Because bisphosphonates bind strongly to bone, local treatment in conjunction with implant insertion will stay local, and thus not impair the ability to delineate the site in case of infection. We did a blinded controlled randomized trial of dental implants, coated with a protein layer loaded with bisphosphonates. The resonance frequency was 6.9 ISQ units higher for the coated implants compared to the controls (\(P = 0.0001\); Cohen’s \(d = 1.3\)). X-ray showed less bone resorption at the margin of the implant both at 2 months (\(P = 0.012\)) and at 6 months (\(P = 0.012\)). The patients have been followed for 5 years without complications. Systemic antiresorptives may somewhat impair protection against osteomyelitis. Local bisphosphonates seem not to confer this risk, and improve implant fixation.
No teeth, no money; what to do in the elderly patient?

Martin Schimmel
School of Dental Medicine, University of Bern, Bern, Switzerland

The prevalence of edentulism is already a scarce condition in high-income households in the US (Slade et al. 2014). It is projected to fall to 2.6% by 2050 and will be seen mostly in an older, economically deprived population. There is no doubt that this trend can be observed in most of the western world. What to do if the “average” edentulous patient is old, medically compromised, frail and poor? Should this vulnerable population be excluded from the benefits of implantology even if edentulous elders benefit the most of all patient groups from the treatment? Some countries provide funds for implant-prosthesis for the edentulous through the national health insurance system (like the host-country of the 2015 EAO). Nevertheless, most governments ignore the evidence that the treatment, as suggested by the McGill consensus statement, is favourable in regard to biological, psychological and sociological aspects and shows a favourable cost-benefit ratio in the medium-term. Should implants be placed at all in elderly patients? What are the prerequisites and what are the specific considerations for the treatment? There are recent developments to simplify the procedures for providing complete removable prosthesis with CAD/CAM technology. They have the potential to drastically reduce chair-side time and laboratory costs. Also, with the advent of short and narrow diameter implants, minimally invasive surgical procedures become very popular in the treatment of elderly patients. Such treatments must always be part of on-going dental care approach, especially in frail elders.

Minimal number of implants in the upper jaw?

Anja Zembic
Center of Dental Medicine, Zurich, Switzerland

A high life expectancy and continuous population growth will increase the amount of elderly patients visiting the dental practice in future. As a consequence, there might be a higher rate of edentulous patients. The introduction of dental implants offers several treatment alternatives to conventional dentures and represents a huge improvement for those patients. By means of implant-supported overdentures the patient’s quality of life significantly improved in terms of psychological factors, mastication, stability, comfort, speech, food choice and impact on social activities. Still, the number of edentulous patients undergoing an implant treatment is rather small due to anxiety for surgical risks and costs. Therefore, it would be advantageous to offer the patient a minimal number of implants needed for a successful outcome. Evidence on the edentulous maxilla treated with implants is rather scarce, making it more difficult for the practitioner to decide on the ideal number of implants. To help the practitioner find the minimal number of implants in the upper jaw for each individual patient, relevant information from the existing evidence will be presented. In addition, key factors will be discussed which might have an impact on the treatment of the edentulous maxilla with different numbers of implants.

Minimal number of implants in the lower jaw?

Gerry Raghoebear
University Medical Center Groningen, Groningen, Netherlands

When resorption of alveolar bone after tooth loss progresses, resorption of basal mandibular bone may occur as well. As a result, edentulous patients with conventional dentures often experience serious functional and psychosocial problems due to an impaired load-bearing capacity. These problems include pain during mastication, and insufficient stability and retention of the mandibular denture, which may be treated by an implant-retained overdenture. In this respect, a two-implant mandibular overdenture, being a cost-effective treatment with a favorable long term prognosis, should be considered the first choice of treatment. Often there is even no need to augment a resorbed mandible as short implants also are accompanied by favorable results. Issues that remain include [1] when to use short implants or a combination of bone augmentation followed by implant placement and [2] are always two implants needed or will one implant do also the job in selected cases. There is mention in the literature that indeed one implant might be sufficient for support of a mandibular overdenture. In particularly for elderly and compromised patients this protocol can serve as an alternative for the common approach of a mandibular overdenture on two implants. When one implant is used, the mesostructure and its retentive parts are probably easier to cleanse for patients with impaired skills. This presentation will discuss advantages and disadvantages of various treatment options to rehabilitate the edentulous mandible and will provide a proposal how many implants are needed for specific conditions.

