Program for the IJP/Karlsruhe Workshop for Young Prosthodontic Educators in Baden-Baden, Germany, June 7–10, 2012

Day 1: Thursday, June 7
Chair: Dr Sree Koka

1. Welcome. Introduction of sponsors and guest observers (Drs Winfried Walther and George Zarb)
2. Morning session's objectives regarding "Clinical scholarship in prosthodontics" and introduction of speakers
3. Prosthodontics' journey as an academic discipline: Our dogmas and our fluid paradigms (Gunnar E. Carlsson)
4. Where is prosthodontics now as an academic discipline? What is evidence-based practice? Why is it important? What are the strengths and weaknesses of EBP? (James Anderson)
5. On planning a well-conducted clinical research study (Clark Stanford)
6. The manuscript reviewer's role in evaluating clinical research and assisting authors to improve their manuscripts* (Sree Koka)
7. Overview discussion. Setting the stage for the afternoon's assigned tutorial sessions to review the other three preassigned papers
8. Small group tutorial sessions to review manuscripts and discuss strengths/weaknesses of assigned papers
9. Coffee and plenary session conducted by the morning's speakers for all participants and faculty

June 8/9, mornings. Selection of short 15-minute lecture review topics presented by faculty. The selections related to both afternoons' selected case histories as well as to aspects of clinical research design.

June 8/9, afternoons. As on the previous Thursday afternoon, participants again split into eight small groups under the guidance of their three assigned tutors. Each afternoon's objective was a debate of the available information required to select and manage each patient's management considerations. The morning's presentations served as resource material for the afternoon sessions. At the end of each afternoon session, the entire group of participants reassembled to seek a consensus on an overall pedagogic reconciliation of the days' discussions. The first late afternoon review was chaired by Drs Hobkirk and Duyck, the second by Drs Klineberg and Chang.

Day 2: Friday, June 8
Chair: Dr John Hobkirk

1. Longevity of restorations used to restore worn teeth (David Bartlett)
2. Age-related dental challenges (Joke Duyck)
3. Altered VDO: Its implications and management (Aaron Fenton)
4. Do wearing removable prostheses doom patients to intraoral ecological compromise? (Ting-Ling Chang)
5. Does severe wear of the dentition predispose a patient to TMD? (Pierre de Grandmont)
6. Reduced dentitions and TMD (Nico Creugers)
7. Are zirconia-based implant-supported prostheses suitable treatment for edentulous patients? (Max Guzzato)
8. Controversy of bilayer and monolithic ceramics: Facts and visions (Petra Guess)
9. Implications of neuroplasticity research for prosthodontists (Limor Avivi Arber)
10. Have we been here before? A historical scan of prosthodontics (Michael MacEntee)

The afternoon case history was of a partially edentulous, elderly male with a compromised vertical dimension of occlusion and severe anterior wear.

Day 3: Saturday, June 9
Chair: Dr Iven Klineberg

1. Management of edentulous and partially edentulous patients in clinical dental education: Standards, methods, and outcomes (Mijin Choi)
2. On the dry mouth predicament (Leslie Laing)
3. Endodontic interventions and treatment outcomes—How much tooth structure is needed? (Shane White)
4. Is overdenture treatment still a viable educational therapeutic procedure? (Francesco Bassi)
5. So-called biologic width and OI (Terry Walton)
6. Immediate or delayed implant treatment for patients with advanced periodontal disease (Ignace Naert)
7. Tilted implants: Clinical and biomechanical considerations (Maria Menini)
8. Adverse treatment outcomes in implant prosthodontics (David Chvartzsaid)
9. What can we learn for dental implants from failures of total hip replacement (Hans Schmotzer)
10. Maxillofacial prosthodontics: Education and research today (Caroline Nguyen)

The afternoon case history was of a middle-aged female with a "terminal dentition" and high expectations for a fixed solution.

Day 4: Sunday, June 10
Chair: Dr George Zarb

1. Statistical certainty—An oxymoron? (Danielle Layton)
2. Ground rules for day's wrap-up session. Representatives from each of the eight participant groups presented their recommended choice of treatment and its rationale
3. Four groups and case history 1 plus discussion
4. The other four groups and case history 2 plus discussion
5. Workshop review, closing remarks, and adjournment

*Participant involvement based on previously assigned readings.

Longevity of Restorations Used to Restore Worn Teeth

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- Tooth wear is a combination of erosion, abrasion, and attrition and can cause shortening of the clinical crowns of teeth. A consequence of shortened teeth is alveolar compensation, which is a natural response to loss of tooth tissue.[1] A very similar process occurs with overeruption of teeth following extractions.
- Once the clinical crown is reduced, conventional techniques to restore teeth become too challenging and either those related to the Dahl concept or crown lengthening are indicated.[2] There is reasonable clinical evidence to support the use of the Dahl appliance for worn teeth.[3]
- Fixed orthodontic appliances can be difficult to attach to short or worn teeth. This may often make the Dahl concept a reasonable option.
- Alternatively, crown-lengthening surgery increases the clinical crown height by repositioning the gingival margin in a more apical location, but further tooth reduction is needed to provide adequate retention for conventional crowns. This can result in further reduction of tooth tissue over the palatal surfaces of anterior teeth, increasing the risk of exposing the pulp.
- The materials used to restore worn teeth can be composites or metal-ceramic crowns. When used, composite can be considered for short- to medium-term restorations but requires considerable maintenance.[4] This is partly a result of the multifactorial nature of the condition whereby the parafunctional component of tooth wear increases the risk of failure, particularly with brittle materials.
- All-ceramic materials suffer a similar risk to composites in that they are also brittle materials.
- In summary, tooth wear is a multifactorial condition, often with parafunction being a component. This increases the risk of failure of brittle materials, and so the use of conventional metal-ceramic crowns is the optimal result.

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Age-Related Dental Challenges

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Elderly individuals challenge oral health care workers in many different ways. We face challenges pertaining to age-related oral pathologies, specific treatment needs, patient complexity and comorbidity, as well as the challenge for our profession to cover the excessive treatment needs of the elderly population. Finally, there is also the challenge to educate and motivate oral health care workers to actually take responsibility in taking care of this particular patient group.

