

Prosthodontic Research: Breaking Traditional Barriers

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A b s t r a c t

There is considerable concern among leaders in both academia and the prosthodontic profession about the vitality of prosthodontic research and the discipline in general. Many feel that prosthodontics should be focused more on issues of societal significance. In addition, patient-oriented research is becoming more difficult to support within the current climate of ever-lower priority for discipline-based research. A break with traditional lines of enquiry is required, which will entail a corresponding break with established departmental boundaries, to gain access to a multiplicity of complementary skills. Several themes will be crucial in future prosthodontic research: clinical decision making, including health economics; materials science and host response at the implant interface; biocompatibility, functional properties and serviceability of prosthodontic materials; and function and dysfunction of the masticatory system. These themes are at the core of future projects that will address quality-of-life issues related to tooth loss. Prosthodontic researchers will have to be far more aggressive in developing synergistic collaborative arrangements, to align prosthodontic research with the major issues of the day, such as aging of the population, health disparities and access to preventive strategies. Through these collaborations, prosthodontics will remain a flagship discipline within dentistry, and its practitioners will be engaged in the major issues of health care.

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Does research in prosthodontics impress by its momentum? Is it representative of a flagship discipline of dentistry? Do traditional disciplinary strengths form a solid base for the future of prosthodontics? What distinguishes the prosthodontic research base from that of other dental specialties? Are prosthodontic research questions distinct from those of other specialties, so as to avoid unnecessary duplication of effort? Is this discipline more than “glorified general dentistry,” as George Zarb has often asked us?¹ Questions such as these exemplify painful problems within the discipline of prosthodontics — problems that “quick fix” approaches can’t solve.

Indeed, the answers to these questions have raised considerable concern among leaders in both academia and the profession about the vitality of the prosthodontic research enterprise and the discipline in general. To quote Zarb again, “a lingering sense of uncertainty about the direction of the prosthodontic discipline threatens to undermine my optimism about the future.”¹ If these concerns are valid, what can be done to foster refreshment of the research endeavours that support the discipline of prosthodontics? What powerful sense of purpose might

provide the basis for mounting and sustaining a high-profile prosthodontic research program? Can current prosthodontic training environments for graduate students and post-doctoral fellows be better aligned with the frontiers of science? Can today’s prosthodontic research questions be energized in terms of their societal significance? Can the discipline address the pressing, often diverse prosthodontic needs of the world’s population? How can young clinician–scientists successfully manoeuvre through the jungle of interdisciplinary and translational research that defines the scope of the prosthodontic discipline? In sum, will prosthodontic research “face perpetual obscurity” or can it, again using Zarb’s words, rebuild momentum on the basis of “a sufficient scientific underpinning to justify an existence in the world of scholarship beyond exotic handicraft status”?¹ Must prosthodontics break with tradition, with old ways of thinking? Can it make the necessary quantum leap to realign its thrust with outside pressures? The answers to these questions are in turn related to answers to some other key questions, such as What should be done and why? and How can these tasks be accomplished? Such questions are fundamental to how prosthodontics will define itself at

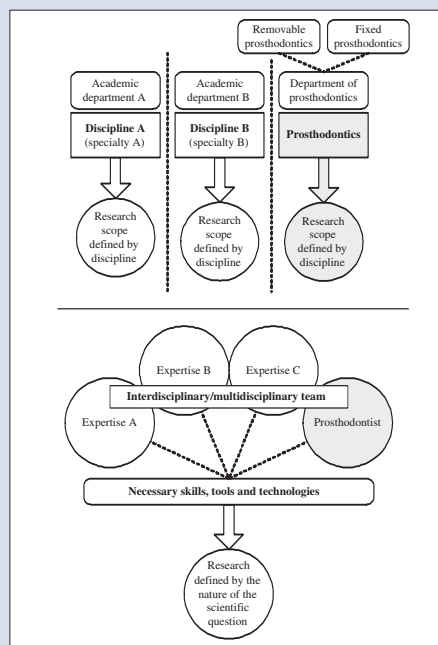


Figure 1: The changing nature of prosthodontic research. Top: Classical, discipline-based research model. Bottom: The current research model is no longer discipline based. Instead, the new model is facilitated by the expertise, tools and technologies required to tackle a particular scientific question. The prosthodontist has become part of a multidisciplinary or interdisciplinary research team.