Maxillary sinus grafting complications and how to avoid them

Pascal Valentini
University of Corsica, Paris, France

According to the literature, It is well known that the occurrence of post operative chronic sinusitis appears to be limited
The surgeon as the complicating factor

Franck Renouard
Paris, France

In 1981, PI Branemark introduced the global medical community to a new treatment for edentulism – that of replacing lost teeth with implant-supported prostheses. At the time, many thought that edentulism would be banished thanks to this thoroughly-efficient technique which appeared to have no or very few disadvantages. The surprising fact of the matter is, however, when we compare implant dentistry then and now, in 2015, we’re faced with the question, ‘why is implantology probably no more reliable now than it was in the 1980s?’ This is despite the fact that today we know much more about the biology and biomechanics of implant dentistry than we did then, as demonstrated in the innumerable scientific publications that deal with these fields of activity. It is undeniable that many practitioners are beginning to question the supposed infallibility of implants. Commercial aviation started to become a safer mode of transport when the role of human factors and behaviours in the occurrence of complications and accidents began to come under the spotlight. We are only just starting to explore both the impact of human factors and human attitude in medicine – and we haven’t even begun this process in the fields of implant dentistry. The aim of this presentation is to demonstrate that to reduce the number of errors and complications arising in these fields, it is absolutely crucial to adopt a new approach, one that emphasizes an examination of the non-technical factors that are part and parcel of this specialization.

On the evolution of complications in implant prosthodontics

Bjarni Pjetursson
University of Iceland, Reykjavik, Iceland

It is already more than half a century since the first endosseous dental implants were placed in a patient to support a fixed reconstruction. Over the decades the experience with dental implants has been very positive. Hundreds of clinical studies have reported very high survival rates of dental implants and implant supported reconstructions. Many of those studies have also reported on biological complications, such as marginal bone loss and soft tissue complications. Technical complications and the prevalence of patients with or without failures and complications have received significantly less attention. For implant-supported reconstructions, complications can occur over the years in function. These can be minor complications, which can be corrected or repaired without investing lots of time and effort. But there are also complications, classified as major complications, resulting in a lot of time and effort to be invested or even worse, the reconstruction has to be removed and remade. In this lecture, the incidence of different technical complications by implant-supported reconstructions and what we have learned from technical complications will be presented. The etiology of technical complications will be addressed and discussed how it is possible to reduce or eliminate the incidence of technical complications in implant dentistry. Finally, guidelines on how to report success and complications in implant dentistry will be presented.

What have we learned from mucogingival complications?

Rino Burkhardt
University of Zurich, Zurich, Switzerland

A complication in periodontal or implant surgery is an unfavourable evolution of a health condition or a therapy. Depending on several factors - local and general ones - such as age, health status, immune system and others, complications may arise more easily and cause an adverse effect. In the last decades, most of the complications in periodontal surgery have been described and we have learned how to minimize the risk to provoke them. On the contrary, in implant therapy, adverse effects such as esthetic problems, are often caused by an incorrect procedure and, therefore, must be called treatment or medical errors and not complications. It is the goal of the presentation to evaluate the most severe complications that may arise after mucogingival surgeries and how these adverse effects can be avoided in implant therapies. Additionally, the differences between true complications and treatment errors will be discussed. In the conclusion, the measures that have to be respected to reduce adverse effects in implant surgery to their minimum will be listed up.

What have we learned from immediate implant placement and immediate restoration?

Markus Hürzeler
Hürzeler /Zuhr GmbH, Munich, Germany

There are two major factors which need to be taken into considerations when it comes to immediate implant placement.
Peri-implantitis: diagnosis and prevention through case selection and proper treatment execution.

Hugo De Bruyn  
Ghent University, Ghent, Belgium

Peri-implantitis is a bacterial disease that affects soft and hard tissues around dental implants in a dramatic way. In contrast to the bone adaptation that occurs in the initial time frame of implant loading, due to biologic width formation, it is characterized by ongoing bone loss, pocket formation and suppuration. This has a direct effect on the aesthetic appearance as well as location of the gums. Often and certainly in the anterior zone of the maxilla this leads to esthetical consequences and patient’s dissatisfaction. Prevalence of the disease is controversial due to disparity of disease thresholds, however, recent systematic reviews and long-term clinical trials present figures of 10 to 20% of affected patients. In this presentation disease prevalence in relation to diagnostic threshold with respect to bone loss and peri-implant inflammation will be discussed based on long-term clinical studies. Furthermore measures to prevent disease initiation will be discussed including patient selection, presurgical planning and proper surgical and restorative treatment execution.