Although the most prevalent oral pathologies in the elderly ([root] caries and periodontitis) are common ones, they present in a way that requires careful diagnosis and treatment planning. Besides pathology, many elderly individuals have lost teeth, which in turn requires prosthetic or restorative treatment. This treatment planning is particularly challenging due to the complexity of this group of patients. The patient's physical and mental condition, social context, and frailty need to be taken into consideration. Since treatment should focus on improvement of the patient's quality of life and function, the proposed treatment plan needs to comply with the patient's complaints and expectations toward treatment. In addition, the proposed treatment should restore function, prevent predictable damage, and be feasible for a particular patient.

Abundant literature is available indicating the excessive treatment needs in the older population, although the frequency of dentist visits is lower compared to younger persons. The reasons for these barriers for dental follow-up and treatment are related to the older individuals themselves as well as to the health care system and the dentists. Dentists' negative attitudes toward elderly and lack of confidence due to insufficient knowledge and skills have an adverse effect on oral health care for the elderly. Appropriate education in geriatric dentistry is therefore mandatory to improve the latter. Besides courses, sufficient clinical exposure and training is crucial to improve dental students' skills and attitudes toward oral health care for the elderly.

Alteration of Occlusal Vertical Dimension

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- Occlusal vertical dimension (OVD) of the natural dentition has been considered a standard that should not be changed; however, it is often useful to alter the OVD when natural teeth or prostheses have excessive occlusal wear. If restorations are provided in the space immediately above worn occlusal surfaces, the benefits include pulpal protection, increased crown retention, esthetics, and finding the necessary minimum space for restorative materials.
- No one assessment method of OVD is infallible. Multiple assessments should be used to evaluate patients' responses and tolerances to change.
- Patients trust dentists to look after the dental details. Their parameters are, *"Do I look good? Can I speak, chew food, and make love? Am I comfortable, and are my teeth in the right place?"* These are the ultimate arbitrators.
- Patients can tolerate considerable changes in vertical dimension when it is perceived to be desirable and socially acceptable, eg, high heels are worn by many and appreciated by others.
- Dentistry often cannot be changed as easily as shoes. Patient acceptance of change may be assessed using study models, altered study models, wax-ups, direct wax or composite application to teeth, images and altered images, and provisional prostheses.
- Alterations of occlusal vertical dimension can range from temporary nocturnal bite planes to replacement of the entire occlusion and articulation on teeth and/or implants or mucosa. The minimum space for a strong wear-resistant dental material is approximately 2 mm.
- Long-term alteration of the OVD is best created with fixed prostheses due to their better internalization and security. Alterations of OVD with only mucosa-supported prostheses may result in soreness and future alveolar resorption.
- Practitioners need to avoid making patients so aware of their teeth that they become preoccupied. That can lead to an abnormal perception or "phantom bite syndrome" that cannot be satisfied with conventional dental therapy. It is a tragedy for the patient.
- The challenge of dental practice is to create improvements that are within the patients' range of tolerance.

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Does Wearing Removable Prostheses Doom Patients to Intraoral Ecologic Compromise?

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- Fixed and removable prostheses with and without the use of implants are viable tooth replacement options available to partially edentulous patients. Clinical decision making desires comparative data for similar tooth loss patterns managed with different prostheses as well as measuring all important clinical- and patient-based outcomes. However, a recent systematic Cochrane review concluded that there is insufficient evidence to recommend one prosthetic intervention versus another for patients with partial edentulism.
- Historically, there was a widespread belief that removable partial dentures (RPDs) were often associated with severe periodontal lesions and caries decay based on some clinical studies from the 1950s to 1960s. However, scientific breakthroughs during the 1960s, especially within periodontology, encouraged prosthodontists to apply new knowledge about prevention and maintenance care in their treatments when replacing lost teeth. As a consequence of this new approach, studies initiated during the late 1960s and since have reported only moderate or small adverse periodontal reactions and caries decay in connection with RPD treatment.
- A randomized prospective clinical trial on mandibular RPDs in 134 patients with Kennedy Class I and II concluded that a well-fabricated RPD, supported by abutments with healthy periodontium and 70% or more bone support, and adherence to a 6-month regular recall program is an acceptable treatment modality with a follow-up period of 5 years.
- A 25-year longitudinal study on 23 patients treated with RPDs showed similar results and conclusions: If plaque control is established, the prosthetic treatment carefully planned, and the prostheses and oral hygiene checked and indicated measures undertaken

at regular recall appointments, long-term treatment with RPDs does not generally seem to be associated with any more obvious damage to the remaining teeth and their periodontal tissues. Under these circumstances, the RPD is a valuable treatment procedure for patients with a markedly reduced number of teeth.

- Support, stability, and retention are three key elements to be considered when designing an RPD. There are distinct biomechanical differences between tooth-borne and extension-base RPDs. Extension-base RPD designs must anticipate and accommodate the movements of the prosthesis during function without exerting pathologic stresses on the abutment teeth.
- Implants can be considered for extension-base RPD scenarios to obtain Kennedy Class III and control RPD movement under function. Implant-retained partial overdentures with resilient attachments are a predictable and cost-effective treatment option for partially edentulous patients to enhance patient satisfaction. More comparison and effectiveness studies are needed to validate whether the implant-assisted RPD is superior to conventional RPD therapy.

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Does Severe Wear of the Dentition Predispose a Patient to TMD?

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By definition, bruxism and attrition are closely related, and it is believed that tooth wear increases with the severity of parafunction. It is also believed that parafunctional habits constitute a major risk factor for temporomandibular disorder (TMD). Muscle hyperactivity could lead to myofascial pain, and overloading of the temporomandibular joints could induce disc displacement, arthralgia, and degenerative changes.

Many studies report a positive correlation between bruxism and signs and symptoms of TMD, and in the presence of TMD symptoms, clinicians often suspect parafunctional activities and focus their therapeutic approaches toward their control.

However, recent systematic reviews have concluded that the nature of a relationship between bruxism and TMD is unclear, with scientific evidence lacking support for a cause-and-effect relationship. Therefore, TMD treatment that is based solely on the control of parafunctional activities has been questioned.

We need to pose the question: What should clinicians consider when dealing with patients showing significant tooth wear and TMD symptoms?

Evidence Against a Cause-and-Effect Relationship

Most evidence supporting a causal relationship between bruxism and TMD comes from epidemiologic surveys, which use a cross-sectional study design and cannot be used to establish a temporal relationship. In such studies, diagnosis of bruxism is often based on patients' self-report of the habit or the presence of tooth wear. The clinical specificity and reliability of both methods as an indicator of bruxism should be questioned. Perception of symptomatic patients can be influenced by the general belief that bruxism and TMD are related. Tooth wear is highly prevalent in the population, multifactorial, cumulative, and its history difficult to establish. If tooth wear could be useful to discriminate bruxers from nonbruxers, it is a poor indicator of parafunction severity. Moreover, there are disparities between demographic characteristics of patients with tooth wear and/or bruxism and those suffering from TMD. Finally, pain is not a consistent feature among bruxers, and it has been shown that those who report TMD symptoms exhibited a lower level of muscle activities.

