# Commentaries: Quality of Dental Implants

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At a point in the evolution of dental implant therapy when hundreds of implant brands and countless variations of implant design exist, the astute clinician must evaluate claims made by the manufacturers, the investigators sharing outcome data in peer-reviewed journals, as well as the clinical experts who offer insight through alternative publications or podium presentations. In "Quality of Dental Implants," our colleagues provide an important evaluation of the relationship between existing data concerning dental implant performance and various claims made regarding different implant design features.

The scope of this report is striking. Summarizing, logically collating diverse data sets, and ranking the data according to scientific rigor represents an enormous task. This effort implicitly argues that defining implant quality is an important part of our professional obligation and defines the shared commitment of prosthodontists to excellence of comprehensive dental rehabilitation using dental implants.

Jokstad and colleagues selected seven clinical outcomes that were considered in the context of six sets of dental implant design features. Whether we agree with the chosen outcomes or the precise design features chosen, the work is exhaustive and serves to indicate at least two important points. First, a clinical study that is specifically designed to measure one or more of these specific outcomes is both complex and difficult to perform well. Second, the quality of existing data sets ranges from good to poor with few randomized prospective comparative clinical trials of sufficient size to provide statistical power to adequately test superiority regarding one or another implant design parameter.

A third and important general observation made from compilation of this data set is that only a very few dental implant manufacturers are engaged in creation of this important data set. What this means to one reader or another is appropriately left unstated, and is one important point that every reader must consider in providing patient care.

Can the reader accept the conclusion that "several implant systems appear comparable"? One interpretation is that this statement is true in the context of the suggested limitations of data. Alternatively, given the limitations in data ("the scientific evidence of the influence of dental implant materials, geometry and surface topography on clinical performance is limited and not particularly methodologically sound"), particularly the lack of studies designed specifically to compare one design feature to another, it can be argued that the impact of implant design features on the practice of dental rehabilitation remains an important unresolved issue of merit.

What do implant design features offer the practicing clinician and what potential benefits are derived by the patient? Optimism requires believing that improved clinical control of outcomes will be derived from changing implant design features. Caution requires data supporting new theories be tested first in the laboratory, second in preclinical studies, and ultimately in controlled clinical studies prior to widespread use. "Quality of Dental Implants" offers an important source of information, raises important questions, and provides a focal point for considering the products in the dental implant marketplace.

**Pierre de Grandmont**
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This paper addresses important issues in dentistry: how can practitioners best make their choice amongst the numerous dental implant systems on the market these days? Can selection be based on quality of the dental implant? How can that quality be defined?

Jokstad et al proposed that quality of dental implant be linked to clinical performance and searched scientific evidence to assess the influence of a series of design characteristics on this outcome. Their approach seems logical and is well articulated. It provides a better understanding of the problem and has the merits to lay out a basis for an eventual definition of dental implant quality.

Unfortunately for some readers, this paper is not a "best-buy" listing. In fact, the authors had to conclude that the scientific literature does not permit a practitioner to determine superiority between implant systems. The relatively small numbers of trials designed to evaluate the influence of implant characteristics on performance and, too often, the poor quality of the trials, leave clinicians without strong evidence. Moreover, as stressed by the authors, it is deplorable that most companies contribute to this situation by providing little information on their implants' performance. This provocative message should cause clinicians to question their implant selection process and to challenge manufacturers claims.

The authors chose to rank implant systems in regard to the quality and quantity of the clinical reports referring to their performances. This ranking helps the reader identify the systems which have been most documented. However, as stated in this paper, readers should not readily conclude that this ranking automatically grants superiority to those systems as it does not take research outcomes into consideration. It could be added that almost all implant systems have gone through significant design and surface characteristics changes in the past years. One should therefore be careful not to use clinical reports on previous versions of an implant system and assume that new and improved versions will just be as good, if not better, than the preceeding ones. These changes, which are driven by a search for excellence, as well as by commercial considerations, complicate the analysis of dental literature, which quickly could become obsolete. It is therefore very pertinent to pursue evaluative studies and the search for scientific evidence.

