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Thomas R Pitt Ford: detail, diligence and determination

Reviewing the academic achievements of Tom Pitt Ford provides a measure of consolation to a mourning friend. As professionals, we all seek to add to the knowledge base of our discipline and to aid in its development, clinically and scientifically. More often than not, we are too busy to reflect on if and how we succeed in these efforts. Tom definitively was busy in his career, and if he reflected on his achievements (I hope he did), he certainly did not boast of them in public. It is therefore with great pleasure, and some melancholy, that I review his scientific career.

His scientific production may be divided into several main areas of interest. From the outset, one topic of particular interest to him was dental materials, particularly, endodontic materials.

As we have come to realize and to use as a reference for our clinical and scientific efforts, endodontics is largely the cure, or the prevention, of apical periodontitis. Apical periodontitis is preceded by infection and necrosis of the pulp, which is caused by traumatic or infectious damage to the pulp-dentine organ. A crucial step in the prevention of pulpal and periapical infections, is the immediate damage control of exposures of the pulp; i.e. indications and procedures for pulp capping. This clinical procedure represents the link between Conservative Dentistry and Endodontics, and it was in this field Tom's scientific endeavours started.

His early work compared the ability of commercial brands of calcium hydroxide-containing materials to induce or support the formation of a dentine bridge under the capping material. He demonstrated that the mere presence of $Ca(OH)_2$ was not enough for such support; other factors of the formulations were necessary for optimum results (Pitt Ford 1980). Materials for pulp capping hardly changed for the next two decades, but with the advent and application of mineral trioxide aggregate (MTA), we can sense Tom's excitement when this material that he tested so extensively, proved to give enhanced tissue responses and stimulate pulpal repair better than the conventional materials (Mitchell *et al.* 1999, Nair *et al.* 2008), and when he could see that it was adopted and taught in dental schools throughout the UK (Pitt Ford *et al.* 2007).

In the late 1970s, at the start of Tom's scientific carrier, we may safely say that experimental, clinical and laboratory research in dentistry was still in its infancy. The field of Endodontics was dominated by strong opinion-makers, and teaching and clinical practices were based much on expert opinion in the absence of sound clinical data. Concepts of aetiology and pathogenesis, on effects and importance of clinical procedures, and on criteria for testing of new methods and materials varied widely. Tom was among the first to address such issues with a modern approach of generating hypotheses and testing them in discretely designed experiments where one could assess one variable at the time.

Resisting fluid leakage along root fillings was, at that time, considered crucial for their clinical performance, both conventionally and surgically placed. Tom's initial work followed this mainstream of research, and he set out to test endodontic materials for leakage and to evaluate the then novel glass–ionomer cements for suitability as root filling materials. He quickly realized that glass–ionomer cements, at least with regard to leakage resistance, were not optimal as root filling materials (Pitt Ford 1979, Pitt Ford & Roberts 1990). However, Tom pursued and extended his research into biological aspects of these materials, and made some discoveries that we should heed even today. One of them was that leakage, at least in the form of *ex vivo* dye leakage, was not *per se* related to biological tissue responses to root fillings with different materials in animals (Pitt Ford 1983). He went on to study which measurable factors in the filled root canal were indeed associated with an inflammatory response (translating into 'failure' of treatment). He then made another astute and easily forgotten observation: debris in the root canal was not related to infection or to the inflammatory response (Pitt Ford 1982). This was and in part still is, contrary to the opinion of many, but in

this work he very elegantly demonstrated that debris in the root canal was of significance in this regard only when infested with microorganisms. Whilst the foundation for the modern concept of the singular importance of microbial activities for the initiation, progression and persistence of apical periodontitis had been laid by the studies of Kakehashi *et al.* (1965), Bergenholtz (1974), Kantz & Henry (1974) and Sundqvist (1976), Tom's work here coincided with and was supported by the extensive experiments by the group of Möller in Gothenburg (Möller *et al.* 1981, Dahlén *et al.* 1982), and solidified the infectious nature of the disease.

More than many, he then rightly focussed on the importance of the irrigation liquids and preparations for medication of the canal as keys to improved success in endodontic treatment. Today, we see a renewed interest in the effect of instrumentation techniques on 'canal cleanliness' and debris removal. Whilst these are important in the overall antimicrobial strategies of treatment, we may be wise to remember the conclusion from Tom's paper in 1982 (Pitt Ford 1982): 'There was a close association between not only infection and inflammation, but also infection and resorption. In contrast, there was no relationship between infection and the extent of debris in the root canal'. The ability of procedures to remove debris is clearly subordinate to measures ensuring asepsis and antisepsis.

Early in his career, Tom took a particular interest in materials for root-end filling. Whilst endodontic surgery and apical filling is a time-honoured procedure, it was considered until recently to give unpredictable and often poor clinical and radiographic results. The material of choice for filling up to the 1990s was amalgam, the performance of which had been improved by changes in its formulation and in its preparation. However, significant improvement in the treatment outcome awaited the use of the surgical microscope and the introduction of new materials.

