Summary of: Implant surface characteristics and their effect on osseointegration

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VERIFIABLE CPD PAPER

FULL PAPER DETAILS

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Aim The aim of this literature review is to find current knowledge of dental implants focusing on materials, designs and surface modifications and to understand which implant surfaces have more predictable clinical outcomes. **Research material and methods** An electronic search using PubMed/Medline, Scopus and The Cochrane Library databases from 1950 onwards was conducted using keywords and terms. Published papers were then obtained online or from specialist libraries. References from individual published papers were also searched for relevant publications. **Results** Different designs, materials and methods to modify surfaces of implants have been discussed in this paper. Many laboratory studies using animal models reported improved biological outcomes with surface modification of implants at the microscopic level. Despite pure titanium being commercially the prime material of choice, ceramics have the potential to become the next generation of dental implants. Presently there is not sufficient scientific evidence for routine use of ceramic implants. **Conclusions** Pure titanium is the ideal material for implants. Rough implant surfaces are believed to deliver better osseointegration compared with smooth surfaces however, results from different studies vary. It is not clear which combination of different surface modifications provide a more predictable outcome. More standardised high quality prospective studies are required to prove which implant surfaces have the optimum properties for replacing missing teeth.

EDITOR'S SUMMARY

In the annals of human endeavour some themes recur with a frequency that might be construed as tedious or predictable but which might also be viewed as reassuring. The uptake of new ideas is invariably the preserve of what we might nowadays describe as entrepreneurs, those who take a chance, see a gap in the market and explore, or exploit, a product or service with a view to commercial advantage.

History and current everyday life are littered with examples, and readers, after a moment's reflection, will be able to list instances in their own spheres of activity inside and outside their working environments. The race for supremacy in the Victorian world of railways might provide a macro example. Which route would enable faster travel, which might provide connections for industries previously hampered by poor distribution, which would attract an as yet untapped leisure market?

In our present circumstances dental implants are a classic case in point. From clumsy and disastrous early beginnings, the advent of titanium as a main material transformed success rates and with them a superfluity of systems, designs, applications, connections and so forth. All the paraphernalia, as with any 'new' product, has spilled into the open as companies vie with one another for market share, clinician endorsement and evidence-based advantage. Whilst this provides the classically declared positive of choice, it also presents the bewildered practitioner with confusion. How does one select the 'best' of whatever variants are offered? We have two routes, trial and error (not a very good option in an expensive and litigious world) and research.

As we learn from this paper, and indeed know from life's vagaries, there is never enough research and it rarely seems to be able to answer exactly the question to which we urgently need a response. 'That' we are told 'will be years away'. The authors here have done a very good job in assembling the knowledge we do have into a sensible catalogue of what does and doesn't work: pure titanium is the ideal material for implants; rough implant surfaces are probably better for osseointegration compared with smooth surfaces. In all honesty, not a lot to go on but better than nothing; and no reflection on the authors of this paper. In a hundred years' time we might have a better idea. The Great Western Railway might have now disappeared as an entity but the rails are still there.

The full paper can be accessed from the *BDJ* website (www.bdj.co.uk), under 'Research' in the table of contents for Volume 218 issue 5.

Stephen Hancocks
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IN BRIEF
- Explores the effect of various dental implant surfaces on osseointegration.
- Explains different materials, designs and surface characteristics that are available for dental implants.
- Discusses the techniques that are used to modify dental implant surfaces to provide more predictable outcomes.

COMMENTARY

Over the last 15–20 years, dental implants have become increasingly important as a means by which to replace missing natural teeth. They have significantly expanded the range of options available to clinicians, and in many scenarios constitute the single best option for tooth replacement, in preference to provision of fixed or removable partial dentures.

Large numbers of dentists now place implants as part of their routine practice, and patients are increasingly aware of implants as a viable treatment option. Dental implants are not without their problems, however. Once regarded (particularly it seems by patients) as a panacea for replacing teeth, we now recognise that, while success rates (defined as implant retention) remain high, a number of complications may arise, including failure of osseointegration and development of peri-implantitis, which can present very significant management challenges. Case selection continues to be fundamentally important when embarking on implant therapy.

A large number of manufacturers now produce an even larger number of different types of implants, with considerable variations in the material used, the morphology of the implant, the type of abutment connection and the surface characteristics. In short, an almost bewildering array of different implant systems is available – the question is, which ones offer the most predictable outcomes? This is the topic addressed in the paper by Barfeie *et al.*, who have systematically reviewed the available scientific literature in relation to implant surface characteristics and effects on osseointegration. It becomes clear that new implant systems are being produced at such a rate that the research cannot keep up. Much of the published literature describes findings from animal studies, and many of the human studies relate to implant systems that are no longer in production. Despite these difficulties, some clear messages emerge from the available literature; titanium continues to remain the material of choice (though ceramics have potential to become the next generation of implants), and rough implant surfaces result in better osseointegration than smooth surfaces (though smooth surfaces seem have a reduced risk of future bone resorption). This paper is an excellent resource for dental clinicians who provide implants, but as highlighted in the paper, more research is required to establish the specific implant characteristics that will optimise both short- and long-term success of implant therapy.

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AUTHOR QUESTIONS AND ANSWERS

1. Why did you undertake this research?

It has been reported that there are currently over 500 dental implant systems with various designs and surface characteristics available in the market. In recent years, with rapid increase in the use of dental implants in order to replace the missing teeth, there is a need to increase the awareness and understanding about implant surfaces. This research was conducted to provide an overview of available implant surfaces in terms of designs, materials and surfaces characteristics, and their effect on osseointegration.

2. What would you like to do next in this area to follow on from this work?

Implant dentistry is an evolving science. New materials and designs for dental implants are being introduced and the impact of these surface modifications on osseointegration remains unclear. Part of this research paper discusses the future of implant surfaces. The authors are interested to investigate newer generations of implant surfaces (eg ceramic, zirconia oxide, nanotube surfaces) and understand what combination of surface modifications will provide more satisfying results for both patients and practitioners.