This is a most interesting and very informative review. It also provides an excellent overview. However, as the assessment of dental implant quality requires an analysis of a multiplicity of factors, this topic deserves to be elaborated upon and needs additional scrutiny. Hopefully this paper will serve as a catalyst and inspire researchers to conduct investigations that could help to better define the influence of implant characteristics on performance.

**Steven E. Eckert**
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Years ago, dental implantology stood on the outer fringe of legitimate dentistry. The seminal work, however, of P.-I. Brånemark and a number of replication studies showed that implant-supported prostheses could perform as predictably as conventional prostheses. Today we see implant support as a viable, oftentimes preferable, alternative to tooth- or mucosal-supported prostheses. In response to this acceptance we are witnessing an explosion in the number of implant manufacturers.

The current status of dental implant documentation is described in this paper. Despite the fact that two NIH conferences provided a clear outline for meaningful research in implant dentistry, the authors found few studies comparing the clinical performance of different implants. Clearly this is not for lack of effort, as the authors conducted a painstaking review of the literature to uncover supporting material for more than 220 different implant brands. Sadly, "high-level" supporting literature was available for only 10 brands and the criteria for this classification was not stringent, being limited to only four supporting articles.

This review provides valuable information for a clinician who is considering the use of a new implant system. When choosing a system, clinicians could compare scientific integrity, manufacturer reliability, price, or a myriad of other factors. For me, science leads the way. Use of an undocumented system turns me into an unpaid volunteer researcher for a company that may not exist in a few years. Worse yet, it turns my patients

into uninformed study participants. Personally it seems reasonable to only use implants for which supporting research is available and the more documenting material, the better. One may question whether the use of undocumented implants is akin to reckless endangerment of the patient. Failure on the part of dentists to commit to purchasing only documented materials will lead manufacturers away from costly, but necessary, research. Ultimately products will be introduced without any testing and the clinician will have no understanding of anticipated complications.

Clinicians probably expect regulatory agencies to test implants before their introduction to the marketplace. Unfortunately this is not the case as these agencies simply ensure that products are manufactured using standard, safe practices.[1] Jokstad et al recognized this as a problem, stating: "It can be speculated whether the present regulatory systems in the USA and Europe can account for the fact that the large majority of dental implant brands lack solid clinical documentation of beneficial effects for the patient."

From an educational standpoint this review is a strong basis for implant teaching. Because it assesses so many implant brands and does so in an unbiased way, the article will quickly become mandatory reading. Using this article as a starting point, students and clinicians can extract data, compile spreadsheets, define results of interest, and compare results using weighted averages for different manufacturers and for known time periods. Literature results can then be compared with the individual's own documented experience to ensure that the clinician is performing similarly. Such an effort will encourage all of us to be critical evaluators, a key step on the path to improving quality of care.

1. Eckert SE. Food and Drug Administration requirements for dental implants. J Prosthet Dent 1995;74:162–168.

**Gary Goldstein**
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This is exactly the type of paper clinicians need to determine a course of therapy for their patients. The authors did an exhaustive job of finding, collating, and reporting on the best literature available. Unfortunately, as they stated in their review, it is what is not reported that is of concern. The last paragraph in the conclusion aptly states the problem. Most outcome assessments are dentist-driven, not patient-driven. In addition, there is no standardization between studies. Authors compare different variables and measure variables differently. It is hard to wade through the mass of data and impossible to relate studies, especially in the presence of conflicting evidence.

Why do clinicians change what they do?

- Unacceptable failure rates
- Unacceptable mechanical and repair problems
- Unacceptable morbidity due to the treatment
- Unacceptable costs which prohibit providing therapy to the patient

Each of these items in themselves is problematic, as each clinician must decide independently what is acceptable in their practice and what is not.

But how do we look at evidence to answer these questions? As stated by the authors, statistical significance may not relate to clinical significance. How do we determine clinical significance? Is 0.1 mm more or less of bone loss clinically relevant? At which point does it become meaningful to the patient and clinician, especially when compared to other variables—some studied and some avoided—that may be more consequential? Most statistics are stated in the positive. This "product" or treatment had an 85% success rate after 5 years. But, can your practice accept a 15% failure rate and survive? And, was the study really 5 years? Most 5-year studies have minimal patients who have completed the full course of treatment. Many patients are enrolled 3 years or less and hopefully, not too many are of one year or less duration masked by statistics to predict what will happen in the future. What percentage needs to have been in the study the full 5 years in order to avoid chronology bias and for the clinician to have confidence in the data? Do we compare prosthesis stability or individual implant failure? It is obvious that each reader could add numerous questions to this list.

