

# State of the Science on Implant Dentistry: A Workshop Developed Using an Evidence-Based Approach

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**Purpose:** This overview was prepared to describe how an evidence-based approach was used to develop an Academy of Osseointegration (AO) Workshop on the State of the Science on Implant Dentistry (SSID). **Materials and Methods:** An AO SSID Workshop Planning Committee was appointed in 2001 to follow an evidence-based approach for reviewing published clinical data using strict inclusion and exclusion criteria in order to answer 8 closed-end 4-part clinical questions. A systematic approach was employed to assure coherent data management and analysis. Reviewers, co-reviewers, and a biostatistician were appointed. The workshop agenda was developed to include participants who had the primary responsibility for each of the 8 workshop sections to answer 5 consensus questions for the section's systematic review. The planned outcomes of the SSID Workshop included publication of the 8 consensus reports with their respective systematic reviews in *The International Journal of Oral & Maxillofacial Implants* (supplemental issue), 2007; the development of clinical guidelines responding to each of the 8 focused questions; and the identification and prioritization of questions or topics requiring further research. **Results:** The evidence-based approach was utilized successfully in planning and carrying out the AO SSID Workshop held on August 3–6, 2006, in Oak Brook, Illinois, and the subsequent publication of its proceedings. **Discussion:** Although successful in its objectives, the outcome of systematic reviews is only as good as the published data. Significant deficiencies in published implant studies were identified, including, but not limited to, a lack of randomized controlled prospective clinical trials, universal acceptance and publication of defined implant survival and success criteria, and clear questions with well-defined research design. **Conclusion:** The evidence-based approach can be used to systematically review the literature for a workshop on important questions related to implant dentistry. A major limitation is the lack of common outcome variables between published studies. *INT J ORAL MAXILLOFAC IMPLANTS* 2007;22(SUPPL):7–10.

The Academy of Osseointegration (AO) is a multidisciplinary, international dental implant organization that exists to bring together individuals of different backgrounds in order to share experience and knowledge regarding dental implants. Academy members share the common goal of moving the field of osseointegrated implants forward through clinical and evidence-based research and education. The AO mission is to advance oral health and well-being by disseminating state-of-the-art clinical and

scientific knowledge of implant dentistry and tissue engineering. The mission is achieved, in part, through annual meetings, the publication of *The International Journal of Oral & Maxillofacial Implants*, and periodic workshops/consensus conferences.

The first AO consensus conference was held at Babson College, Wellesley, Massachusetts, on November 16 and 17, 1996. It was developed to address questions on the safety and efficacy of the sinus bone-grafting procedure. At that time, a literature review presented at the conference revealed only a few case series with adequate numbers of patients and follow-up. Given the paucity of published data, consensus methodology using the experience of the participants to expand the data base was employed to study the benefits and risks of the sinus graft and its attending technical variables. In spite of the lack of published controlled prospective multicenter clinical trials, the data analyzed indicated that the sinus graft procedure is very successful but the consensus was that clearly defined research was needed on the various aspects of the procedure.<sup>1</sup>

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**Table 1 AO SSID Planning Committee**

<b>Co-chairs</b>	<b>Vincent J. Iacono</b> <b>David L. Cochran</b>
<b>Members</b>	<b>James H. Doundoulakis</b> <b>Steven E. Eckert</b> <b>Marjorie K. Jeffcoat</b> <b>Ole T. Jensen</b> <b>Peter K. Moy</b> <b>Melvyn S. Schwarz</b>
<b>Consultant</b>	<b>James Bader</b>
<b>Biostatistician</b>	<b>Howard M. Proskin</b>
<b>Staff Liaison</b>	<b>Kevin P. Smith</b>

Since the watershed 1996 AO Sinus Graft Conference, an evidence-based (EB) approach has become the preferred method to guide the development of systematic reviews and consensus workshops. At the turn of the century, the American Academy of Periodontology (AAP) was in the process of using the EB approach to plan and implement a consensus conference on periodontal therapy, titled Workshop on Contemporary Science in Clinical Periodontics, that was held in 2003.<sup>2</sup> This highly structured workshop included an analysis of EB systematic reviews on 15 topics associated with contemporary clinical periodontal practice that served as the basis for development of consensus reports that included implications for practice and research. Both coauthors of this report (Vincent J. Iacono and David L. Cochran) were actively involved in the planning of the AAP workshop and discussed its implications at length with the officers of the AO. During the 2001 AO Annual Meeting in Toronto, Canada, Dr Melvyn S. Schwarz, the standing AO president, became intrigued with the possibility of organizing a similar type of conference that would address major questions on implant dentistry. He subsequently directed the AO Board of Directors to sponsor an evidence-based consensus workshop on the state of the science on implant dentistry in 2006 that would be part of the 20th anniversary celebration of the Academy's founding. A planning committee was then appointed that included both a consultant and biostatistician (Table 1).