Bruxers: A Heterogenic Population

Bruxism is classified in two categories: sleep bruxism and awake bruxism. The terms nocturnal bruxism and diurnal bruxism are also often used, but they are considered misleading because of alternative lifestyle.

These parafuntional activities should be considered as two different disorders with different etiopathogeneses. Sleep bruxism is considered as a parasomnia, takes its origin from the central nervous system, and could not be linked to stress. It involves mostly rhythmic muscle contraction and can be associated with severe attrition. Awake bruxism has been poorly documented, and its etiology is not yet well understood, but it seems to be associated with psychosocial factors. Clenching (tonic muscles contractions) is most often involved, and tooth wear is unlikely or localized.

Relationship or No Relationship: Still the Question

Studies on TMD most often fail to identify which type of bruxers are evaluated, and their conclusions seem to be influenced by methodologic choices. However, it seems that studies showing a relationship between the two conditions generally consider clinically diagnosed or self-perceived bruxism. Despite potential bias and poor specificity, those studies are more likely to report on awake bruxism. Studies on sleep bruxism that rely on an objective and strict means of evaluation (polysomnography) do not show a relationship between bruxism and TMD. One should keep in mind that some patients could display both sleep and awake bruxism.

If a relationship exists, it is far from simple, and it should be considered that bruxism alone cannot lead to TMD. Models where predisposing, engraving, and perpetuating factors play a role as well as possible "ménage à trois" between bruxism, TMD, and mental disorders must be considered.

It seems important that in the future, attention should be given to developing a more objective and specific means of evaluating awake bruxism.

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Reduced Dentitions and Temporomandibular Disorders (TMDs)

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- Reduced dentitions are characterized as having fewer teeth and fewer functional units than complete dentitions. This may result in interrupted dental arches, shortened dental arches, or combinations of these features.
- TMD is a collective term that includes a number of clinical problems that involve the masticatory muscles, the temporomandibular joint, and associated structures. It is considered a musculoskeletal disorder and is the main cause of pain of nondental origin in the orofacial region.
- Although the role of occlusion in TMD has been considered to be limited since the 1980s, occlusion cannot be excluded when analyzing the etiology of TMDs.[1]
- There are few data on the relationship between the number of teeth and TMD in the dental literature. In a systematic review, it was concluded that reports on the relationship between the number of teeth and signs and symptoms related to TMD provide little understanding.[2]
- No significant relationships between reduction of occlusal support and symptoms of TMD have been demonstrated.[3]
- In interrupted dental arches, occlusal interferences (supposed to trigger bruxism) have been associated with TMD. However, migration of teeth opposing or adjacent to posterior edentulous spaces is found to be limited.[4] Therefore, the supposed development of disturbing occlusal interferences that may cause bruxism is unlikely.
- In shortened dental arches, changes in the condyle/fossa relationship have been reported, but since there is no increased risk for TMD signs and symptoms compared to complete dental arches, these changes are most probably the result of adaptation rather than of pathology.[5] Occlusal force on each remaining tooth increases, but total occlusal force and joint loads decrease. It seems that neuromuscular regulatory systems control maximum clenching strength under various occlusal conditions.[6]
- Distal extension removable partial dental prostheses in shortened dental arches without molar support have no effects on occlusion and objective and subjective TMD-related signs and symptoms.
- Individuals with only unilateral posterior support seem to present more signs and symptoms related to TMD.[7,8] Unilateral masticatory function has also been associated with joint pain.[8]

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Are Zirconia-Based Implant-Supported Prostheses Suitable Treatment for Edentulous Patients?

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- Metal-acrylic and metal-porcelain prostheses have been commonly used to restore completely edentulous patients with fixed prostheses.[1] The use of metal-acrylic prostheses is affected by a high incidence of acrylic chipping and fracture. Metal-porcelain implant-supported fixed prostheses are poorly documented in the literature. However, it is accepted that in general, casting of large restorations is challenging, the use of gold alloys has become significantly expensive, and options such as titanium-porcelain or base alloy–porcelain are affected by a significant incidence of porcelain chipping and delamination.[1]
- Zirconia has been proposed as an alternative to conventional solutions since this ceramic material displays good mechanical properties, a toothlike appearance, and excellent biocompatibility.
- Clinical studies reporting on the clinical outcomes of zirconia porcelain full-arch implant-supported prostheses have confirmed that the mechanical properties of zirconia are sufficient for this clinical application. On the other hand, the incidence of porcelain chipping is very high.[2]
- Chipping of the veneering porcelain in zirconia restorations is related to the poor mechanical properties of the porcelain, the design of the restoration, incorrect handling, contact damage, and most importantly, the low thermal conductivity of the materials.[3]
- The use of slow cooling rates, designs where the zirconia framework supports the veneering porcelain, and proper handling of the material has in general improved the clinical outcomes in multiunit partial prostheses. The problem of chipping of the veneering porcelain, however, remains partly unsolved.
- The use of full-contoured zirconia has been anecdotally reported as a successful solution. Full-contoured zirconia prostheses are often made with a zirconia that is sintered at a higher temperature and stained with metal-oxides prior to sintering to improve the appearance of the material. Sintering at higher temperatures and staining prior to sintering may affect the long-term mechanical performance of the materials. In addition, the influence of zirconia on the occlusal surface on the wear of the opposing dentition is still not clear.
- Clinicians and manufacturers have been working on the development of veneering ceramic materials with improved mechanical properties. Available studies are insufficient to enable one to draw conclusions and guidelines.
- In summary, the use of zirconia for full-arch implant-supported prostheses as an alternative to conventional metal-based options is promising. More research is required to optimize the use of this material and prevent possible complications

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Controversy of Bilayer and Monolithic Ceramics: Facts and Visions