It is time for us to develop consensus standards for clinical research in this field. The editors of the major dental journals and the leaders of the major dental organizations have a job to do if the profession and the public are to benefit from future research.

**John A. Hobkirk**
**University College London**
**London, United Kingdom**

This is a significant paper, not for the answers which it provides, important though they are, but for the questions which it enables us to ask.

The reader cannot but be impressed by the quality of the scholarship, the volume of the data, the scheme of analysis, and the questioning of conventional wisdom. It is clear that despite much research, however, key questions remain poorly articulated or only partly answered.

Amongst the many questions that arise are those relating to clinical decision-making, the direction of future research, and standards.

## Clinical decisions

A number of multicenter studies have shown osseointegration to be readily achieved and maintained in the majority of patients selected for implant treatment. While pivotal to the outcome, it is not the sole criterion of success, and although currently viewed as a prerequisite for this, is not a comprehensive treatment outcome measure in itself. This paper provides an extensive review of the evidence for possible relationships between implant designs and tissue responses. Nevertheless, all the stakeholders in implant treatment need better information on the parameters that may affect treatment-planning decisions. These include an understanding of systemic and local patient factors and training issues, as well as component design.

The authors have highlighted the very large number of implant systems currently available (> 200), and of particular concern, the significant number, estimated at over 60, which are no longer manufactured, a number which seems likely to increase. Dental implant treatment is very dependent on premanufactured components rather than on custom-fabricated devices, and thus the profession is facing a significant challenge in the coming decades managing commercially obsolete but successfully integrated fixtures.

The authors have proposed a time frame of 5 years for assessing a new implant design, and recommended this as a minimum cut-off point for clinical studies, pointing out that the published data for many systems do not meet these criteria. This has implications when selecting an implant system, as the clinician must weigh up alleged but less well demonstrated benefits against long-term results for an older design. Given the high success rates of many current devices, the advantages may be minimal in terms of successful osseointegration, although possibly greater in terms of technological advance.

## Research

Although it is important to maximize implant success, the failure rates of many current systems and techniques are relatively low, calling into question the priorities set when choosing themes for implant research. The authors highlight the considerable body of work that has been carried out on implant designs, including shape and surface texture, while underlining the lack of solid evidence for the claimed efficacy of many of these features. It could be argued that these developments are based more on a desire for product differentiation in a crowded market, rather than on an assessment of the prime factors in implant success. There are several key areas that should be considered in implant research, including[1]:

- Predictors of osseointegration
- The natural history of implant failure
- The role of implant material in treatment outcomes
- The application of bioengineering principles in implant treatment
- The impact on patients of implant treatment
- The significance of study designs

This paper has a more focused theme and only two of these—implant material and study design—receive significant consideration. The full list provides a considered framework within which to place our current research, and future plans.

## Standards

The paper makes several references to published standards of relevance to dental implantology. Although standards for devices used in healthcare can be very important in ensuring fitness for purpose, as well as for informing treatment and purchasing decisions, their preparation is time-consuming and often contentious. Given that the profession is unsure as to the biological and biomechanical predictors of success or the relative influence of device, patient and operator on outcome, it seems premature to suggest standards in these areas, compliance with which would theoretically provide a defined success level. As highlighted, given the current knowledge base, these can only be secondary to further research. There may however be benefit in considering issues of process management and manufacturing standards, in a field in which complex

pre-manufactured devices are expected to perform interchangeably, with low failure rates, in a hostile environment over several decades.

In an aspirational age when new is a synonym for better, and technology appears to offer limitless horizons, the dental profession sometimes finds it difficult to assimilate implantology in a rational manner. This paper helps us to do so.

1. Hobkirk JA, Zarb GA. On biological and social interfaces in prosthodontics. Implant host. Study group report and discussion. Int J Prosthodont 2003;16(Supplement):47–51.