Supportive therapy following treatment of peri-implant disease

Lisa Heitz-Mayfield  
The University of Western Australia, Perth, Australia

Preventive measures to ensure successful treatment outcomes include establishing healthy oral conditions prior to implant placement and meticulous treatment planning with respect to implant placement and prosthesis design. In order to maintain healthy peri-implant tissues and prevent peri-implant disease, regular monitoring and individualized supportive care is essential. Supportive therapy also plays an important role following the treatment of peri-implant disease. When peri-implant mucositis is diagnosed, effective treatment will result in the resolution of the inflammation, and prevention of progression to peri-implantitis. When peri-implantitis is diagnosed, a successful treatment outcome will lead to a resolution of inflammation and in some cases regeneration of bone. This presentation will focus on supportive peri-implant therapy following the treatment of peri-implant disease. The evidence for maintenance care in prevention of further disease progression will be presented.

How successful is supportive therapy in prevention of peri-implant disease

Mariano Sanz  
University Complutense of Madrid, Madrid, Spain

Peri-implant diseases are defined as inflammatory lesions of the surrounding peri-implant tissues and include peri-implant mucositis [an inflammatory lesion limited to the surrounding mucosa of an implant] and peri-implantitis [an inflammatory lesion of the mucosa that affects the supporting bone with resulting loss of osseointegration]. Primary prevention of mucositis is the main intervention to prevent periimplantitis. In fact, therapy of peri-implant mucositis involving mechanical debridement of the implant surface using curettes, ultrasonic devices, air-abrasive devices or lasers, with or without the adjunctive use of local antibiotics or antiseptics has proven effective. For peri-implantitis, however the results are limited and surgical therapy is indicated when nonsurgical therapy fails to control the inflammatory changes. For this reason supportive therapy is fundamental for preventing mucositis and in case this soft tissue inflammatory disease is present to implement the appropriate therapy. In this presentation we shall discuss the current information on prevalence of these conditions and the evidence on long term prospective studies able to prevent periimplantitis.
29 Implants in the Future 1
The future implant crown; technology, material and tissue guiding designs
Per Vult Von Steyern
Faculty of Odontology, Malmö University, Malmö, Sweden

The requirements for an implant crown are many and challenging. The abutment/crown complex often consists of a small gracile component that should be able to withstand high loads, wear and environmental impact. They should furthermore be biocompatible, beautiful and look natural. With optical properties close to what nature once provided us and with a design that guides the surrounding soft tissues, we can recreate the patients’ appearance. The lecture will highlight how we can use different modern materials and techniques to achieve strong implant-supported reconstructions with tissue guiding design, for optimal aesthetics and function.

30 Implants in the Future 1
Is ceramic the material of choice for future implants?
Eric Van Dooren
Wilrijk, Belgium

The use of dental implants to replace missing teeth is a well-documented treatment modality. Commercially pure titanium has been the material of choice, because of its biocompatibility and his mechanical properties. Zirconia implants can be used as an alternative for titanium implants for several reasons (allergy, esthetic appearance, metal free reconstructions). This lecture will address the information available in the literature and present some clinical cases with a prototype Zirconia implant.

31 Implants in the Future 1
CAD/CAM in removable prosthodontics
Daniel Wismeijer
ACTA, Amsterdam, Netherlands

CAD and CAM are becoming more and more tools that are being used in everyday dental practice. 3D printing of indirect restorations in PMMA, composite and ceramics are slowly taking over the role of milling in the production cycle. Removable prosthesis have stayed a little out of this area of focus but software is giving us the opportunity to plan and execute full and partial denture treatment. Not only the full denture treatment but also implant retained dentures and hybrid dentures can now be fabricated in the digital workflow. Not only the CAD and planning but also the CAM either via milling or 3D printing is now possible. In this presentation the ACTA digital approach to the planning and production of full and partial dentures and the 3D printing and evaluation thereof will be presented.

32 Implants in the Future 2
Digitizing humans
Thabo Beeler
Disney Research Zurich, Zurich, Switzerland

In this talk I will give an overview of our research on digitizing humans. Over the past five years, Disney Research Zurich has devised new technologies for scanning various aspects of the human face. We can capture and reconstruct the facial geometry and appearance at high resolution and accurately measure the deformation of skin. While originally developed for the entertainment industry, our methods become more and more appealing to other domains that require digital humans, such as the medical fields.