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- Zirconia ceramic reveals excellent mechanical properties and can therefore be used for extended full-arch restorations in addition to small-sized core constructions such as resin-bonded fixed dental prostheses.[1]
- In clinical studies, zirconia has displayed high reliability as a core material but is susceptible to low temperature degradation and induction of surface damage by grinding and sandblasting.[2]
- Clinical investigations on zirconia-based restorations revealed that fractures within the veneering ceramic (chipping) are the most common reason for failure.[3]
- Different reasons for chipping such as core design, veneering techniques, and handling procedures (clinically and in the dental laboratory) are discussed in the dental literature.[4]
- Anatomically designed zirconia cores provide support for the veneering ceramic and have revealed significantly smaller chip size fractures and increased reliability in laboratory studies.
- Thermal gradients that evolve during veneer application lead to significant residual thermal stresses at the zirconia core–veneering ceramic interface.[5]
- Monolithic computer-aided design/computer-assisted manufacturing (CAD/CAM)-fabricated lithium disilicate crowns have displayed a high reliability in laboratory studies and in preliminary clinical investigations and can therefore be recommended for posterior crown indications.[6]
- CAD/CAM-fabricated lithium disilicate veneers for zirconia cores appear promising. However, clinical data is currently not available.[7]
- Monolithic zirconia restorations are widely used in the United States. However, only sparse laboratory and clinical data are currently available.

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Implications of Neuroplasticity Research for Oral Rehabilitation

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- Oral rehabilitation with dental prostheses has become an effective treatment modality to restore sensory and motor functions and improve patients' quality of life.
- Edentulism is a chronic clinical entity, and dental prostheses including implant-supported prostheses cannot fully restore the lost periodontium. Consequently, the objective sensory and motor capabilities of edentulous patients do not completely match those of dentate patients. Furthermore, patients vary in their subjective abilities to adapt to their prostheses, and a considerable number of patients cannot adapt at all and may remain with functional motor deficits or develop somatosensory disturbances including phantom sensations and chronic pain.
- The neurobehavioral mechanisms underlying these sensorimotor effects are unclear but may involve brain mechanisms since a large portion of the face primary somatosensory and motor areas of the sensorimotor cortex are devoted to the integration and control of oral sensory and motor functions.
- Consistent with vast research on limb sensorimotor functions, emerging evidence focusing on orofacial functions in animals and humans shows that the face sensorimotor cortex has a remarkable capacity to undergo neuroplastic changes in response to intrinsic or extrinsic influences, experiences, training, learning, behavior, injury, or disease.

- Neuroplasticity is a very important concept in oral rehabilitation, since every time we engage a patient in an intraoral manipulation or oral rehabilitation state, we alter sensory inputs and motor functions that can induce cortical neuroplasticity. These changes are crucial in determining how patients adapt and model their sensory and motor behaviors and recover following injury and rehabilitation.
- Neuroplasticity can also underlie some pathologic conditions. Chronic pain conditions including temporomandibular disorder, phantom sensations, and inability to adapt to dental manipulations may all reflect maladaptive conditions associated with neuroplastic changes within the sensorimotor cortex.
- Ten principles of neuroplasticity have been identified and recently translated into rehabilitation of post-stroke limbs, speech, and swallow motor functions: *(1)* Use it or lose it; *(2)* use it and improve it; *(3)* experience specific; *(4)* repetition matters; *(5)* intensity matters; *(6)* time matters; *(7)* salience matters; *(8)* age matters; *(9)* transference; and *(10)* interference. These may also find application to oral sensory and motor functions.
- Understanding the physiologic signals that drive neural changes leading to neuroplasticity that underlies behavioral changes may assist in the development of improved diagnostic tools and improved rehabilitation strategies for early diagnosis of at-risk patients to prevent the development of maladaptive behaviors and to facilitate behavioral compensation and oral rehabilitation of sensory and motor functions following loss of teeth.

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Have We Been Here Before: A Historical Scan of Prosthodontics

"Life can only be understood backwards."
–Søren Kierkegaard, 1813–1855

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The Chinese during the Tang dynasty (618–06 CE) believed that worms caused caries and that they could be prevented by removing food debris from the mouth.[1] Theories on caries have moved on a little from worms to the Acid Dissolution and Chemico-parasitic theories of Miller and Clark in the 1920s, and now to current beliefs supported by the Extended Caries Ecological Hypothesis.[2] Meanwhile, sales of sugar to feed the worms soared from $73.2 billion to $147 billion over the last decade—with little challenge from organized dentistry.[3] The Truscans, several millennia ago, used wire to splint teeth that had periodontal bone loss, and oral hygiene methods have a long history that continues today with little change despite current theories on how microbes, cells, and genes contribute to the development and progress of periodontitis. Moreover, Hunter's theory of focal infection caused by "mausoleums of porcelain" and accompanying mouth infections in the early 1900s has regained attention as the possible link between oral infections and cardiovascular disease, aspiration pneumonia, and diabetes.[4,5] The search continues also for the source of temporomandibular dysfunction using mechanical and electronic gadgets whose "anatomico-mechanical nature" is as mysterious to us today as it was to Christensen in 1905.[6] Successes with oral prostheses are legendary through the intricate creations of Fouchard in 1746 to the triumphs of Brånemark's titanium implants in the middle of the past century, but alas with little but minor refinements of technique and materials since then.[7] Searches for the optimal dental restoration still hover around the fear of amalgam as in the "amalgam wars" of the 1840s and the dominance of G.V. Black in the 1900s,[8] and so it will continue with the emerging biological concerns about the adhesive materials that presently dominate dental restorative dentistry.[9] Yet, esthetics continue to trump infection as the source of our patients' demands—a search that dentistry exploits with great economic success but with little theoretical foundation beyond the square, tapered, and ovoid variations of teeth helped by the golden proportions of a youthful smile.[10,11] In summary, we've moved forward but not always looked back to judge our achievements and how we've progressed.

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Management of Edentulous and Partially Edentulous Patients in Clinical Dental Education: Standards, Methods, and Outcomes

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- Traditionally, dental school curricula have focused on the method of intervention used for management of partial and complete edentulism.
- Those procedure-centered curriculum structures were not designed to produce clinicians with the ability to critically analyze clinical conditions and provide appropriate treatment options that will result in the optimal treatment outcomes for *patients*.
- Dental school curricula should shift curricula foci to emphasize the selection of treatment options through "patient-centered risk and benefit analysis."
- Dental school programs must include all modes of care that benefit overall treatment outcomes for managing partial and complete edentulism.
- Implant therapy has been well established as a predictable treatment option for managing partial and complete edentulism. Despite considerable evidence, implementation of implant therapy as a standard of care in dental school education has been lagging.
- Setting clear guidelines for appropriate case selection is the key to successful implementation of curriculum design. We educators must help our future colleagues recognize the states of partial and complete edentulism and their consequences. Then, clear standards of care, including simple implant therapies, must be available to serve all patients, especially low-income populations reliant on dental school clinical programs.
- The New York University College of Dentistry clinical implant program has allowed all students to graduate having provided a single implant restoration and implant-retained overdenture for partial and complete edentulism.
- In a survey of graduating students, students showed that they felt confident in treatment planning for patients with partial and complete edentulism using single implant restorations and implant-retained overdentures.

