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REVIEW ARTICLE

EVIDENCE BASED DENTISTRY IN PROSTHODONTICS

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ABSTRACT

Statement of problem: With rapid advancements in dental materials and dental technology and improved understanding of clinical outcomes, a surfeit of research has been published in prosthodontics and dental implant–focused literature. It is well known that not all published literature is scientifically valid and clinically useful. Therefore, a critical analysis of the quality of published research and consolidation of the excess scientific information is necessary to render them significant and useful.

- Prosthodontics is a unique speciality that offers numerous merits and demerits for application of principles of evidence based dentistry (EBD).
- Evidence based prosthodontics can change the future course of prosthodontics education, clinical research oral health policies that have an impact on prosthodontics and the provision of care to patients.
- In the evidence based approach to clinical decision making, dentists incorporate the best scientific evidence—evidence that is critically appraised in systematic reviews—with clinical experience and their patients' preferences for treatment outcomes. The dental profession should define clinically relevant questions, commission systematic reviews to answer those questions and, when evidence is not available, advocate for good-quality clinical research to be conducted to provide the answers.
- (EBD) takes a systematic approach to summarize the large volume of literature that health care providers need to assimilate into their practices.

Key words: Evidence based dentistry, Prosthodontics, Levels of evidence.

INTRODUCTION

Evidence-based dentistry is the integration and interpretation of the available current research evidence, combined with personal experience. The term 'evidence-based medicine', from which evidence-based dentistry has followed, is relatively new (it first became current in the early 1990s) but the core principles that underlie the subject have been in place for many decades in the areas of epidemiology and public health (Hackshaw, 2007). According to the American Dental Association (ADA), EBD is defined as "an approach to oral healthcare that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, with the dentist's clinical expertise and the patient's treatment needs and preferences (ADA, 2012)." Therefore, the EBD process is not a rigid methodologic evaluation of scientific evidence that dictates what practitioners should or should not do but also relies on the role of individual professional judgment and patient preference in this process (http://www.ada.org/1754). Evidence dentistry has two main goals- Best evidence/ Research and the transfer of this in practical use. This involves four basic phases; Asking evidence based questions (framing an answerable question from a clinical problem); Search for the best evidence, Reviewing and critically appraising the evidence, Applying this information in a way to help the clinical practice.

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Epidemiological Background

The epidemiologic background for evidence-based practice dates back to the nineteenth century, to the work of John Snow, who is widely regarded as the father of modern epidemiology (http://www.ph.ucla).

Need to study evidence based prosthodontics

Graduates from dental schools are up to date with the best practice in dentistry current at the time they graduate. Some of this knowledge gradually becomes out of date as new information and technology appear. It is important, especially with regards to patient safety, for dentists to be able to keep up to date with developments in diagnosis, prevention and treatment of oral disease, and newly discovered causes of disease (Hackshaw, 2007). In an extensive analysis of scientific publications between 1966 and 2005, Harwood (Harwood, 2008), noted that there were 44,338 published articles in prosthodontics. Of these, there were 955 randomized controlled clinical trials (RCTs) (2%). Nishimura & colleagues (Nishimura et al., 2002) identified 10,258 articles on prosthodontic topics between 1990 and 1999 and estimated that to stay current in the year 2002 would require reading and absorbing approximately 8 articles per week, 52 weeks per year, and across 60 different journals. These numbers do not include published articles on implant dentistry. Russo and colleagues (Russo, 2007) identified 4655 articles published

between 1989 and 1999 dedicated to implant dentistry and estimated that to stay current in the year 2000 would require reading and absorbing approximately 1 to 2 articles per week, 52 weeks per year. It is not difficult to assume that these numbers are significantly higher in the year 2013 and will continue to grow due to increased growth in the number of journals and publications, underscoring the need for computer-based clinical knowledge systems and for clinicians to acquire new skills to use the best available scientific evidence (BASE) (Bidra, 2014) as shown in Fig. 1.