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This systematic review reports on more than 220 implant brands fabricated by 80 manufacturers. The authors looked at the promotional materials of the manufacturers, which claim superiority of their products with regard to specific clinical performance of the implants. Altogether, seven aspects, such as ease of surgery, implant geometry, surface components, esthetics, costs, etc., were identified and critically analyzed. Whereas most companies comply with fabrication quality standards it appears that the level of scientific documentation by means of clinical studies to support such claims is limited, low, or nonexistent.

This excellent review, with its tutorial character, is highly recommended for practitioners, academics, and experienced clinicians as well as for beginners in the field of implantology. It addresses many aspects that manufacturers, users, patients, and companies may regard as important. However, the review fails to demonstrate the superiority of one implant system over the other with regard to specific implant characteristics. The understanding from the reading is that we should not rely on promotional reports and manufacturers' claims, but must critically build up our own opinion, experience, and skills in implantology. Direct recommendation of how this can and must be done cannot be drawn from the report.

The review implies that it is questionable whether quality standards of implants and design features are adequate determinants for the choice of an implant. Evidence-based decision-making to ensure optimum patient treatment requires other criteria.

Thus, we may come to the simple conclusion that more research is needed, which is in some way an expression of the reader's frustration because:

In spite of the enormous task undertaken by the authors we do not have clear decision-making criteria and do not know which are the important product features for the choice of an implant system.

Many manufacturers sell their products without any qualified documentation. These products are used in daily practice and would disappear from the market if performance was weak. Thus, it can be that our academic view disregards what in fact happens in daily practice and patients' treatment. In a broad sense, in spite of our studies we know little about effectiveness of implants.

Cost must be considered more completely. The authors briefly allude to the fact that cost is the decisive factors for the choice of an implant system. Cost comprises direct costs, to buy the equipment and implant material, as well as indirect costs. This includes time and ease of performing the procedures and maintenance service. The authors negate that the ease of implant placement, which was in a few studies indirectly expressed by time measurements, is a quality criteria. Nevertheless, the impact of ease of procedures is obvious for clinicians and practitioners. The presentation of the surgical box, the set of instruments, the configuration of the implant/prosthetic component connection, this all influences all clinical steps with regard to limitation of errors and wrong selection of instruments; it enhances straightforward procedures and safety of procedures. This also results in limitation of surgical time, which means a reduction in local anesthetics, anemia, and exposure of the bone.

The authors view implies that the body of research is too weak to elucidate their question. The best study designs, ie RCT, is rarely represented and for most implant brands they do not exist. The authors criticize the weakness, flaws, and biases of many studies including RCTs. This is one reason for contradicting findings. As clinicians, as readers of the implant literature, and as clinical researchers we may therefore wonder: Is it an inherent problem of clinical practice that questions are not answered by current studies? Further, there are doubts related to the external validity of RCT with regard to daily practice.

If this review does not reveal clear differences between systems, this lack should not exclusively be ascribed to the weakness and limitations of most studies. A major problem is that studies first of all report on survival and success. We urgently miss studies dealing with failures; we miss scrutiny in investigating details of failures, their clinical manifestations and possible causes. The study design would be on the bottom

of the study hierarchy, namely single case reports and case controls that look at the negative treatment outcome instead of the positive. Details in superiority of on implant system onto the other may rather be found in negative than positive treatment outcomes. As these appear to be rare, it is important to report and analyze any failures very carefully.

**Harold W. Preiskel**
**London, United Kingdom**

This seminal work is impressive both in scope and depth. It quotes more than 220 implant brands and 2,000 different implants. As its title implies, the paper concentrates on dental implants, rather than dental implant systems.

### The significance of the work

Written by internationally recognized scientists, virtually every aspect of dental implant manufacture and design is considered. A helpful table associating design characteristics with clinical success is provided. Clinical documentation is graded from A, where there is extensive clinical documentation, to D, where there is none published. Ten implant manufacturers are quoted providing grade A documentation and 29 with grade D. Nevertheless, the authors point out that although controlled clinical trials with patient randomization (RCT) may represent the highest category of clinical trials, they do not automatically translate as a high-quality paper. Critical appraisals have suggested that numerous RCTs are poorly reported. In its present form, the paper offers more to the scientifically trained community than to those who may be daunted by the sheer bulk of information. A simpler form of presentation might prove helpful.