33 Implants in the Future 2
The origin, present and future of 3D printing
Dianne Rekow
King’s College London Dental Institute, London, UK

Digital data acquisition and restoration design, tied to milling machines revolutionized restoration production, opening new classes of material choices. Now, replacing the milling machine with 3D printing further expands flexibility and opportunities in dentistry. With 3D printing, structures are created by printing layer by layer, then fusing the layers together. The term, 3D printing, encompasses an array of different technologies each creating a capitalizing on a different approach to fusing layers together. Some of these technologies, available since the mid 1960’s, are still in use today. In this rapidly expanding field with a host of different technologies, capabilities [and costs], new systems are being introduced and applications growing seemingly exponentially. Most current systems are often quite inflexible in terms of materials from which structures can be created. The future is ripe for further material developments to expand the capability of existing printing machines. A further consideration is the difference in structure/restoration/implant physical properties between structures milled and those that are printed. This presentation will briefly describe the evolution of the technologies; overview the existing systems ’s capabilities, costs to acquire and operate the system as well as material-related costs, and implications of additive manufacturing processes on material properties of the structures produced; and then imagine future developments and the implications for dentistry with particular focus on implants.

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3D printing in maxillofacial surgery & reconstruction

Lawrence E Brecht
NYU Langone Medical Center, New York, USA

Advances in CADCAM technologies and 3D printing have led to unprecedented levels of precision in maxillofacial surgery and reconstruction. The development of computer-aided planning and 3D printing provides the reconstructive team with highly accurate models, surgical splints, implant placement guides and cutting jigs. These devices allow for a prosthetically-driven and occlusally-based jaw reconstruction. This presentation reviews the evolution of the collaborative effort of our team of an oral and maxillofacial surgeon, a microvascular plastic surgeon and a maxillofacial prosthodontist in optimizing the outcomes in our patients requiring complex maxillofacial reconstruction.

3D printing in prosthodontics

Vincent Fehmer, Irena Sailer
University of Geneva, Geneva, Switzerland

The recent digital technology offers numerous new and efficient options for restorative dentistry. Within digital dentistry the optical impressioning is the first step towards a digitalization of the patient’s intraoral situation. The resulting digital file is then used for the virtual planning and the virtual design of reconstructions, which thereafter can be milled out of prefabricated blanks of different materials with aid of CAD/CAM systems. Evenmore, these CAD/CAM reconstructions can either be made in a centralized production facility or chair-side in the dental office. The digital systems available today offer numerous advantages, like e.g. the precision of the reconstructions. A high number of studies has demonstrated good accuracy of the current subtractive manufacturing, i.e. the computer-aided milling or the grinding of ingots. More recently, additive procedures have been introduced. Stereolithography, laser sintering or printing of materials like wax, resins or metals has shown to be even more precise than the subtractive manufacturing. Furthermore, the additive fabrication of reconstructions may even be more efficient due to the fact, that less time may be needed for the fabrication and no material excess is produced. Finally, the „digital workflow“ and the associated additive procedures, is not only interesting for the fabrication of dental reconstructions but also for a better patient/dentist communication. As an example, 3D prosthetic diagnostic files of digital wax-ups or set-ups may be printed out of resin and used for try-in in the clinical situation.

Clinicians traditionally assess the outcome of dental implant treatment on the basis of clinical parameters such as implant and suprastructure survival, marginal bone loss, complications and aesthetics. Economic and psychosocial parameters have gained considerable interest in recent years. This evolution seems logic taking into account that patients need to function with a prosthesis. Thus, their final evaluation should be considered pivotal, even if such assessment is subjective and therefore difficult to quantify. Early reports on patient centered/reported outcomes in implant dentistry focused on general patient satisfaction, which may not suffice to assess the impact of implants on treatment outcome as perceived by patients. Detailed questions are needed to give insight into what aspects are improved by prostheses with or without implant support. Controlled studies [randomized controlled studies [RCTs], cohort studies, cross-over studies and comparative studies] with data on patient satisfaction, patient preference, Oral Health-Related Quality of Life [OHRQoL], chewing ability, cleansability, phonetics, and aesthetics may be considered the primary source of such information. An overview of these studies has been recently described in a systematic review and will be presented to assess the true benefit of implants and specific prosthetic designs in oral rehabilitation, as perceived by patients. Recognizable clinical scenarios will be used to illustrate how fully edentulous patients perceive a fixed implant prosthesis or implant overdenture and to what extent partially edentulous patients consider fast treatment concepts and straightforward surgery important.