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On The Dry Mouth Predicament

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- Saliva plays a significant role in the preservation and maintenance of oral health and function. It aids digestion by preparing food for mastication and swallowing, contributes to taste perception,[1] and facilitates communication while providing protection of the oral tissues from desiccation, microbial penetration, or ulceration. By reducing clotting time and accelerating wound contraction,[2] saliva can stimulate soft tissue repair. Its lubricating ability provides comfort while wearing dentures.
- **Xerostomia** is the subjective sensation of dry mouth. It occurs when the salivary flow rate (SFR) is less than the rate of fluid loss from the mouth by evaporation (mouth-breathing, conversation, condensation of water from expired air in the form of a dripping nose) or by absorption of water through the oral mucosa. Dry mouth is a frequent complaint of elderly patients, primarily due to dehydration, autoimmune disorders (Sjögren syndrome, systemic lupus erythematosus, scleroderma, diabetes, graft-versus-host disease, rheumatoid arthritis, primary biliary cirrhosis, etc), therapeutic medication (especially parasympathetic drugs), head and neck immuno- or radiotherapy, or even to age-related decline in salivary gland function.[1,3,4]
- **Hyposalivation** is the objective measure of a low SFR of less than 0.1 mL/min (normal unstimulated SFR, approximately 0.3 mL/min). Hyposalivation may leave patients susceptible to dry or cracked lips, angular cheilitis, dry tongue, oral candidiasis, difficulty swallowing, and difficulty wearing removable dental prostheses. Dry mouth has been reported to be associated with dissatisfaction with chewing and speaking as well as soreness in denture-bearing areas in denture wearers.[1]
- **Sjögren syndrome** (SS), the most common disorder associated with xerostomia, is a chronic inflammatory autoimmune condition with a peak incidence between 40 and 50 years of age. Approximately 3% of the American population is estimated to suffer from SS, 90% of whom are women. A diagnosis of SS is based on subjective symptoms of dry mouth and dry eyes, objective oral and ocular signs of dryness, definite lymphocytic infiltration within minor salivary glands of the lip, and the presence of auto antibodies to Ro/SSA and La/SSB. While the manifestations vary according to the individual, oral and ocular symptoms are numerous and debilitating,[5] with an adverse effect on quality of life. Upon oral examination, a tongue depressor may stick to the buccal mucosa. SS is not a curable or preventable disease at present, and whether it can be prevented or delayed is unknown. Treatment is generally symptomatic and supportive. Since it takes anywhere from 5 to 9 years for SS to be diagnosed definitively, we in the dental community must be alert to patients with reduced salivary flow and suggest appropriate medical consultations.
- Although there are only a limited number of short-term case studies in the literature involving the outcome of implant-supported prostheses in patients with dry mouth, the use of osseointegrated prostheses should be considered in such instances even though some of the other difficulties that ensue from hyposalivation, such as difficulty chewing, swallowing, and speaking, are still very possible. However, it may be such that the xerostomic patient may be noticing the discomfort associated with a lack of unstimulated saliva that coats the oral tissues and providing lubrication and relief from desiccation rather than a decreased stimulated SFR and that the decline in salivary gland function may be associated with reduced masticatory function.[6]
- In fact, **hypersalivation**, commonly associated with Parkinson disease, Down syndrome, autism, cerebral palsy, and amyotrophic lateral sclerosis, is a common phenomenon associated with the insertion of dentures, regardless of whether the dentures are for the partially or completely edentulous patient or whether it is an initial insertion or insertion of a replacement set of removable dentures.[6] It is speculated that the dentures act as foreign bodies in the mouth and consequently as sialogogues thereby stimulating salivary flow.
- Thus, by providing an optimal occlusal force through prosthetic treatment with more functional dental prostheses, a synergistic effect of stimulation for salivary glands on bolus formation in addition to lubrication and protection of the oral mucosa may be generated. In such a manner, proper prosthetic rehabilitation may contribute to the treatment of hyposalivation.

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Root Canal Treatment Prognosis: How Much Remaining Tooth Structure is Needed?

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- Before root canal treatment is initiated, a comprehensive endodontic evaluation (history, examination, tests, and radiographs) must provide a pulpal diagnosis, a periapical diagnosis, and a prognosis so that a treatment plan can be made and informed consent obtained. The endodontic prognosis is dependent on the extent of the microbial insult to the pulp and periapical tissue, as reflected by the periapical diagnosis and the magnitude of periapical pathosis.
- Systematic reviews of longitudinal outcome data indicate that root canal–treated teeth, as generally performed by generalists, have excellent long-term survival rates equivalent to those for single-tooth implant crowns, as generally performed by specialists, and markedly superior survival rates to those for fixed dental prostheses.
- In the event that the tissues surrounding an endodontically treated tooth do not heal, retreatment—not apical surgery—is generally advised. Over time, retreated cases continue to heal, whereas surgically treated cases tend to relapse.
- The data describing the excellent long-term survival of endodontically treated teeth pool all types of restorations, whether appropriate or not. However, it is known that posts do not increase success or survival and should be avoided if at all possible, that coronal coverage improves outcomes for posterior teeth and worsens outcomes for anterior teeth, that prompt restoration decreases the risk of coronal leakage, and that caries risks matter.
- If the circumference of the remaining endodontically treated tooth is more than 75% intact, more than 1-mm high, and more than 1-mm thick, the 10-year survival rates for a variety of crown restorations are above 90%. If these conditions are not met, then restoration survival rates drop by approximately 10%. Much additional in vitro evidence suggests that a ferule of more than 2 mm will substantially increase load and fatigue resistance.
- Root canal treatment has several advantages in that it removes pain, retains the natural state (preferred unless the replacement is less expensive or better), and is associated with a lower incidence of complications and with less need for additional interventions than replacement.
- Unfortunately, the real-world quality of root canal treatment along with other restorative and implant interventions likely differs from that provided within longitudinal studies in institutional environments. Practitioners, educators, and payers must strive to ensure that best and evidence-based practices are followed in community settings.