Prospective data are difficult to obtain in useful numbers, particularly over an extensive period, and the paper highlights the usefulness of an implant register to analyze data retrospectively. Although the evidence may be of lower grade, valuable lessons could be drawn from the vast bulk of data from today's end users. For example, manufacturers have responded to clinicians' problems by modifying abutments, abutment screws, and even implants. Advice as to design characteristics that make implants susceptible to fatigue fracture, particularly after surrounding bone loss, would be valuable.

The paper highlights aspects of the quality of materials, surface characteristics, and of the designs, together with the dimensions of dental implants. Minor differences between mechanical and physical properties on clinical performance are uncertain. Clinicians are often confused by tolerances quoted for matching components. The most likely complication of poorly adapted components is loosening of the prosthetic elements, but on the other hand there is little evidence that extreme accuracy is required. Indeed, extreme accuracy would make the devices difficult, if not impossible, to employ in clinical practice. What are acceptable limits?

Particularly significant is that neither the clinician nor the patient is really protected by the regulatory jungle of certification. These procedures appear primarily directed at compliance with the product descriptions supplied by the manufacturer and by the production procedures involved, not the end product in the form of the dental implant.

### Additional research information for our patients' benefit

The report challenges accepted dogma. For example, do longer implants enjoy greater success than shorter equivalents, or is it because longer implants are used in better sites? Our patients will certainly benefit from clinicians' closer appraisal of the literature. Abutments, together with associated components, need to be considered with an eye toward esthetics and maintenance. Furthermore, the availability of spare abutments or other components manufactured 10 years or more previously might be a valuable yardstick of the manufacturer's commitment to service.

### Has the report changed my clinical practice concerns?

While the report has not changed my implant practice I have learned about systems with which I was unfamiliar and it has taught me to evaluate research papers far more carefully. It's particularly worrying how flaws in research findings, so easily unnoticed, have been detected by later careful analyses. In fact, a group that followed up their own results with more sophisticated statistics showed the opposite findings to those originally published. Advertised claims must therefore be viewed with circumspection.

### How would you use this paper in guiding your residents/staff/students to approach implant prosthodontic decision-making?

The paper may be of greatest value because of the number of questions it raises rather than those that it answers.

Mere knowledge of the literature is insufficient; it is the ability to analyze the literature that is essential. The work underscores the fact that implants are instruments to be used within the prosthodontic armamentarium.

This mammoth report is likely to serve as a landmark for some years to come. Expert and beginner alike can only benefit from reading this significant work. The authors are to be both thanked and congratulated.

**Clark M. Stanford**
**Unversity of Iowa**
**Iowa City, Iowa, USA**

Why should clinicians, educators, and industry opinion leaders read and digest the article "Quality of Dental Implants" reprinted in this edition of *IJP*? The article clearly shows the limits of current clinical outcome data behind most implant systems. It is obvious that the authors spent the time before starting the study to design and agree upon a level of criteria for quality assessment of each implant system they reviewed. The data in this comprehensive report was diligently compiled and the literature rigorously reviewed.

For each of the implant systems assessed, company data was provided, Web sites were critiqued, and an overt ranking of the quality of the clinical research and performance data for each system was provided. Winners got the gallant "A" and stragglers received the deficient mark of "D." Readers may be surprised about the lack of clinical performance data for widely marketed implant systems and the fact that different regulatory environments provide a very limited level of protection to the clinician. The review assumes the conventional evidence-based approach of RCT as being the best, but doesn't explore the importance and relevance of well-performed retrospective and case series studies. Further, the review doesn't outline the significant value in assessing the safety validity and cost benefit of clinical procedures (eg, immediate loading, placement in extraction sockets, etc) rather than the focus on the device alone (safety, marketing claims, etc). This may be more a limitation of space and the desire to focus on data to support the device side of clinical care. Readers should recognize that manufactures must operate in a diverse global market with competing demands and limited resources. The limitation of resources and limited interest on the part of federal research funding agencies (eg, USPH-NIH, Canadian Research Council, etc) to fund the comparative, multicenter trials on dental implant outcomes limits the literature to primarily short-term safety studies funded by industry for marketing purposes. The review does point out the quality of clinical research that is performed and demonstrates the interest by key players in industry who do go through the effort to document the clinical performance of the devices they sell.