The planning process emulated the high standards of scientific rigor and ideals followed for the 2003 AAP workshop and was enhanced by the timely impact of important practical organizational information from the AAP Executive Director, Alice DeForest, and the 2003 AAP Director of Scientific, Clinical and Educational Affairs, Carol Dingeldey. During several Planning Committee meetings, EB implant dentistry was defined to include a 5-step method for problem solving: (1) ask answerable questions, (2)

search for the best evidence, (3) critically appraise the evidence, (4) apply the evidence to patient care, and (5) evaluate the outcome.

The focus of much of the early planning activity was on the topics to be evaluated and the formulation of answerable questions. The committee formatted highly structured closed-end, 4-part clinical questions on 8 topics. The format used is called the PICO format, an acronym that includes 4 key elements that are essential components of the question (adapted from Newman and associates<sup>2</sup>):

1. **P**—Population or patient (or problem)
2. **I**—Intervention (or cause, prognosis)
3. **C**—Comparison (or control)
4. **O**—Outcome(s)

Eight PICO questions were finalized and a reviewer and co-reviewer were identified to conduct the literature search related to the questions and write the systematic reviews as follows:

1. What is the effect on outcomes of time-to-loading of a fixed or removable prosthesis on implant(s)?  
Reviewer: Asbjørn Jokstad  
Co-reviewer: Alan B. Carr
2. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement?  
Reviewer: Tara L. Aghaloo  
Co-reviewer: Peter K. Moy
3. In patients requiring single-tooth replacement, what are the outcomes of implant- as compared to tooth-supported restorations?  
Reviewer: Thomas J. Salinas  
Co-reviewer: Steven E. Eckert
4. For teeth requiring endodontic treatment, what are the differences in outcomes of restored endodontically treated teeth compared to implant-supported restorations?  
Reviewer: Mian K. Iqbal  
Co-reviewer: Syngcuk Kim
5. Does the type of implant prosthesis affect outcomes for the completely edentulous arch?  
Reviewer: S. Ross Bryant  
Co-reviewers: David MacDonald-Jankowski  
Kwonsik Kim
6. Does the type of implant prosthesis affect outcomes in the partially edentulous arch?  
Reviewer: Hans-Peter Weber  
Co-reviewer: Cortino Sukotjo
7. How do smoking, diabetes, and periodontitis affect outcomes of implant treatment?  
Reviewer: Perry R. Klokkevold  
Co-reviewer: Thomas J. Han

**Table 2 Critically Appraising the Evidence**

Level of evidence <sup>3</sup>	Study type
Fair	Retrospective study
Average	Prospective case study
Good	Prospective study with historical controls
Better	Prospective study with concurrent controls
Best	Double-blind randomized controlled trial
Unknown	None of the above

8. How does the timing of implant placement after extraction affect outcomes?

Reviewer: Marc Quirynen  
 Co-reviewers: Nele Van Assche  
 Danielle Botticelli  
 Tord Berglundh

The reviewers were instructed to conduct systematic reviews on the knowledge base related to each PICO question using a data bank of more than 1,700 manuscripts published in peer-reviewed journals with a cutoff date of May 2005. The reviewers were trained to be rigorous, minimize bias, and identify all relevant research on the PICO questions. They used a pre-stated systematic approach with a well-defined research methodology.<sup>3</sup> Critical to the process were the determination of inclusion and exclusion criteria, identifying relevant studies with the search strategy, and abstracting and critically appraising the information. The latter component necessitated the development of a quality score that could be assigned to each publication based on study design.<sup>3</sup> In this manner, the significance of different studies would be weighted to achieve balance and avoid bias. A qualitative description of the level of evidence for each study was then applied to the reviews,<sup>3</sup> and is depicted in Table 2.

The data abstracted needed to be consistent for each of the 8 PICO questions and recorded on standardized forms in order for a meta-analysis to be performed. Abstraction forms and the identification of major outcomes to be analyzed were developed with the critical input of Marjorie Jeffcoat, Planning Committee member, and Howard Proskin, the workshop's biostatistician. A major issue for all 8 systematic reviews was the variability or non-disclosure of criteria for implant survival and implant success in the reviewed publications. To compensate for this deficiency in the published literature, broad criteria were used to define implant survival and implant success in order to be as inclusive as possible. These criteria are listed in Table 3.