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Is Overdenture Treatment Still a Viable Educational Therapeutic Procedure?

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- An overdenture (OD) is a partial or complete removable denture that covers or is partially supported/retained by natural teeth or implants. The literature lacks manuscripts specifically regarding the subject of ODs on teeth in undergraduate education programs. Such a topic should be included in the removable prosthodontics curriculum. ODs are usually covered in removable denture textbooks. A trend can be easily outlined: The amount of time dedicated to prosthodontics in dental undergraduate programs has dramatically decreased over the past 40 years.[1,2] Such a phenomenon is even more evident if one considers the topic of complete dentures alone. As implants were introduced into dental undergraduate programs, ODs on implants have become part of this curriculum.[3]
- From a marketing point of view, the need and effective demand for removable dentures has been an objective of interest since the 1950s. Many studies have tackled the argument and have reached the same conclusion: Removable dentures will still be necessary for a long time.[4]

- ODs on teeth still prove to be the first-choice rehabilitation of partial edentulism for elderly patients who present a worn dentition and who cannot afford expensive rehabilitative prosthetic treatments.[5]
- ODs on teeth can also be used as a transitional rehabilitation from partial to complete edentulism, thus easing the process of adaptation in elderly patients.[6]
- ODs on teeth are not a much-researched topic nowadays; only a few publications can be found in the last few years. It is desirable that research will increase, above all, in the epidemiologic field.
- ODs on implants in the mandible are considered as the standard of care for the completely edentulous patient.

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Biologic Width and Implants

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- The concept of the biologic width was introduced to provide guidance for subgingival placement of restorative margins.[1] The dentinogingival complex was described, and the mean dimension of 2.04 mm for the combined junctional epithelium (JE) and connective tissue (CT) attachment[2] was termed the *biologic width*. These tissues provided protection against bacterial penetration into the underlying bony crest. It was considered that encroachment of more than 0.5 mm into this complex resulted in a "violation" of the biologic width, with inevitable resultant inflammation of the tissues.
- The same tissue types were described around implants, and the dimensions, at least for one-piece nonsubmerged implants, were claimed to be the same as those around teeth.[3]
- A critical review of the original paper by Gargiulo et al[2] revealed the wide variation in the measurements of the biologic width. It was subsequently claimed that this wide variation of measurements also occurred around implants, but the overall combined mean measurements of the JE and CT attachments were consistent and similar to that around teeth and dimensionally stable over time.[4]
- A critical commentary[5]:
  - Acknowledged that there is inevitably a layer of CT between the JE and bone around both teeth and implants.
  - Challenged the presumption that the dimensions of the JE and CT barrier between sulci and bone around both teeth and implants are specific, scientifically robust, and dimensionally stable over time.
  - Challenged the concept of the inviolability of the biologic width.
  - Argued that it is the inadequacies of the tooth-implant/restoration transition zone (roughness, misfit, excess cement) that results in tissue inflammation rather than a violation of the biologic width.
  - Argued that the biologic width could be "physiologically disturbed" and restoration margins could be placed > 1 mm into the sulcus without creating tissue inflammation.
  - Endorsed the prudence of supragingival or minimally penetrating (< 0.5 mm) restorative margins to minimize iatrogenic consequences, without attributing this to a "pseudoscientific" rationale of not violating specific dimensions of the biologic width.
  - Cautioned that mathematically derived "averages" tend first to become absolutes and, eventually, dogmas.
  - Advocated that in any individual, JE and CT attachments "measurements" will change with time and in response to variations in the local and systemic environment.
  - Suggested a name change to "biologic barrier" because of the misconceptions associated with the term "biologic width."
- It has been acknowledged that the margins of implant-supported prostheses can be placed up to several millimeters into the peri-implant mucosa without initiating an inevitable inflammatory response. This was considered possible, contrary to what was proclaimed to occur around teeth, because of the geometric configuration of the implant-abutment connection.
- A critical review of several papers associated with measurements of bone levels around different implant-abutment connections revealed inadequacies in study design, selective reporting, publication bias, and the "decline effect."[6]

- New products and techniques such as internal connections and platform switching have been introduced to modify the inflammatory response at the implant-abutment junction without any true scientific validation.
- Research into the relationship between implant-related study outcomes and funding sources is required.[7]

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Immediate or Delayed Implant Treatment for Patients with Advanced Periodontal Disease

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How do we decide to extract periodontally involved teeth? If after initial periodontal therapy and follow-up the patient remains categorized as "high risk" (more than two parameters outside the second bold ring according the functional diagram or "spider web") (Nyman et al, 1977; Lang and Tonetti, 2003), extraction of the teeth involved becomes mandatory. Indeed, when there is no patient cooperation (or cooperation is not to be expected), full-mouth tooth extractions have been proven to be the most effective therapy to treat advanced periodontitis (Taylor et al, 2006). However, the choice of oral therapy may depend not only on the outcome measures of probing pocket depths and clinical attachment levels but also on other variables such as patient discomfort and apprehension, root sensitivity, and esthetic and phonetic considerations among other individual patient factors.

What is the implant outcome in patients treated for periodontitis versus the nonperiodontitis patient? It is said that implant sites with a history of periodontal disease may yield decreased survival rates. Many studies showed significantly more biologic complications (Karoussis et al, 2003), greater peri-implant marginal bone loss (Mengel et al, 2007; De Boever et al, 2009), and increased implant failure rates (Hardt et al, 2002) in periodontitis-susceptible subjects than nonsusceptible subjects. Furthermore, a recent review indicated that subjects with a history of periodontitis might be at greater risk for peri-implant infections (Renvert and Persson, 2009). However, according to a systematic review by Ong et al (2008), the implant survival rates are high (90% to 95% at 10 years). Therefore, implant treatment in periodontitis-susceptible patients is not contraindicated, provided that adequate infection control and an individualized maintenance program is established. However, the high incidence of peri-implantitis may jeopardize the longevity of the implant treatment (percent of sites with bone loss ≥ 3 mm was 4.7% for healthy, 11.2% for moderate periodontally compromised, and 15.1% for severe periodontally compromised patients [severe vs healthy, $P < .05$]). According to Consensus Statement 1 of the EOA workshop 2012, one of five patients will suffer from peri-implantitis 5 to 10 years after implant treatment (Mombelli et al, 2012).