How would this review therefore be of value to educators in dental schools and residency programs? The greatest value lies in the background description and emphasis on the need for clinical performance data and the tables that outline the manufacturers and the "grading" of quality of clinical research performed for the respective system. There are few side-by-side comparisons of such material available and this is one of them. The article is a provocative wakeup call for clinicians, for educators and, most of all, for industry.

**Dennis P. Tarnow**
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This paper is certainly one of the finest examples of a properly done literature review. The authors are to be commended for their hard work in organizing this difficult topic.

The Editor-in-Chief asked us to consider four questions concerning this article:

***1. Do you regard this systematic report as significant?***

The answer is, of course, yes, but only as a literature review. We must be careful when looking at these types of articles before we condone or condemn various aspects of clinical dentistry. They certainly tell us whether there is a consensus about specific aspects of implants or their use. However, in any isolated clinical situation, the clinician may find that the use of a specific implant may be better suited than another even though it may not have the same success rate as one that is more commonly used. Another problem for the clinician in regard to these types of literature reviews is that they do not usually take into consideration changes and improvements the manufacturers have made over the years, particularly if they place all of the

studies under one category statistically, without considering when they were published. For example, screw loosening used to be one of the most significant problems with implant-supported prostheses. If one does a literature review on screw loosening you would think that implants have more than a 25% screw-loosening problem. Manufacturers have addressed this issue by using different screws, applying torque drivers, as well as using better fitted and different abutments, and this problem now occurs in less than under 1% in implant designs today.

***2. What additional research information is required to ensure optimal evidence-based decisions for our patients?***

This paper clearly addresses concern about the lack of proper studies to give us the information that we need for our patients. The sad part is that we may never get them, because most research today on implants is paid for by the manufacturers. And, as stated in the article, they don't want to risk side-by-side comparisons with other implants unless they know the probable outcome already. The proper place for this funding should come from NIH and similar nonbiased research organizations. However, with dental implants doing so well clinically with a relatively low morbidity, they don't have any desire to fund the basic solid research that we so desperately need to make the proper decisions for our patients. The research grants today are going to tissue engineering biomimetics, cellular biology and genetics. Clearly we need this type of research but the basics should not be overlooked. This paper shows us all too well that we still need basic questions answered while we look to the future.

***3. Has the report changed your implant practice concerns in any way?***

No. I am familiar with this research and I try to practice in an evidence-based way. This is, however, an excellent summary of the literature.

***4. How would you use this paper in guiding your residents/staff/students to approach implant prosthodontic decision-making?***

This paper makes them realize that we certainly know that we can place implants successfully in most of the clinical situations that we are presented with. However, what this paper also does is to make them realize how little we really know about what we are doing clinically. In addition, this paper can be used to help them understand the difference between statistical significance versus clinical significance. Sometimes a paper can show statistical significance and the authors and manufacturers can therefore make certain claims about an implant, however, many of these results mean absolutely nothing in the clinical arena.

The biggest problem with this paper is that is has done its job well. That is, it will only be read by academics and students. The average nonacademic clinician will not read this article even though it is an excellent one.

**Terry R. Walton**
**Sydney, Australia**

The article "Quality of dental implants" by Jokstad et al is both significant and timely. Like many clinicians I find it difficult to keep up to date with the current dental and prosthodontic literature.

Presenters at a seminar on occlusion I once attended made me feel guilty of providing inadequate patient care as they showed two carousels of slides of the front covers of textbooks, journals, and magazines. How could I possibly have the time to read and digest all this information and apply it to my everyday clinical practice? The bottom line was that the sponsoring organization had the time and resources to review this information and all I had to do was pay several hundred dollars to attend its course and receive all the answers. I have subsequently realized that this is the marketer's classic approach—make the consumer feel inadequate/guilty in their current circumstances, then promise "salvation" in the product.