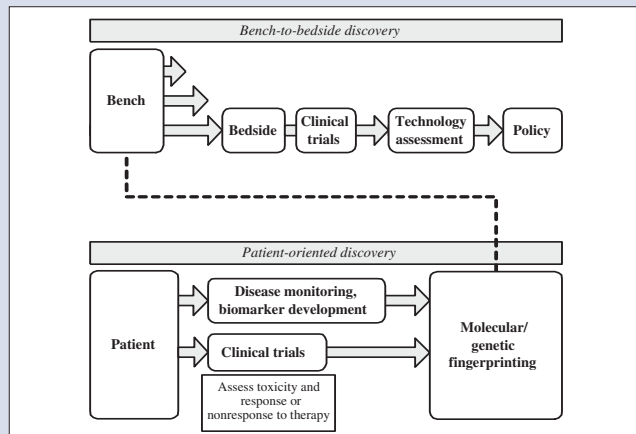


Figure 2: The changing nature of patient-oriented research. The classical bench-to-bedside discovery process (shown at top), is cumbersome, expensive and often flawed. A parallel track of patient-oriented research, from the top down and starting with clinical observations, has emerged (shown at bottom), that will remedy many of the shortcomings of the classical innovation pipeline, which only in few occasions results in translational breakthroughs.

the intersection of knowledge, skills and the desire to make a difference for those in need of prosthodontic services.

Patient-oriented Research

Although neglected for too long by the discipline, the issues are greater than just the vision for research within prosthodontics. Patient-oriented investigations — research on human subjects in which the investigator or a colleague directly interacts with the subjects — have become an endangered commodity in most academic health care environments, and prosthodontic research has not been spared. In addition, lines of inquiry originating within the prosthodontic community have been questioned or abandoned because they did not fit the traditional mould. Just as investment in research points to the future of a discipline, in the words of Zarb, “death by default” because of limited significance and research appeal has become a possible scenario for prosthodontics.¹ A decade of low priority for research, with a heavy focus on old questions, has had negative consequences for the discipline of prosthodontics and those who practise the specialty.

Conversely, high-impact patient-oriented research has become progressively more feasible and exciting. Biotechnology now provides unprecedented insight into mechanisms of human disease and the modes of action of

various therapeutic interventions, including the reasons why certain treatments do not work and why particular materials cause complications in individual patients. Using a range of research methods, such as outcome assessment, evidence-based decision making, biometry, bioinformatics, and clinical, environmental, nutritional, molecular and genetic susceptibility trials, clinician–scientists are looking for new ways to more rapidly produce and advance innovation, other than simply adopting the lengthy and costly road map of discovery that was established in the 1960s. In this respect, realignment of prosthodontic investigations with current trends in patient-oriented research, incorporating opportunities common to a diverse range of health issues, has become critical for leveraging resources and developing credibility. Scientific pursuits that explore new territory add breadth and depth to the field. Uniquely powerful techniques produce substantive novelties rather than just repeating investigations related to a trendy theme. Instead of adhering to traditional or questionable thinking, irrespective of how comfortable or lucrative it might be, the discipline becomes invigorated with excitement, regains momentum and may even redefine itself. And the topics of research within a discipline are closely related to what that discipline is at its core!

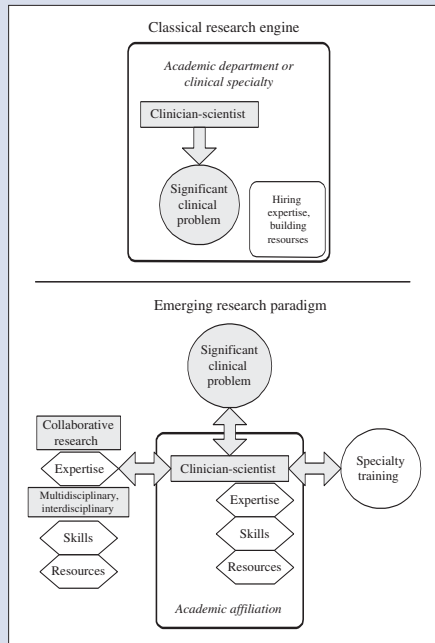


Figure 3: Leveraging the change engine. Although “borrowing” resources (i.e., collaborating with colleagues in other departments or specialties) may be perceived by some as a sign of weakness, abstaining from collaborative arrangements will in fact weaken the discipline over the long run. No longer does the discipline have the resources to support competitive research on its own.