Quality of life in patients undergoing bone grafting procedures

Guido Heydecke
Universitätsklinikum Hamburg-Eppendorf, Hamburg, Germany

Lots of patients still decline implantation due to biased and unrealistic expectations and concerns about the surgical procedure and the consequences. Recent studies showed evidence that dental implant surgery has a low overall perceived burden and is significantly less burdensome than other common surgical procedures. However, bone graft harvesting procedures for dental implants are very likely to negatively affect patients. Therefore, we assessed and compared changes in health-related quality of life [HRQoL], oral health-related quality of life [OHRQoL], and pain after bone graft harvesting for dental implants in a convenience sample of 23 patients. We
found that patients with extra-oral donor sites (anterior iliac crest) reported a substantial deterioration in the physical component of HRQoL 3 days and 4 weeks after surgery compared to the preoperative state, whereas this score did not significantly change in patients with intra-oral donor sites (chin, ascending ramus, buttress region). The mental health component of HRQoL stayed virtually identical in both groups. Changes in OHRQoL were not statistically significant. Bone graft harvesting from extra-oral donor sites resulted in a higher increase in numbers of pain locations, pain intensity, and negative pain experiences than for intra-oral donor sites. Therefore, in clinical decision-making regarding donor site for bone graft harvesting, patients and clinicians should be aware of the expected decrease in HRQoL and increase in different aspects of pain if deciding for extra-oral donor sites. Whenever possible, intra-oral donor sites should be preferred.

38 Parallel Session 1

Management of bone defects in the esthetic zone

Dehua Li
School of Stomatology, the Fourth Military Medical University, Xi’an, China

Alveolar bone defects are anatomical challenges to implant application and sufficient bone support is considered as a key factor for implant esthetics. Guided bone regeneration provides a good solution to bone defects around implants. Nonetheless, the bone defect resolution has not been demonstrated 100% predictable in practice. Starting from analysis of the reason for this unpredictable reality, this presentation will introduce a classification of alveolar bone defects based upon bony morphology and defect location, and discuss a strategy in treatment planning of bone augmentation, including surgical timing after tooth extraction and the horizontal deficiency of alveolar bone. Bone expansion, titanium mesh technique and selection of bone filling materials will mainly be introduced.

39 Parallel Session 2

Preclinical imaging in implant treatment: from guidelines to clinical use

Michael Bornstein
University of Bern, Bern, Switzerland

Most published national and international guidelines on the use of CBCT in implant dentistry do not offer evidence-based action statements developed from a rigorous systematic review approach. The reported clinical indications for CBCT use in implant dentistry vary from preoperative analysis regarding specific anatomic considerations, site development using grafts, and computer-assisted treatment planning to postoperative evaluation focusing on complications due to damage of neurovascular structures. Indications or contraindications reported for CBCT use in implant dentistry are still based on non-randomized clinical trials, either cohort or case-controlled studies. It will be difficult to prove a clear and statistically significant benefit CBCT over conventional 2-dimensional imaging such as panoramic radiography with respect to survival / success of dental implants, damage of the IAN or other vital neurovascular structures in the arches resulting in dysesthesia or pain in comparative prospective studies due to the high number of cases needed for such an evaluation. The present lecture will focus on recent guidelines and indications / contraindications for CBCT use in implant dentistry.

40 Parallel Session 2

Radiographic bone quality aspects in planning implant surgery

Christina Lindh
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A low bone quality and limited bone quantity is correlated with early implant failure and decreased success rate of dental implant treatment. Therefore, evaluation of jaw bone tissue prior to dental implant treatment is essential. Jaw bone tissue may be evaluated by different clinical and imaging methods and with morphometric analysis. Bone quality is a complex term and no clear definition exists. The term comprises several parameters such as bone density, degree of mineralization, mechanical and physiological parameters. The classification of bone quantity and bone quality proposed by Lekholm and Zarb [1985] is the one most frequently used according to the scientific literature. The classification is based on evaluation of radiographs and tactile perception during installation and has been compared with objective microstructure parameters measured by microCT and histomorphometry. The lecture will illustrate different parameters of bone quality and imaging methods used to evaluate these parameters. Examples of imaging methods are intraoral and panoramic radiography, computed tomography and cone-beam computed tomography. For some of these imaging methods correlation with implant treatment outcome has been described and the methods can be valuable in the planning of implant treatment.