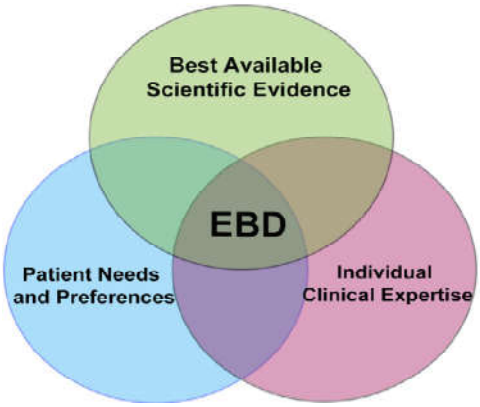

Figure 1. EBD involves integration of best available scientific evidence along with individual clinical expertise and patient treatment needs to provide dental care.

The need for evidence-based prosthodontics

- Enable the recognition of best available scientific evidence in prosthodontics.
- Consolidate the scientific information overload in prosthodontics and related literature.
- Scrutinize the scientific basis for existing prosthodontic treatments.
- Improve current and future treatments.
- Encourage improvement in the quality of clinical research as well as in reporting.
- Distinguish and advance the specialty of prosthodontics.

Box 1- Summarizes need for evidence based prosthodontics

New skills required by clinicians to adopt evidence-based prosthodontics

- Asking the appropriate research question for a clinical situation of interest.
- Acquiring information through efficient scientific literature search.
- Appraising the acquired information.
- Applying the acquired information to clinical practice, along with individual clinical expertise and patient preferences.
- Assessing the results of the applied intervention to optimize the clinical situation.

Levels of evidence and prosthodontics

Evidence in medicine has been popularly categorized into 5 hierarchical levels and widely represented as a pyramid with the "weakest/lowest level of evidence" at the base and the "strongest or highest level evidence" at the apex as shown in Fig 2. The applicability of this paradigm to prosthodontics is questionable because few articles in prosthodontics comprise RCTs and large cohort studies, implying that most current clinical practices in prosthodontics are all based on "weak evidence." Additionally, 2 critical elements of importance to prosthodontics that are omitted from the evidence-based pyramid are sample size and duration of a study (Bidra, 2014). Therefore, an alternative approach for prosthodontics literature is suggested. The suggested paradigm involves a horizontal spectrum encompassing 3 stages of evidence— preliminary evidence, substantive evidence, and progressive evidence as shown in Fig-3.

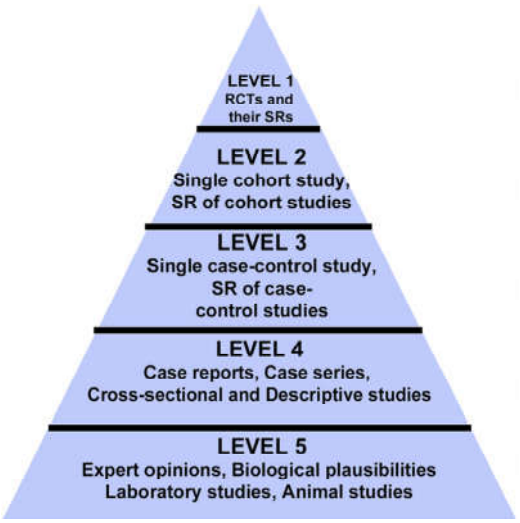

Figure 2. Evidence in medicine has been popularly categorized into 5 hierarchical levels and widely represented as a pyramid with the "weakest/lowest level of evidence" at the base and the "strongest or highest level evidence" at the apex. This model may not be applicable to prosthodontics.

Figure 3. The suggested new paradigm involves a horizontal spectrum encompassing 3 stages of evidence—preliminary evidence, substantive evidence, and progressive evidence.

Preliminary Evidence

Expert/experience-based opinions, philosophies, theories, and biologic plausibilites

Expert opinions, philosophies, theories, and biologic plausibilities are all important, because they provide a starting point to initiate and propel new ideas, theories, and innovations and develop further research. Unfortunately, many expert opinions are biased and scientifically not validated. As a result, several popular opinions and philosophies in prosthodontics have not been clinically validated. Some examples include need for balanced occlusion in complete dentures, designs for removable partial dentures, tooth preparation designs, types of restorations in fixed prosthodontics, and many others.