Tom pursued his interest in new materials for root-end filling with animal testing. In an elegant paper from 1990, he documented that the disinfection of the main root canal is of crucial importance, and that even an adhesive material, the glass–ionomer cement, was unable to prevent bacterial leakage, and subsequent apical inflammation, from an infected root canal when placed as a root-end filling (Pitt Ford & Roberts 1990). Working with Bunsan Chong, he assessed modifications of the glass–ionomer cements for their suitability as root-end filling materials, but observed that the introduction of composite resins for light curing of the glass–ionomer reduced rather than enhanced important physical properties (Chong *et al.* 1991). Around this time, he also initiated work together with Jens Andreasen in Copenhagen, and tested extensively a variety of materials for root-end filling also prior to replantation of extracted teeth (Andreasen & Pitt Ford 1994, Pitt Ford *et al.* 1994).

These studies of Tom's placed zinc-oxide-eugenol-based cements in the forefront of currently available materials for root-end filling; particularly, the resin-reinforced variant known as IRM. Tom's work in this field was essential in side-lining the traditionally dominant use of amalgam; this material is now no longer recommended for this usage.

Since the mid-90s, the collaboration with Mahmoud Torabinejad on MTA has been the most extensive of Tom's scientific activities. If you were looking for expertise on the biological effects of endodontic materials including materials for root-end filling (a phrase promoted by Tom) in the early 90s, Tom stood out as one of the most knowledgeable and productive in this field. So, when the MTA idea was to be tested and put into practice, it was quite natural that Tom and Mahmoud should work closely together. This collaboration would turn out to be a very productive and fruitful one. The design and refinement of the composition of the MTA, together with the extensive technological, biological and clinical testing of this material have provided endodontics with a highly versatile and forgiving material to be used in a variety of situations. It is to their credit that we for the first time in decades have seen the implementation of a product that not only eases the job and looks good, but which may also improve the clinical results of endodontic procedures.

Tom's experience with clinical and biological studies was particularly important for the documentation of MTA (Koh *et al.* 1997, Camilleri & Pitt Ford 2006, Nair *et al.* 2008); and he also concluded the first truly randomized clinical trial of two materials for root-end filling: MTA and IRM. This study (Chong *et al.* 2003) stands out as the best documentation of apical surgery with either material so far designed and executed, and gives proof that both can provide impressively high healing rates.

Being a teacher and a skilled practitioner with an inquisitive mind, Tom was also engaged in many other fields of research: he published high-quality research papers on pulpal blood flow and devices for assessment of pulpal vitality; he worked in radiology on practical issues of film sensitivity and on the radiographic

detection of periapical lesions; on dental students' performance of endodontic procedures; and more.

It was his activity in endodontic filling materials that initiated my collaboration with him: in 1988, he visited NIOM, the Scandinavian Institute of Dental Materials, where I also worked at the time. At that particular time, the concept of endodontics as either the prevention or cure of apical periodontitis was being developed. Later, when the idea to present this concept in a comprehensive text was pursued, it was my good fortune to benefit from the superb qualities of Tom as an experienced writer and co-editor of the ensuing text, *Essential Endodontology: Prevention and Treatment of Apical Periodontitis*, now in its second edition (Ørstavik & Pitt Ford 2008). The book would not have happened without him applying his best qualities: attention to detail, diligence and determination to get the work done. Tom had then finished a 10-year period as editor of the *International Endodontic Journal*. During that period, the journal had become truly international, with contributions from many of the foremost scientists in Endodontology as well as in related fields. His ability to attract authors from other, established, science-based disciplines and to integrate their work with the traditionally technical discipline of endodontics was one of the prerequisites for the general acceptance of Endodontology as a topic with a scientific base and with proponents and practitioners that have academic training and evidence-based procedures. As if this were not enough, he has edited the later versions of *Harty's Endodontics in Clinical Practice* (Pitt Ford 2004) as well as publishing his own textbook together with Heather Pitt Ford and John Rhodes: *Endodontics: problem-solving in clinical practice* (Pitt Ford *et al.* 2002).

He carried his work to the European scene as an active member of the European Society of Endodontology. In 1993, the British Endodontic Society hosted the sixth ESE biennial congress in London, with Tom as a major driving force together with the President, Anthony Hoskinson. He chaired the committee for endodontic education within the ESE, and thus had a major impact on the policy document which has been an important source of reference for the endodontic curriculum in dental schools in Europe and world wide.

The books also supplemented Tom's long-standing commitment to the advancement of Endodontology as a discipline and a speciality. His pioneering work in setting up the comprehensive graduate programme at Guy's and St Thomas' together with the Institute of Dental Surgery was essential for the eventual recognition of Endodontics as a specialty in the UK. The UK specialty and the programme are now references for the work seeking recognition of Endodontics as a European specialty (ESE 1998).

The academic activities of Tom Pitt Ford have been important for the development and recognition of Endodontology as a clinical and scientific discipline over the past 30 years. His efforts have contributed significantly to important scientific issues, particularly in relation to endodontic materials and their application. He has raised the standard for scientific writing and communication in the field; and he has been instrumental in the development of Endodontology as a specialty in the UK as well as in Europe. We hope that he himself did see and feel the effects of his work as his career developed, and that he felt the recognition by his peers and students that he richly deserved.

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