41 Parallel Session 2

Do we still need to use hounsfield scores in presurgical planning?

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Over the last decades, oral implant placement has evolved towards a predictable and routinely used treatment, with local and systemic factors influencing its outcome. Considering
that all these variables and conditions may directly or indirectly affect bone conditions of the host bed, it is obvious that attention should be paid to the local bone quality during presurgical planning. Nowadays, CBCT is often available for such planning, implying that one might focus on potential techniques for bone quality assessment using these radiological 3D datasets. Yet, it should be noted that CBCT devices exhibit wide ranges for grey value distribution, creating an uncertainty on the validity and reliability of CBCT bone density measurements as an index of bone quality. Thus, Hounsfield units scoring of bone density may not apply. Meanwhile, it should be realized that the introduction of new and improved implant surface characteristics has tremendously changed the requirements on bone quality. Considering the fact that a healthy vascularized bone structure may be more clinically relevant, the limiting factor for bone density measures in CBCT may be easily overcome. What might be needed presurgically is a bone structural analysis. Unfortunately, such analysis is not yet available in CBCT diagnostic and implant planning software tools.

42 Parallel Session 2

Creating the virtual patient: how to integrate facial, optical and radiological imaging components

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3D technologies and applications are today no science fiction but daily routine in the dental practices. CBCT devices and Intra oral Scanner (IOS) devices in conjunction with several software applications and other hardware devices have found their way in our dental professional life already and expanding their influences as we speak. The key development in these matters was undoubtedly the superimposing technology where the different image data can be combined to create realistic images of our patient with diverse intra and extra oral information. Dicom images conducted from CBCT scanners together with STL files retrieved from IOS devices can be combined with 3D surface scanners giving a realistic and dynamic view of our patients. This information can be utilized to plan our daily patients cases, design the future restoration, follow up our patients but also their functional pattern over time. This lecture attempts to give an update about these technologies and their applications in our daily practices and academic centres.

43 Parallel Session 3

Do we still need autogenous bone for ridge augmentation or can we use growth factors?

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Further improvements in bone augmentation procedures can either be related to simplification of the clinical handling or influencing biological processes. Growth factors or bioactive proteins and peptides in combination with adequate carrier systems are nowadays able to stimulate the natural regeneration process, to accelerate bone regeneration and to increase predictability in bone regeneration therapy. Although, there are a lot of preclinical studies and a few clinical studies, growth factors are still not in general practice. One reason for that might be the lack of ideal carrier materials allowing to reduce the costs and the dosage. This lecture will provide you with the latest clinical results on a randomized comparison between the use of autogenous bone blocks for ridge augmentation and the use of growth factors.

44 Parallel Session 3

Soft tissue grafts out of the box, what can we expect in clinics?

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Soft tissue replacement grafts have become an essential component to increase tissue volume in plastic periodontal and implant surgery. Autogenous subepithelial connective tissue grafts are more and more applied in aesthetic indications like soft tissue thickening, recession treatment, ridge preservation, soft tissue ridge augmentation and papilla re-construction. The available donor sites are the anterior and posterior palate including the maxillary tuberosity, providing grafts of a different geometric shape and histologic composition. The selective clinical application of different grafts depends on the amount of required tissue, the indication and the personal preference of the treating surgeon. But grafting procedures at all these harvesting sites are accompanied by increased patient morbidity due to the second surgical site. Therefore the development of alternatives is in the focus of science and the industry for the good of the patient. The aim of this lecture is to discuss the advantages and shortfalls of currently available substitute materials and to give a future perspective regarding the desired characteristics of soft tissue substitutes.
Emerging concepts in maxillofacial surgery: Indications for graft materials

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Graft materials are used for the repair of periimplant bone defects in order to avoid the additional morbidity associated with the procurement of autogenous bone grafts. There is a huge variety of available materials and preparations. All materials currently in routine clinical use have to be considered as passive scaffolds that can convey osteoconductive enhancement of bone ingrowth into the defect and thereby improve defect repair to a certain extent. However, there are limitations to the use of these materials depending on the characteristics the defect under repair. In order to understand the biological rules behind bone regeneration in jaw defects, the role of the skeletal envelope for osseous repair in bone defects has to be taken into account. In this concept, the use of graft materials in defects within the skeletal envelope can be considered to provide satisfactory repair in conjunction with barrier membranes whereas defects outside of the skeletal envelope are likely to provide incomplete bone fill and/or insufficient three-dimensional stability. The present contribution gives an overview on the function and the limitations of graft materials in clinical use. Strategies to overcome these limitations by using biotechnological approaches that enhance the biological quality of graft materials are discussed.

