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Commentary by Mahmoud Torabinejad

Torabinejad M, Pitt Ford TR, McKendry DJ, Abedi HR, Miller DA, Kariyawasam SP (1997) Histologic assessment of Mineral Trioxide Aggregate as a root-end filling in monkeys. *Journal of Endodontics* 23, 225–8

Thorough cleaning and proper shaping of root canals and sealing them carefully usually results in clinical and radiographic success of a high percentage of teeth requiring root canal treatment. Following careful evaluation of the aetiology, the preferred treatment of failing root filling cases is nonsurgical retreatment. Complexity of root canal systems, inadequate instrumentation and presence of physical barriers make it difficult to achieve ideal goals for nonsurgical retreatment. When nonsurgical efforts fail, surgical endodontic therapy becomes the first alternative treatment to save the natural dentition.

Because most endodontic failures occur as a result of egress of irritants from root canals into the periapical tissues, a root-end filling material is used to provide an apical seal. In addition to its ability to seal, an ideal root end filling material must be biocompatible with periapical tissues and promote regeneration of these tissues that have been altered as a result of pulpal and periapical pathosis. Numerous materials have been suggested as root-end filling materials. Despite its many disadvantages, amalgam has been the most commonly used root-end filling material, and any new filling material is usually compared with it. Most of these materials have been tested in restorative dentistry under circumstances that are different than present in periapical tissues. The materials used to seal the root-end cavities are in constant contact with moisture and bear little or no pressure. When I came up with the idea of using Mineral Trioxide Aggregate (MTA) (which provides good seal under moist conditions) I contacted Dr Tom Pitt Ford and discussed experiments to test its efficacy.

Previous studies in this area lacked a systematic approach to the use of *in vitro* and *in vivo* tests. He helped me develop a set of laboratory, biological and animal studies before the use of MTA in humans. We published a series of experiments together regarding MTA as a root-end filling material. The article that he and I like the most in that series is entitled 'Histologic assessment of Mineral Trioxide Aggregate as a root-end filling in monkeys' and was published in the *Journal of Endodontics*.

This experiment was the final test to examine the suitability of a new root-end filling material. After demonstrating that MTA had similar or better properties compared with the commonly used root-end filling materials in *in vitro* tests, we performed a usage test in dogs. The use of MTA as a root-end filling material caused regeneration of new cementum over this material. This was a unique phenomenon that had not been reported to occur when other root-end filling materials had been investigated. To confirm this phenomenon and prove that the use of MTA as a root-end filling material results in complete regeneration of periapical tissues we used MTA or amalgam as root-end filling materials in six nonhuman primates and followed a clinical protocol for endodontic surgery in humans. After 5 months, the periapical tissues were evaluated histologically in a blind manner. We found no periapical inflammation in five out of six root-ends filled with MTA. In addition, we found five of the six root ends filled with MTA had a complete layer of cementum over the resected root-ends and root-end filling material. In some specimens fibre insertion into the new cementum covering MTA mimicked Sharpey's fibres. In contrast, all root-end cavities filled with amalgam showed periapical inflammation, and lack of cementum formation over this material.

Dr Pitt Ford was so excited about these findings that he knowingly called me at 3:00 in the morning when he looked at the histological slides for the first time. The findings from this study showed that complete regeneration of periapical tissues is possible when MTA is

used as a root-end filling material. In contrast, the use of amalgam as a root-end filling material should be discontinued because it does not allow regeneration of the periapical structure. The stark differences between histological findings in root-ends filled with MTA or amalgam in this study paved the way for the final phase of evaluation of this material in humans. Today, MTA is the material of choice for those who are looking for a material that seals well, is biocompatible and promotes regeneration of periapical tissues. Thanks to the insight and contributions of Tom Pitt Ford who helped us to examine this material systematically and use it as an aid to preserve the natural dentition.