Lasers have been used in different medical fields for many years and have revolutionised many treatments, notably eye surgery and hair removal. This technology is also an established aspect of modern dentistry and is widely used in Europe and the USA. DTI editor Anke Schiemann had a chance to speak to Graeme Milicich, who is a fellow diplomat, and founding board member of the World Congress of Minimally Invasive Dentistry (WCMID), prior to the recent FDI Congress in Stockholm in Sweden.

Anke Schiemann: In a nutshell, what are the benefits of using laser in clinical dentistry today?
Graeme Milicich: Lasers have many applications in clinical dentistry. My research in the last four years focused on the clinical applications of hard tissue Erbium:YAG lasers. The broad range of laser applications has benefits for both the patient and the dentist. Many hard and soft tissue laser treatments are much less invasive compared with conventional approaches. I do not think there is another piece of technology in dentistry that has the ability Erbium lasers have to treat soft tissue, bone, and tooth structure, simply by changing laser-operating parameters.

What is the advantage of lasers over rotary cutting instruments, and are there limits to what a laser can do?
Yes, there are some limitations as to what can be done with a laser, like the removal of metal restorations and crowns. But if you consider the totality of the types of treatments offered by general dentists, these limitations are far less compared to conventional rotary instrumentation. For example, you could run into problems with soft tissue contours or bone levels associated with a deep cavity while cutting tooth structure. With a laser you can remove both bone and soft tissue by simply changing a setting, and are therefore able to complete the procedure in one appointment—something that cannot really be done with a high-speed drill. Generally speaking, what can be done with a drill, scalpel, or bone bur can also be done with a laser. Additionally, many patients have a fear of dentistry based on the association of vibrations and sensations associated with rotary instruments. These sensations do not occur with the laser, meaning the patients find treatment much more acceptable.

What role does laser fluorescence detection currently play in the prevention of oral disease?
With the advent of the KaVo DIAGNOdent more than ten years ago, the first general dentistry application of laser fluorescence was introduced. Like with any new technology, it had to be understood first, in order to achieve the best results.

In order to provide patients with accurate treatment recommendations based on the results of early cavity detection, an understanding of minimally invasive concepts is essential. Otherwise, the profession can be open to claims of over treatment. These changes often derive from a lack of understanding of the technology, its accurate application, and the concepts and applications of minimally invasive techniques. Often, astute clinicians are at the forefront of the application of new technology and techniques, and the research literature struggles to keep up with the clinical pioneers. This leads to a period with a shortage of validation for what eventually becomes a new and accepted standard of care. Further developments in the field are occurring and, as they filter into general practice, the standards of diagnosis will continue to improve. For new diagnostic technology to be readily implemented in general practice, it has to be both cost-effective and time-efficient.

What are the advantages of lasers in endodontics or periodontology?
There are many case studies showing excellent results when treating peri-implantitis with a laser. The laser’s use for debridement and disinfection gives the clinician a tool that previously wasn’t available. The laser is safe to use around implants with little risk of damage to the implant. Personally, I have only treated one case of peri-implantitis so far, and it was a complete success.

The use of laser in fields like endodontics or periodontology is highly controversial. What are the main issues here?
Once again, competent laser clinicians are ahead of the research in these fields. Clinical results are being achieved that are now only beginning to be validated by research, until the research results are available, use of lasers in these fields is going to remain controversial for many. Those that are using lasers & are observing the clinical outcomes, have little doubt as to the efficacy of their treatments. Personally, I have been involved in research using the Waterlase (Er,Cr:YSGG) in endodontics. The ability for complete debridement of the canals following conventional canal preparation using radial firing tips in a non-ablative mode is significant, and addresses the issues of air and fluid entrapment at the apex that are associated with conventional techniques used for final canal debridement and rinsing.

In your FDI lecture you talked about new concepts associated with laser therapy. Can you give our readers a brief overview and explain these concepts?
The most common complaint from a new user is that it will not cut fast enough. The most significant contributor to slow ablation rates is the user, not the technology. The single biggest hurdle a dentist faces when beginning with laser is the difference between rotary instrumentation and lasers. When this is understood, a new laser dentist can become competent in a very short time. If these concepts are not well taught, then the new user will become frustrated and may fail to integrate their new laser into their treatment regimes.

The first concept is that lasers are end cutting. We have all become very competent using rotary instrumentation and have developed reflex motions as a result. The natural tendency is to apply these reflexes when using a laser and this leads to frustration for the new user. When using a high-speed bur, we tend to move the bur laterally to extend a cut. This does not work with a laser because it is end cutting, not side cutting. Therefore, the operator needs to learn a new way of pointing the laser directly in the direction where a cut needs to be extended. Anyone who has become competent in the use of air abrasion masters the use of a laser very quickly because the same concepts apply to both technologies.

The second concept is that lasers is slow. Once again, this concept is associated with our reflex motions associated with using high-speed handpieces. We tend to use a fast painting motion on the surface when contouring a cavity. Exactly the opposite applies when using a laser. Ablation rates are stalled by this rapid painting motion, and initially it requires a mental awareness to slow the motion of the tip, to allow ablation to occur. As competence increases, this phenomenon is used to control ablative actions. The natural reflexes are used to change laser settings, by increasing or decreasing the motion of the tip.

The third concept is focusing and defocusing the beam, to alter ablation rates without having to change power settings on the laser. This technique, in combination with slowing or speeding up the motion of the tip, allows the operator to finesse ablation rates to create very smooth contours.

The final concept is the clinically observable ablation threshold. Many new users focus on power settings and how far the tip should be from the surface, depending on what they want to do. Absolute distances in relation to operating parameters are impossible to give because there are so many variables involved, including the tip being used, the state of the tip, the air/water ratios, and the surface being ablated. As a tip is moved towards the tooth, it reaches a point where the operator can begin to see the commencement of ablation. This then gives a reference maximum operating distance in relation to the current operating parameters and tip being used. New users are taught to start out of focus and move towards the tooth until the clinically observable ablation threshold is reached. This distance can range over several millimetres depending on the various parameters. Understanding the concept helps new users avoid inadvertent high fluence effects at the ablation surface.

There are two other issues that will be dealt with as separate topics in the lecture in regard to ablation rates in enamel. This is the area that new users find most frustrating, because they tend to use rotary cutting movements with an end-cutting device. Firstly, because laser ablation is a non-contact technique, magnification is essential. Secondly, enamel ablation rates are related to the orientation of the long axis of the enamel prisms in relation to the plane of the ablation face. Ablation rates are 40 per cent greater when enamel prisms are ablated from their sides, rather than on their ends. This requires an understanding of the orientation of the long axis of enamel prisms in different surfaces of a tooth. The culmination of this understanding is epitomised in the time it takes a new user or a competent laser clinician to cut a slot preparation, with a new user often taking more than twice the time to complete the same procedure.