**Table 3 Criteria for Implant Status**

Implant survival
Implant is in the mouth and functioning
No mobility (if it can be measured)
No pain
No infection
Implant success
Implant is in the mouth and functioning
No mobility (if it can be measured)
No pain
No infection
Less than 50% bone loss

Data extraction, management, preparation, and analysis were performed according to approved formats developed by Marjorie Jeffcoat and Howard Proskin.<sup>3</sup> The reviewers and co-reviewers were instructed to include in each of their systematic reviews:

1. Tables/figures of evidence to summarize study characteristics and data (eg, study size and quality)
2. Statistical methods (eg, random effects or fixed-effect meta-analytic models)
3. Forest plots and/or 3D graphs
4. Specific conclusions and areas needing further research

As indicated by Proskin and coworkers,<sup>3</sup> to the extent possible, a common format was used to display the results of the analysis performed for each of the 8 PICO questions, including 3D graphs and forest plots.

The 8 systematic reviews were then reviewed by the Planning Committee and distributed to the workshop participants for assessment. Workshop participants were assigned to each of 8 sections. The primary responsibility of the participants for each of the 8 workshop questions was to read the review and referenced papers and to answer 5 consensus questions for the section's systematic review:

1. Does the section agree that the systematic review is complete and accurate?
2. Has any new information been generated or discovered since the review search cutoff date (May 2005)?
3. Does the section agree with the interpretation and conclusion of the reviewers?
4. What further research needs to be done relative to the systematic review focus questions (PICO)?
5. How can the information from the systematic review be applied for patient management?

**Table 4 Additional Publication Guidelines****For papers published prior to May 2005:**

1. Section must verify that the paper meets the inclusion criteria.
2. Data from the paper must be inserted into the data extraction table template.
3. Section should list the publication(s) identified in the answer to Consensus Question 1.
4. Section should also include a comment on how the publication(s) may impact the conclusions of the section's systematic review in the answer to Consensus Question 3.

**For papers published after May 2005:**

1. Section must verify that the paper meets the inclusion criteria.
2. Data from the paper must be inserted into the data extraction table template.
3. Section should list the publication(s) identified in the answer to Consensus Question 2.
4. Section should also include a comment on how the publication(s) may impact the conclusions of the section's systematic review under answer to Consensus Question 3.

During the workshop, concern was raised by the participants regarding methods to include data from before or after the cutoff date that might affect the interpretation and conclusions of the analyzed data. After much discussion and agreement by all in attendance, additional publication guidelines were developed and implemented (Table 4).

At the workshop, each of the 8 sections presented the answers to the 5 consensus questions in completed consensus reports at plenary sessions, following which the reports were edited as deemed appropriate by the respective section participants. At the final plenary session, the 8 revised and completed reports were presented and votes of affirmation of consensus were obtained. After editing, the 8 consensus reports with their respective systematic reviews were scheduled to be published in a 2007 supplement of *The International Journal of Oral and Maxillofacial Implants* (this issue).

The practical outcome of the 2006 AO SSID Workshop is the dissemination of the information to the communities of interest and the development of clinical guidelines responding to each of the 8 PICO questions. Equally as important, through the intense

discussion by the workshop's participants, the thought leaders in implant dentistry, questions and topics requiring further research were identified and prioritized. Indeed, as eloquently stated by Peter Moy and Tara Aghaloo: "Systematic reviews can provide an extensive amount of data, but sometimes the existing literature does not provide the quality of data to answer specific questions. If controlled trials or only studies of high quality are evaluated, then a small amount of data may be available for analysis. In other cases, a large amount of data derived from many uncontrolled case studies may be difficult to interpret, and the methodology may be so diverse that comparing studies may not yield meaningful results."<sup>4</sup>

It became quite clear to all in attendance at the workshop that there is a need for clearly defined research questions answered through properly designed research protocols. Given the paucity of randomized controlled clinical trials (RCTs) in implant research, it was strongly suggested that RCT teams on important questions be identified and more universally accepted and reported implant success and survival criteria be implemented. In addition, it was stressed that future systematic reviews needed to be performed on original research of sufficient power for significance to be determined on clinical protocols that would impact the practice of implant dentistry and enhance the oral health and well-being of our patients.

## REFERENCES

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