Another classic marketing strategy is based on the fact that all products have a bell-shaped usage curve. An initial slow uptake is followed by a surge to a peak and then a tapering off. This occurs regardless of the benefits of the product, although the timeframe will vary. To even out revenue receipts, a new product must be released as the previous product hits its peak.

Why the economic ponderings? At no time in dentistry have we been so reliant on product "research" information and associated marketing provided by the commercial implant companies and so poorly serviced by the traditional sources of unbiased research, such as the universities. The clinician must be both a wary

and informed consumer in order to provide the best treatment for patients given the significant impact/control exercised by these companies.

Jokstad et al's article provides a comprehensive and unbiased review of the current state of implant products while identifying the many deficiencies in our current knowledge of the associated biological and physiological responses. It helps to negate the emotional marketing impact. Although emphasizing that the existing scientific clinical documentation (albeit somewhat inadequate) should be the major consideration for selecting various products, other factors, such as manufacturer representation, reliability, ethics, flexibility, ease of use, and costs are identified. These are practical considerations for the clinician. Also reinforced is that the technique and the experience of who delivers it is probably more significant than the specifics of the product. I now feel comfortable rather than inadequate concentrating on treatment planning and delivery of prostheses, my area of expertise, and leaving the surgery to the experienced operators.

The poor scientific methodology and paucity of long-term outcome data identified by this article in most of the recent literature is disheartening. Of particular concern is the potential for control of the science by commercial companies with undue influence over researchers and institutions, undue emphasis on short-term outcome, and suppression of "uncomfortable" data.

Perhaps it is time for a "consumer" revolt. We clinicians have the potential to provide the definitive outcome data by pooling our results. Using appropriate computer programs and the Internet as the conduit, universities or other organizations, such as the International College of Prosthodontists, could be the central data repository. The academics could use their expertise in assessing the data. This would provide the ideal "connect" between the clinician and academic and free both from undue commercial influence.

**Nicola Zitzmann**
**University of Basel**
**Basel, Switzerland**

Clinicians are currently overburdened with a tremendous number of clinical reports, longitudinal studies, and few randomized clinical trials (RCT) presenting promising results on a large variety of dental implants. The assessment of the study methodologies and the implant systems used is a complex approach, and a comprehensive paper like the one presented here is required to help clinicians identify those products with quality claims that are based on some scientific evidence.

With the increasing number of implant types, the detailed list (including 220 brands and 80 manufacturers) is of increasing importance, especially when treating patients who received implants elsewhere. The detailed description of variations in implant design enables the operator to identify the implant by clinical or radiographic assessment. The authors describe the different study designs, their scientific value, and specific applications related to the purpose of the study. It is, for instance, recommended to use an RCT when two products are to be compared. The presentation of opportunities and limitations of different study designs accompanied by clinical examples may be useful for researchers in planning implant trials.

The authors present the guidelines for standardization of dental implant products for the US (FDA) and Europe (ISO), and describe the problems encountered with certification, which focuses mostly on the production process instead of the implant itself. It is appalling that extensive clinical documentation is available from only 10 manufacturers, and 29 companies are selling their products without providing any documentation at all. The authors emphasized that the selection of an implant system that holds records of clinical documentation for at least 5 years is mandatory.

Seven important clinical outcome parameters have been selected by the authors for their perfectly structured presentation. These parameters are related to implant placement and osseointegration (the influence of implant geometry, surface topography, and implant material), esthetics, complications such as periimplant mucositis and marginal bone loss and mechanical problems, which affect either the implant itself or the superstructure.

The pertinent literature has been thoroughly reviewed and the relevant studies presented according to the methodology strength of the study design (categories A1, A2, B, C). A summary of the results is always placed in front, providing the reader with a comprehensive overview.

Additional factors for selecting an implant system are the service offered by the manufacturer, implant costs, and patient satisfaction in relation to the treatment costs. The latter were not included in the present manuscript, but should be considered as important and may, therefore, be the topic of further studies. One should keep in mind that by reducing material costs a larger group of patients would be able to afford and benefit from implant treatment.