Immediate implant placement and restoration in patients with severe periodontal disease (potentially edentulous patients)

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It’s a worldwide challenge to achieve esthetic implant restoration and predictable result in patients with severe periodontitis. It will be more risks or not? This work tried to improve clinical result in those patients with different approaches and evaluate their stability. From 2006 to 2014 in the department of oral implant of Peking University, School of Stomatology, 509 patients with periodontitis underwent implant treatment and 1799 implants were placed totally. Different clinical approaches were performed to improve clinical result. [1] Changing neighbor teeth topography to close black triangle between natural tooth and implant crown with non-invasive ceramic veneer in 31 cases. [2] Changing original crown form of missing tooth into rectangular implant crown tried to compensate the deficient papillae in 191 patients. 3.Subapical osteotomy in mandible front were performed to correct unfavorable intermaxillary relationship in 39 patients. 4. The ceramic gingival were performed to compensate vertical defect and avoiding bone grafts. 5. Following All-on-Four concept, Immediate implant and restoration were performed in 136 patients with hopeless teeth rest comparing with edentulous Jaws in 51 patients Mean follow up was 39 months (ranged from 10 to 93 months), Implant survival rate is 99.1%, MBL changing of implants between patients with hopeless teeth and patients with edentulous jaws showed no significant difference. Implant restoration in patients with severe periodontitis is still a dilemma worldwide, it seems no simple, ideal method presented. The crown reforming, non-invasive veneer could improve clinical result and complete implant restoration such as all-on-four concept is effective alternative for patients with severe periodontitis.
Osseointegration as a foreign body reaction

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The aim of this presentation is to discuss alternative ways of looking at the concept of osseointegration and secondly to address the reasons for marginal bone loss around dental implants. When a foreign body is placed in bone or soft tissue, an inflammatory reaction inevitably develops. Hence, osseointegration is but a foreign body response to the implant, which according to classic pathology is a chronic inflammatory response and characterized by bone embedding/separation of the implant from the body. A balanced, steady state situation of the inevitable foreign body response will be established for the great majority of implants, seen as maintained osseointegration with no or only very little marginal bone loss. It can be speculated, based on this theory, that marginal bone loss is the result of different tissue reactions coupled to the foreign body response and less related to biofilm-mediated infectious processes as the primary cause. The presentation will present current knowledge on healing mechanisms controlling the implant/host interaction and its biological implications related to this hypothesis and further correlate this to the clinical setting with possible clinical recommendations.

Brain signaling from teeth and dental implants

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Osseointegrated dental implants lack a periodontal ligament naturally occurring around the roots of teeth. As a consequence, they also lack the highly sensitive periodontal mechanoreceptors that are located in the ligament. These sensors play a central role in encoding patterns of forces acting on the dentition and contribute significantly to the perception of tooth loading and the regulation of masticatory forces. The sensation evoked when a force is applied to a dental implant, osseoperception, is qualitatively different from dental tactile sensations. The balance between the dynamic and static sensitivities of the mechanoreceptor systems available to the implant patients clearly differs from those of dentate patients with periodontal mechanoreceptors. To be able to understand how implant treatment affects oral sensory and motor functions, we must first learn about the role of the natural tooth as a sensor in the nervous system. This presentation will provide a summary for the clinician of recent studies on the sensorimotor regulation of masticatory function with natural teeth and dental implants. Focus will be on the regulatory changes that occur when a natural tooth is replaced by an implant and its clinical implications.

PRF and its application in immediate implant placement

Yanmin Zhou
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It is widely acknowledged that the best therapeutic option for replacing absent teeth is the placement of osseointegrated implants, but the resorption of both horizontal and vertical alveolar bone after tooth lost is a challenge to dental implantology. Platelet-rich plasma is an autologous product that is derived from whole blood through the process of gradient density centrifugation. The proposed value of this product lies in the ability to incorporate high concentrations of the growth factors, nowadays PRF is widely used in dental implantology and in bone augmentation procedures and has achieved promising results.