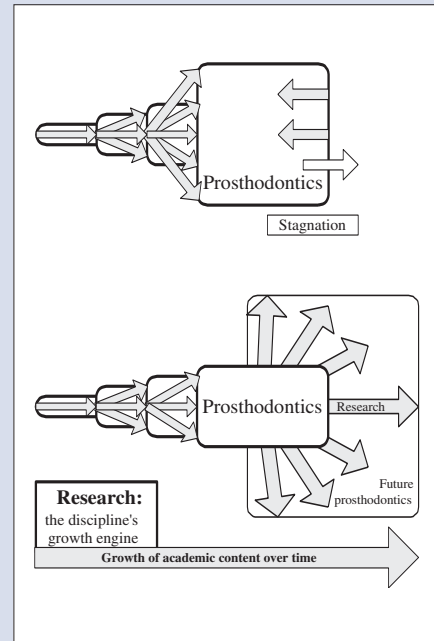


Figure 4: The future of prosthodontics rests on its investment in research and development. Top: Stagnation occurs if the focus of research is retrospective and expansion of the scope of research is limited by those within the discipline. Bottom: Academic content can be expanded through investments in progressive research that are realized by leveraging opportunities outside the discipline’s domain.

While the opportunities sound exciting, implementation represents a particular challenge for prosthodontics. Academic workforce issues in prosthodontics (and other dental specialties) have not been successfully addressed by the approaches that were in effect when erosion of the research base occurred. Now, there is a dearth of well-trained clinician–scientists, compounded by the need for those researchers to access a multidisciplinary set of skills and technologies, which presents a quandary within rigid, departmental university structures. Developing one’s career in large multidisciplinary or even interdisciplinary research teams is not possible for new researchers trying to establish a reputation in a competitive academic environment with the unforgiving tenure clock ticking in the background. Building comprehensive research resources is also required, given the limited programmatic funding available for new areas of study (which do not have high priority among federal funding themes). Consequently, in the absence of new revenue streams, sustaining any broad-based research initiative will be challenging for today’s dental schools. Only a handful of federally funded senior prosthodontist–investigators remain as mentors, and their field of study is often difficult to consolidate with mainstream prosthodontics. In other

words, without the injection of new resources, the research capabilities of the field of prosthodontics are limited, and sustaining them from within is doomed to hurt the discipline because of its narrow appeal.

As discussed above, current approaches in prosthodontic research leave much to be desired in terms of scientific breakthroughs, both phenomenally and conceptually. Few topics in prosthodontics remain that will create professional excitement and appeal to a broad audience, including investigators of the scientific community at large. For example, because it is capable of lessening many of the worst effects of tooth loss, dental implantology generates broad excitement and is prone to exponential growth, as witnessed in recent times. However, instead of fostering the necessary multidisciplinary and interdisciplinary research environment, rigid departmental boundaries and competition for limited resources have stifled the growth of this topic and narrowed the scope of research to questions that approximate triviality. Scientific inquiries are driven largely by departmental entitlements and territorial stakeouts, instead of embracing state-of-the-art methods and technologies from the broader field of science that have the potential to resolve meaningful questions (Fig. 1).

Science First

When academic departments and disciplines were essentially synonymous, research was driven to a greater extent by the academic departments (e.g., prosthodontics) than by the nature of the research question or its significance from a societal perspective. Not surprisingly, research questions tended to be narrowly focused on topics within each respective discipline. Most investigations addressed improvements in techniques and materials, including aspects of clinical convenience. To support research endeavours, departments nurtured the necessary expertise, skills and resources, but there was little need to engage in collaborative arrangements. The thrust of prosthodontic research has mostly been (and continues to be) driven by master's theses, which have produced a large number of individual pieces of the knowledge puzzle; however, the creation of knowledge by this mechanism is inherently slow and of limited scope, and rarely does it produce knowledge that questions prevailing thinking. This tradition must change significantly, such that there is less emphasis on the role of the discipline in guiding research with more support for the core values matching the unique skill set of and technologies available to the prosthodontist.