Laboratory studies and animal studies

In prosthodontics, due to rapid emergence and advancements of new dental materials, dental technology, and improved

biologic understanding, these studies are important because they provide a good foundation before proceeding with clinical studies. Pioneering work on osseointegration done by PI Branemark in his animal/laboratory studies and its subsequent development through progressive research is a testimony for this type of preliminary research.

Case reports and case series

They have high sensitivity for detecting novelty and form the basis for detecting new concepts, etiologic clues, side effects, and new treatments and have contributed to major breakthroughs in medicine (Bidra, 2011). In prosthodontic literature, case reports/series typically depict management of unique situations through unique techniques and/or unique materials. Such reports not only help clinicians in management of similar situations but also aid in laying the foundation for future laboratory studies and clinical trials.

Substantive Evidence

Cross-sectional studies/surveys and descriptive studies

A cross-sectional study is defined as a study measuring the distribution of some characteristic(s) in a population at a particular point in time (The Cochrane Collaboration, 2012). Essentially, the exposure and outcome are measured simultaneously, at the time of the survey. An example in prosthodontics is a cross-sectional study to analyze the prevalence of halitosis in patients with fixed complete dentures. In this example, because there is no temporal assessment, it is difficult to conclude that halitosis is related to fixed complete dentures. However, if significant numbers of samples are from a certain social or ethnic background, have a history of smoking or poor oral hygiene, then the researcher can investigate further to delineate the risk factors. Descriptive studies are studies that describe a particular characteristic and any related changes due to an intervention. They are commonly reported in prosthodontics with respect to anatomic variations and esthetic-related characteristics. Therefore, temporal considerations, cause-effect analysis, and survival outcomes are usually not applicable to such studies, which does not mean that the evidence from these studies is "weak." Major understanding of complete denture principles and esthetic dentistry has resulted from such studies. These studies are specific to a given population, however, and describe preliminary data or trends that may or may not be extrapolated to different populations. Some descriptive studies, however, have large sample sizes encompassing different countries and races (Owens, 2002).

Case-control studies

A case-control study is defined as "a study that compares people with a specific disease or outcome of interest (cases) to people from the same population without that disease or outcome (controls), and which seeks to find associations between the outcome and prior exposure to particular risk factors (Owens, 2002)." Case-control studies are not commonly described in the core prosthodontics literature, probably because prosthodontics typically does not deal with diseases and cure but with treatment outcomes. Compared with cohort studies, they are inexpensive and afford potential for large sample sizes. They are often associated with controversies and have a potential for propaganda by the media.

A popular recent example that is relevant to prosthodontics is a case-control study linking the risk of meningiomas and dental radiographs (Claus, 2012).

Cohort studies

A cohort is a well-defined group of persons who have had a common experience or exposure and are then followed-up to determine the incidence of new diseases or health events. Therefore, by definition, they have the potential to establish causal relationships between exposure and disease. Some examples of cohort studies with long-term follow-up, which have had a significant impact on prosthodontics, include Tallgren's 25-year follow-up study on reduction of the residual alveolar ridges in complete denture wearers (Tallgren, 1972) and a 20-year follow-up study by Douglass and colleagues (Douglass, 1993) on cephalometric evaluation of vertical dimension changes in patients wearing complete dentures. Unfortunately, such studies are uncommon because they are expensive, time-consuming, and difficult to execute without a significant loss to follow-up of patients. Therefore, short-term cohort studies have become widely popular in the prosthodontics literature, but they do not have the potential to change clinical practices or provide enough data for confident clinical decision making. Furthermore, many cohort studies in prosthodontics with longer follow-up periods lack adequate sample sizes and do not report a life table (survival) analysis.