How does the timing of implant placement to extraction affect the outcome? Recent systematic reviews reported on the topic regarding estimate survival and success rates of implants and implant-supported prostheses; the prevalence of biologic, technical, and esthetic complications; and the magnitude of soft and hard tissue changes following implant placement immediately into fresh extraction sockets (Esposito et al, 2010; Lang et al, 2012). According to Esposito et al (2010), there was insufficient evidence to determine the possible advantages or disadvantages of immediate, immediate-delayed, or delayed placement of implants. These preliminary conclusions were based on few underpowered trials often judged to be at high risk of bias. There is a suggestion that immediate (within 24 hours after tooth extraction) and immediate-delayed implants may be at a greater risk of implant failure and complication than delayed implants. On the other hand, the esthetic outcome might be better when placing implants just after tooth extraction. There is not enough reliable evidence supporting or refuting the need for augmentation procedures at immediate implants placed in fresh extraction sockets or whether any one of the augmentation techniques is superior to the others.

The most recent systematic review by Lang et al (2011) was based on a total of 46 prospective studies with a mean follow-up of 2.08 years. The survival rate was 98.4% (range: 97.3% to 99%). Among the five factors analyzed (reasons for extraction, antibiotic use, position of implant [anterior vs posterior, maxilla vs mandible], and type of loading), only the regimen of antibiotic use significantly affected the survival rate. Lower failure rates were found in groups that were provided with a course of postoperative antibiotics. A single dose of antibiotics prior to surgery did not sustain the suppression of bacterial levels below the critical threshold throughout the healing period, but provision of antibiotics for 5 to 7 days after surgery may have helped to prevent postoperative infection, and hence, contribute to higher implant survival rates. One should add that these findings have to be interpreted with caution since the number of implants included in the single-dose preoperative antibiotics group was substantially fewer. Primary stability is of paramount importance for implant survival. No significant difference could be noted between the maxilla or mandible nor between anteriorly versus posteriorly placed implants. Indeed, as long as immediate implants were placed with a minimal insertion torque and 3 to 4 mm apical bony engagement, primary stability was ensured.

The success of implant therapy was difficult to assess due to scarce reporting on biologic, technical, and esthetic complications. Soft tissue changes occurred mostly in the first 3 months after restoration and stabilized toward the end of the first year. Marginal bone loss predominantly took place in the first year after implant placement with a magnitude generally less than 1 mm. Controversy on hard tissue preservation with the platform-switching technique remains unsolved.

Overall, despite the high survival rates observed, more long-term studies are necessary to determine the success of implant treatment provided immediately after tooth extraction. Special attention has to be given to esthetic outcomes of immediately placed implants and their restorations.

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Tilted Implants: Clinical and Biomechanical Considerations

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- Prosthetic rehabilitation of atrophic arches with implant-supported prostheses frequently represents a challenge because of the lack of an adequate quantity and quality of bone, especially in posterior areas. The use of distal tilted implants (parallel to the anterior maxillary sinus wall or anterior to the mental foramen, positioning the implant platform in a more distal position) has been proposed as a viable alternative to traditional protocols.
- The rationale of using tilted implants is to overcome anatomical limitations, such as the mandibular canal or the maxillary sinus, while improving implant length to obtain primary stability.
- Tests on models and by finite element analysis performed on single tilted implants showed that tilting implants increases the stress to the surrounding bone.[1]
- On the contrary, when the implants are rigidly splinted in partial or full-arch rehabilitations, the use of tilted distal implants, with consequent reduction of the posterior cantilevers, results in decreased stress values both in peri-implant bone and in the prosthesis framework.[1]
- Some biomechanical and clinical advantages of using tilted implants can be identified:
  - Reduction or avoidance of distal cantilevers
  - Avoidance of bone grafting procedures (reduced morbidity, reduced treatment time and cost, possible immediate loading)
  - Obtainment of a wide anteroposterior spread with a favorable distribution of the occlusal load
  - Increase of primary stability (due to long implants in denser residual bone and potential bicorticalism)
  - Reduced number of implants and wider interimplant distance (biologic and economic advantages for the patients, surgical and prosthetic simplification for the clinician, easier oral hygiene procedures)
- Recently, the use of tilted implants has been proposed in full-arch immediate loading rehabilitations of the maxilla.[2,3] A systematic review and meta-analysis of

the literature showed favorable short-term results, but randomized trials and long-term data are still lacking.

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Adverse Treatment Outcomes in Implant Prosthodontics

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Implant therapy is a very successful treatment modality, but a variety of treatment risks exist. No agreement exists as to the best way to classify complications. Implant failure can be regarded as the fundamental biologic complication. Many complications are thought to be preventable, and this drives the efforts aimed at complication prevention.

Complications may impact the process or the outcome of care and may affect the patient, the treatment provider, or both. Some complications are "silent" and have no direct impact on the patient. In these cases, the increased effort on the part of the treatment provider as well as the patient's large capacity for physiologic and psychologic adaptation make the outcome of the complication imperceptible to the patient.

The field of negative treatment outcomes is best understood by focusing not only on the complications themselves, but also on the errors in judgment or execution that lead to the complications, as well as the consequences of complications or the corrective actions needed to address or rectify them. Looking at all three—errors, complications, and corrective actions—paints a more insightful portrait.

Most of what is known about the occurrence of complications comes from studies based in academic or large specialist centers. The literature is unclear as to which types of prostheses are more prone to complications, but it appears that metal–acrylic resin full-arch prostheses are particularly prone to certain types of complications (eg, acrylic fractures and acrylic wear).

The study of complications is hampered by the issues of threshold, expectations, adaptation, and maintenance.

- A natural variability exists across a number of treatment outcome parameters. It is a matter of debate at which threshold the presence of a complication can be ascertained. Using implant malposition as an example, what extent of positional departure from ideal should be regarded as a complication?
- A patient's starting clinical presentation may limit the range of achievable treatment outcomes, while a patient's expectations may dictate subjective interpretation of the treatment outcome. Both the initial clinical presentation and the patient's expectations may readily impact on whether or not a treatment outcome is regarded as being acceptable or a complication.
- Time-dependent patient adaptation (in terms of speech, feel, etc) takes place after all interventions. It is unclear what length of adaptation should be regarded as excessive and become viewed as a complication.
- Many prosthodontic procedures are known to be accompanied by time-dependent tissue changes as well as wear and tear of materials. Hence, secondary treatments will likely be needed in the future after prosthesis delivery. It is unclear if these secondary treatments should be considered complications. Using implant-supported overdentures as an example, what frequency of need for denture relines or need for replacement or modification to the retentive element should be regarded as a complication?