As a refreshed vision for prosthodontic research emerges, the lens through which the individual prosthodontist views the world is being refocused in terms of excellence, service and, increasingly, the need for parity. Although it may be comfortable to hold on to the classical prosthodontic thinking that has been in effect since the early days of the discipline, change becomes inevitable as soon as the discipline readjusts its research focus and sees itself in a different light. Today's broad research questions require support or direction from more than just prosthodontic expertise; best practices must be shared to leverage efforts and access to expertise, skills, tools and resources. Unlike what occurred in the past, there is now a dependence on external assets to get things done. Furthermore, the resources required to support a meaningful research mission to meet today's challenges can no longer be sustained at competitive levels in academic departments that are narrowly defined by specialty disciplines, such as prosthodontics. The once-prevailing mode of inquiry — research performed in partial fulfillment of the MSc degree — must be redefined in the context of the up-and-coming paradigm.

The broad nature of today's prosthodontic research is illustrated by the themes of a recent symposium entitled "On Biological and Social Interfaces in Prosthodontics," organized by Zarb.² Identified research themes were clinical decision making, including health economics as influenced by attributes of both patients and providers; the host-implant interface, encompassing topics ranging from materials science to multiple aspects of the host response; prosthodontic materials and restorations and their biocom-

patibility, functional properties and serviceability; and the function and dysfunction of the masticatory system, including the consequences of aging and tooth wear. Among these themes, there is no "sexy" disease that is on everyone's mind, begging for a cure because of its increasing societal burden. But by no means does this imply that prosthodontic research is not important or that treatments rendered by prosthodontists should be considered elective. Although prosthodontic treatments do not intervene with a disease process, they do address the consequences of chronic diseases that ultimately cause tooth loss and affect a person's well-being in the broadest sense.

Another consideration is that prosthodontic research is not necessarily congruent with the field of study within which a prosthodontist earned his or her academic degree. The emerging paradigm redefines prosthodontic research as a translational science, concerned with the transformation of fundamental knowledge into treatments, the study of measures to move specific aspects of knowledge into widespread availability as quickly as possible or measures of the feasibility and utility of treatments, including applicable aspects of well-being, health economics and health disparity. With the completion of the genome project, the scope of inquiry has expanded to the discovery of alleles that determine response characteristics for a given patient, including his or her likelihood to experience complications with a particular planned treatment (Fig. 2).

Leveraging the Change Engine

In response to external pressures, prosthodontic research will have to explore collaborative opportunities for which creativity and synergy, the spirit of a "win-win" situation, are the essence. As referred to above, prosthodontic research can no longer be performed in a vacuum because the academic discipline is no longer in a position to sustain, on its own, a research mission that addresses today's broad-based questions at a competitive level. Teamwork and access to established expertise, exceptional skills and state-of-the-art physical resources are promoted in the spirit of creativity and resourcefulness. No longer in competition, investigators value the individual contributions that complement the team's goals. Adherence to classical thinking encourages a restrictive scope of research, whereas the breadth of research begins to change when the community starts to acknowledge the deficit of available options (Fig. 3).

However, leveraging goes beyond fostering creative collaborations. It includes the realignment of prosthodontic research with the "hot" topics in the health sciences at large. For countries where life expectancy has increased, these include measures to increase well-being over an extended lifespan, to reduce health disparities and to allow access to preventive services for all. Without doubt, prosthodontics is well positioned to meet the expectations of an aging population, taking advantage of the principles of implantology,

tissue engineering, stem cell biology, neuroscience, materials sciences and, last but not least, genetics and genomics. Emerging research tools, including computer-assisted design and manufacturing and modern imaging, promise rapid transformation of new knowledge into applications for patients. Once the potential of current lines of research is embraced by the discipline's leadership, classical lines of inquiry will rapidly lose their appeal and the realigned prosthodontic research will be on an upward spiral.

Why are all of these considerations significant? Why should the prosthodontist worry, especially when business has never been better? The answers to these questions place prosthodontics at a crossroads: in one direction lies death by default and in the other an enviably thriving specialty. The discipline needs to acknowledge that it is no different from any other (business) venture and that a continuing process of renewal is the only way to maintain itself as a flagship specialty. Without human, physical and financial assets, there can be no quality research; without addressing relevant questions, there will be no audience; and without R&D, there will be no future (Fig. 4).

Some of my colleagues refer to prosthodontics as a discipline that is stuck in the past, at the mercy of external forces over which no real control can be exerted. On the contrary: realignment of the discipline's research with the needs and expectations of prolonged life, should not be difficult. Opening the gate of change is a matter of leadership that sparks an infectious vision, painting the discipline's next destination for those who care and want to reach it in the not-so-distant future. This is the essence of what George Zarb has represented for the discipline of prosthodontics. ♦



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