Progressive Evidence

Randomized controlled clinical trials

RCT is defined as "an experiment in which two or more interventions, possibly including a control intervention or no intervention, are compared by being randomly allocated to participants (Manhony, 2012)."Because they are interventional/ experimental in nature, they have a high sensitivity to prove causation and also yield quantitative data. They are regarded as the best-known method to minimize/control bias, which is defined as a systematic error or deviation in results or inferences from the truth[10]. Due to these primary factors, they are often considered to provide the "highest level" of evidence in medicine.

Methods of randomization

Randomization is defined as "the process of randomly allocating participants into one of the arms of a controlled trial." Broadly, they can be classified as fixed allocation randomization or adaptive randomization and both methods have inherent advantages and disadvantages. Fixed allocation randomization can involve (1) a simple method, such as use of a random integer table; (2) a block method, involving blocks of integers, symbols, or alphabets (usually blocks of 4, such as ABBA); or (3) a stratified method, involving division of the members of population in homogeneous subgroups before sampling.

Adaptive randomization methods include baseline adaptive randomization and response adaptive randomization. They are designed to change the allocation probabilities as the study progresses to accommodate imbalances in numbers of participants or in baseline characteristics between the two groups. They also accommodate the responses of participants to the assigned intervention.

Another form of allocation that is not truly random is quasi randomization. This entails allocation based on a patient's medical record number or date of birth or by simply allocating every alternate person. Such methods of allocation are easy to manipulate, leading to a selection bias.

Parallel-group trial or crossover trial

Parallel-group trial or independent group trial is a popular form of RCT and is defined as "a trial that compares 2 groups of people concurrently, one of which receives the intervention of interest and one of which is a control group.

Single-mouth trial or split-mouth trial

Single-mouth trials are the popular form of RCT in prosthodontics and involve allocation of 1 treatment of interest per mouth. Split-mouth trials refer to a type of clinical trial comparing 2 or more interventions in which the participants are subjected to random allocation of 1 treatment of half of the mouth and another treatment/no treatment of the second half of the mouth. Depending on the intervention, the mouth can be essentially split into maxilla versus mandible, right versus left, or anterior versus posterior areas. The primary objective of using a split mouth design is to eliminate all components related to differences between subjects from the treatment comparisons and thereby reduce the error variance (noise) of the experiment and obtain a more powerful statistical test (Thompson, 2014). An example of a split-mouth trial in prosthodontics is a comparison between all-ceramic crowns and metal-ceramic crowns between right and left sides of the mandible.

Systematic reviews (SR) and meta-analysis of RCTs only

SR of the literature is defined as "a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review." A meta-analysis (that is, a review that uses quantitative methods to combine the statistical measures from two or more studies and generates a weighted average of the effect of an intervention, degree of association between a risk factor and a disease, or the accuracy of a diagnostic test). For example in a patient with temporomandibular disorder, An attorney contacted a state dental association seeking advice about a lawsuit filed by a patient against a dentist.

The patient was diagnosed several years earlier as having a temporomandibular disorder, or TMD. She had been treated with painkillers and muscle relaxants. However, when she changed jobs and moved to a new city, the patient's new dentist told her that she needed occlusal adjustment to fix her bite, which was causing the pain in the facial muscles.The patient's attorney wanted to know whether there was any credible scientific evidence showing that occlusal adjustment could relieve the facial pain that his client had experienced over the years. Searching the National Library of Medicine database through PubMed, a staff dentist at the state dental association found one systematic review of randomized controlled trials evaluating the impact of occlusal adjustments (occlusal splints and occlusal adjustment) on signs and symptoms of TMD (Forssell, 1999). The systematic review found four randomized clinical trials of poor quality, and thereby determined that the current evidence did not support the efficacy of occlusal adjustment in the treatment of TMD. Hence, this question remains unanswered, and further research is required before a definitive answer can be reached. The evidence does not support or refute the claims of the patient (Ismail, 2004).

Systematic reviews and meta-analysis of observational studies or all clinical studies

SRs and meta-analyses of only observational studies or including all clinical studies (both RCTs and observational studies) are widely popular in dentistry as well as in prosthodontics because such reviews are better poised to analyze more studies/ data to answer a given clinical question, in comparison to SRs of only RCTs, where data are scarce.