Experience of complications is an evolving field. Time-dependent changes in knowledge, experience, clinical practices, and technology lead to changes in the types of complications that occur and their relative frequencies. Geographic differences in these same four factors may also lead to differences in location-specific experience of complications. Similarly, practice-specific or provider-specific patterns of complication occurrence may exist. Hence, educational strategies aimed at prevention of complications may need to be location- or provider-specific and may need to be modified over time.

Common issues in reporting of complications in clinical trials are lack of standardized reporting, lack of agreement on what complications should be routinely reported, nonreporting of "zero" events (ie, non-occurrences), and under-reporting of complications. These highlight the tremendous room for improvement that exists in the reporting of complications in the implant literature.

Maxillofacial Prosthodontics: Education and Research Today

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- Maxillofacial prosthodontics education today varies greatly from one country to another with no clear consensus between schools, and a better listing of programs would be needed to facilitate communication between programs.
- Head and neck cancer etiology has shifted from being a disease afflicting geriatric tobacco and alcohol users and/or new immigrants from low socioeconomic backgrounds to now having a predilection for industrialized countries due to the spread of HPV and impacting nonsmoking, nondrinking, middle-aged (< 55 years) white males of higher socioeconomic statuses. This change has prompted a race for more research for prevention and better treatment modalities in recent years.
- Radiation therapy equipment is constantly more accurate to prevent damage to surrounding healthy tissues. Prosthodontists should be involved in the treatment of head and neck cancer patients to allow repeatable jaw positions between radiation treatments.
- Implants can help maxillofacial reconstructions by decreasing the load on vulnerable mucosa and improving retention, stability, function, comfort, esthetics, and quality of life. However their success rate decreases considerably with chemotherapy and radiation therapy protocols, and further research is needed on this topic.
- Quick progress in medical oncologic equipment, radiation therapy, hyperbaric oxygen treatments, chemotherapy, and surgery make long-term studies of prosthodontic rehabilitations difficult to apply due to constantly evolving oncologic therapeutic protocols. This leads to centers having very different philosophies of treatments depending more on their individual team preferences, and wide data variations create very difficult multicenter studies or comparisons.
- Facial prosthetic research is mainly oriented in creating a material that provides years of color stability and physical properties that are as close as possible to natural human skin.
- In conclusion, although the number of programs teaching maxillofacial prosthodontics seems to have decreased over the last decade, the need for complex maxillofacial prosthetic rehabilitations and research is evolving but still remains.

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Statistical Certainty: Understanding Kaplan–Meier Survival Statistics

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- Experimental and observational trials in prosthodontics often explore the outcome of a prosthesis or intervention over time. Analyses of these studies employ time-to-event statistical techniques, such as Kaplan-Meier,[1,2] to calculate the estimated cumulative survival. In such analyses, common endpoints (events) are "survival" and "failure."
- Longitudinal studies provide two parallel types of data: the prosthesis outcome and the time at which that outcome occurred. As studies progress with time, censorship (such as loss to follow-up) can occur. In other words, not all patients will remain in the study until its conclusion, and not all patients are necessarily enrolled at its inception. Therefore, at each time period of the study (such as year 1, year 2, year 3), patients and their prostheses are assessed as surviving, failed, or censored. This assessment can change as the study proceeds, with surviving prostheses becoming failed or censored.
- Consequently, not all data points are present for the entire study period. The Kaplan-Meier method allows researchers to calculate an "estimated" cumulative survival rather than an "actual" percentage.
- The estimated cumulative survival and its standard error are calculated from two variables: the number of events (such as failures) and the number of prostheses remaining at risk in the study. It is important to note that the number of events is in the numerator of the equation.
- As a study progresses, if the number of failures increases, the estimated cumulative survival decreases.

Also, if patients become lost to follow-up and censored, the number of prostheses remaining at risk decreases and the estimated cumulative survival also decreases. If no failures occur, the survival for that period is 100%. Also, if no failures occur but patients become lost to follow-up, the survival for that period remains at 100%. This is because the number of failures is in the numerator of the equation and no amount of loss to follow-up can affect a change in the estimated survival.

- The mathematics for the standard error works in a similar manner. If the number of failures increases, the standard error (and confidence range) enlarges. Also, if patients become lost to follow-up, the standard error will increase. However, if no failures occur but patients become lost to follow-up, the standard error does not change. It cannot change because the numerator remains at zero. This is of particular concern.
- Clearly, a decrease in the number of prostheses at risk increases the uncertainty within the sample. The mathematics does not necessarily reflect this increased uncertainty by increasing the standard error.
- Uncertainty of clinical outcomes is central to clinical decisions. Research outcomes are used to estimate outcomes that may occur when treating other similar populations. The standard error allows a 95% confidence interval to be calculated, providing clinicians with the range within which 95% of survival outcomes would be expected if a similar study, or similar treatment, were to be undertaken. If the 95% confidence interval does not accurately reflect the uncertainty in the study sample, it cannot reflect the uncertainty within the population and the calculated results remain theoretically accurate but become clinically useless.
- The problem can be compounded when estimated cumulative survivals, containing hidden data uncertainty, are included in meta-analyses. Meta-analytic methodology cannot account for such bias.[3] The resulting summary figure would again remain theoretically accurate but provide clinically useless data and possibly promote harmful management.
- Estimated cumulative survival data can be reported as a single figure for a particular time period, within a life-table for interval time periods, or on a survival curve for all time periods. Reporting the data with all three types of presentation is uncommon. However, inclusion is vital to the interpretation by readers and future secondary researchers, especially when data are censored. Efforts should be made to allow journal page space for complete presentation of data or online electronic access as additional files.
- The estimated cumulative survival is often reported as a single percentage figure without its associated statistical variance (such as its standard error or 95% confidence interval).[2] These data are vital to the interpretation and must not be omitted.
- The dental profession has embraced evidence-based methodology, but with this has come an increased reliance on the statistical genre. It is understandably impossible for practicing clinicians to be familiar with the nuances of individual formulas, and in this specific situation, to detect clinical uncertainty when the reported survival mathematics appears to be so precise. It is also challenging for authors—experts in their scientific field—to become experts in statistical reporting and ensure their manuscript provides sufficient reporting detail.[4]
- It is acknowledged that our current techniques for analysis of time-to-event data are imperfect. It therefore behooves authors to strive to improve reporting transparency, journals to support such industry, and readers to remain mindful that the cumulative survival is an estimate—a reflection of reality.

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