Dentist is the most abundant mineralised tissue in the human tooth. In spite of this importance, over half a century of research has failed to provide consistent values of dentin’s mechanical properties. In clinical dentistry, knowledge of these properties is pivotal to any number of variables ranging from innovations in preparation design to the choice of bonding materials and methods.

The Young’s modulus (the measure of the stiffness of an isotropic elastic material) and the shear modulus (modulus of rigidity) are diminished by visco-elastic behaviour (time-dependent stress relaxation) at strain rates of physiologic (functional) relevance. The reported tensile strength data suggests that failure initiates at flaws. These flaws may be intrinsic, perhaps regions of altered mineralisation, or extrinsic, caused by cavity or post channel preparation, wear, or damage. There have been few studies of fracture toughness or fatigue (1-4). Finally, little is known about the biomechanical properties of altered forms of dentin subsequent to decay, the influence of irrigants, chemicals and the choice of curing techniques used for bonded restorations (5).

Studies suggest that there are at least two forms of transparent or sclerotic dentin; a form associated with caries and a form associated with age-related changes in the root. The impact or extrinsic, caused by cavity or post channel preparation, wear, or damage. There have been few studies of fracture toughness or fatigue (1-4). Finally, little is known about the biomechanical properties of altered forms of dentin subsequent to decay, the influence of irrigants, chemicals and the choice of curing techniques used for bonded restorations (5).

Studies suggest that there are at least two forms of transparent or sclerotic dentin; a form associated with caries and a form associated with age-related changes in the root. The impact of occlusal loads, concentration and high tensile stress between crown–tooth, core–tooth, and core– post, post–tooth interfaces, the shape of the post, the adhesive strength at the crown–tooth interface, the material properties of the crown, post, and core material chosen, the amount of available tooth structure and the anatomy of the tooth. Any combination of vectored stress concentration and high tensile stresses will predispose these teeth to fracture without an adequately engineered restorative design.

Reengineering
Reengineering negative treatment outcomes is a significant part of the contemporary endodontic oeuvre. The presence of apical periodontitis may or may not affect the outcome of initial endodontic treatment (9); however, there is a general consensus that apical periodontitis upon tooth strength as a function of these altered forms of dentin is not well understood.

The long-term predictability of residual coronal tooth structure to function in a manner commensurate with the demands of the orofacial ecosystem, may need to be reassessed in light of observations that sclerotic dentin, unlike normal dentin, exhibits no yielding before failure and that the fatigue lifetime is deleteriously affected at high stress levels (10). Mechanisms for energy dissipation and crack growth resistance present in young dentin are not present in old dentin. Restorative methods and techniques, particularly as it relates to ferrule creation for endodontically treated teeth, may need to be amplified to address the fact that fatigue crack growth resistance of dentin decreases with age (11).

Back to the Egg: Part II
Kenneth Serota continues his look at the Endodontic Implant Algorithm

“...there are primary causes that predispose teeth to fracture and secondary causes that predispose fracture after a period of time.”

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terial and current studies (30-32). Apical surgical “correction” of intracanal infections may isolate, but not eliminate, the residual microflora of the root canal space. It should therefore be limited to situations where non-surgical retreatment is judged impractical.

With the range of sophisticated equipment and material in the conventional endodontic armamentarium, this is a remote consideration at best. When the etiology is independent of the root canal system, surgery is the most beneficial treatment (33). Non-surgical retreatment may still be indicated in these cases, especially when intracanal infection cannot be ruled out. Time constraints or financial pressures, should never be a factor in making surgery the first treatment choice (Fig 7).

Other options

The variables associated with non-surgical retreatment are myriad and treatment outcome studies in endodontics have been egregiously abused by those wishing to diminish the value of re-engineering natural teeth. Many studies have categorised teeth with caries, fractures, periodontal involvement and poor coronal restorations as negative for retreatment as a function of the size of the lesion treated (34).

Levels of apical resection (35) and the type of root end filling material make a difference in surgical treatment outcome success (36); however, the dentin bonded composite technique and the use of composite materials has not been widely reported. As these techniques dote the resected root face, sealing off the cut tubuli, they may prove to be the most effective retrograde surgical protocols of all. In regard to periapical re-surgery, the literature is unclear.

Gagliani et al. (37) compared periapical surgery and re-surgery over a five-year follow-up period. Using magnification and microsurgical root-end preparations, the positive outcome for primary surgery was 86 per cent and 59 per cent for resurgery. While others have shown posi-

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\(^**\) when used twice daily

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References:

tive outcomes for resurgery, the decision remains highly case specific. In spite of our best efforts, negative endodontic treatment outcomes occur and orthopedic replacement of teeth and their surrounding an-
choring structures is an integral part of contemporary founda-
tional treatment planning.

Engineering methods

A recent article by Assuncao et al (14) describes engineering meth-
ods used in dentistry to evaluate the biomechanical behavior of osseo-integrated implants. Photo-elasticity is used for
determining stress concentration factors in irregular geometries. The strain-gauge methodology on dental implants provides both in vitro and vivo measurement strains under static and dynamic loads. Finite element analysis can simulate stress using a computer-created model to calculate stress, strain, and displacement. An analysis of the impact of mechanical/thermal engineering in implant-supported reconstructions are beyond the scope of this publication; however, the replacement of lost teeth by implant should, without exception, provide a feeling of restitutio ad inte-
grem. The means by which the restoration of the original con-
dition at the “crown/root” interface is idealised will be detailed.

‘The structure and composition of teeth is perfectly adapt-
ed to the functional demands of the mouth, and are superior in conjuction with any arti-
cial material. So first of all, do no harm…’ Anonymous

The final part of Kenneth Serota’s paper will be pub-
lished in a future issue of Dental Tribune U.K.

References


Parasites

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About the author

Kenneth S Serota, DDS, MMSc graduated from the University of Toronto, Faculty of Dentistry in 1975 and was awarded the Gwyn N Setter Memorial Key for excellence in Prosthodontics. He received his Certificate in Endodontics and Master of Medical Sciences Degree from the Harvard-Vermont Dental Center in Boston, MA. A Past President of the New York Academy of Endodontics, he has been involved in dental education and research in nuclear medicine scanning procedures related to dental pathology, his passion is education and most recently e-learning and rich media. Ken provided an interactive endodontic program for the Ontario Dental Association and was awarded the GDA award for outstanding teaching at a dental conference. He was selected for Fellowship in the Pierre Fauchard Academy and is a Fellow of the Academy of Dentistry International. The author of over sixty publications, he has lectured on Endodontics internationally. He is on the editorial board of Endodontic Practice, Endodontic Tribune and Implant Tribune. The founder of ROOTS – an online educational forum for dentists from around the world who wish to learn cutting edge endodontic therapy, he recently launched IMPENDYS, www.rximplants.com and www.diedensein.org in order to provide a clear understanding of the endodontic implant procedures in foundation and advanced courses. He is currently pursuing the development of computer-aided design and computer-aided manufacturing in oral implantology. J Craniofac Surg 2009 Jul;20(4):1175-9