Evidence-based considerations for removable prosthodontic and dental implant occlusion

Taylor, Wiens & Carr (2005) presented a dental literature with discussions of dental occlusion, occlusal schemes, philosophies, and methods to correct and restore the diseased, worn, or damaged occlusion. Their review focused on some of the ''classic'' removable prosthodontic literature and the currently available scientific literature involving removable prosthodontic occlusion and dental implant occlusion. The authors reviewed the English peer-reviewed literature prior to 1996 in as comprehensive manner as possible, and material after 1996 was reviewed electronically using MEDLINE and summarized that little scientific evidence supports a direct cause-effect relationship between occlusal factors and deleterious biological outcomes for osseointegrated implants.

To the contrary, the limited evidence available at this time supports the position that there is no direct cause-effect relationship between occlusion and disease processes. Evidence supporting specific occlusal theories for removable prostheses is primarily based on expert opinion and in vitro studies. Evidence supporting specific occlusal theories for implant-supported prostheses is based on expert opinion, in vitro studies, and animal studies (Tyalor, 2005).

Evidence-based treatment planning for dental implants in fixed prosthodontics

Wood & Vermilyea (2004) presented a review with evidence-based guidelines to apply when planning treatment with osseointegrated implants. Peer-reviewed literature published in the English language between 1969 and 2003 was reviewed using Medline and hand searches. Topics reviewed include systemic host factors such as age, gender, various medical conditions, and patient habits, local host factors involving the quantity and quality of bone and soft tissue, presence of present or past infection and occlusion, prosthetic design factors, including the number and arrangement of implants, size and coatings of implants, cantilevers and connections to natural teeth, and methods to improve outcomes of implant treatment in each category. The review demonstrated that there is no systemic factor or habit that is an absolute contraindication to the placement of osseointegrated implants in the adult patient, although cessation of smoking can improve outcome significantly. The most important local patient factor for successful treatment is the quality and quantity of bone available at the implant site. Specific design criteria are provided, including guidelines for spacing of implants, size, materials, occlusion, and fit.

Limitations in the current body of knowledge are identified, and directions for future research are suggested (Wood, 2004).

Guidelines for reporting evidence

With the burgeoning publication growth in prosthodontics, it is necessary for investigators to comply with certain guidelines for reporting scientific evidence. The common goal of all guidelines is to improve scientific reporting and ensure standardization so that they allow an accurate assessment of the presented evidence.

Popular guidelines are

- Consolidated Standards of Reporting Trials (CONSORT) (Schulz, 2010) 1996
- Meta-analysis of Observational Studies in Epidemiology (MOOSE) (Stroup, 2008) 1997
- Transparent Reporting of Evaluations with Nonrandomized Design (TREND) (Des Jarlais, 2004) 2003
- Strength of Recommendation Taxonomy (SORT) (Ebell, 2004) 2004
- Assessment of Multiple Systematic Reviews (AMSTAR) (Shea, 2007) 2007
- Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) (Moher, 2009) 2007

Limitations of evidence based prosthodontics

- Applicability of research to a specific patient population, publication biases, paucity of current data, cost, and ethics.
- Information gained from clinical research may not directly answer the principal clinical question of what is best for a specific patient. This is because it is acknowledged that the homogeneity and characteristics of patients participating in clinical trials may be significantly different from those seen in dental offices.
- EBD does not provide a cookbook that dentists must follow nor does it establish a standard of care (Bidra, 2014).

Conclusion

A primary advantage of the evidence-based practice model is that it provides the least-biased, best-validated information on which to base decisions. However, the available scientific evidence for many aspects of clinical dentistry is either weak or nonexistent. This presents the dental profession with a major hurdle as it begins to implement an evidence-based model of clinical practice. Although some have questioned the rationale for EBD and the opportunities associated with this approach, it is clear that the evidence-based approach raises questions about how the dental knowledge base has been incorporated into dentistry, both in dental education and clinical practice. Presenting selective evidence in teaching and practice can lead to biased decisions, but if the methods of EBD are followed appropriately, there is less potential for bias by researchers, academicians and other experts.

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