Is regenerative endodontics the future?

By Prof. Beena Rani Goel, India

According to the American Association of Endodontists, regenerative endodontics is defined as “biologically-based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex”. There are two clinical concepts for management of endodontically compromised immature permanent teeth, one of which is the revitalisation approach to achieve tissue generation and regeneration in the root canal system. The second is focused on the active pursuit of pulp-dentine regeneration via tissue engineering technology to implant or regrow pulps.

There is hope that in the future regenerative endodontics may be an alternative treatment method for clinical endodontics. There are case reports demonstrating that after conventional root canal treatment, an abcessed tooth can heal and its root continue to develop after successful disinfection. This depends on whether the root canal space can be disinfected. Before the pulp becomes totally necrosed, the remaining pulp tissue may be recoverable after disinfection and help to regenerate the lost portion. Engineered pulp tissue may be inserted into the pulp space to enhance the regeneration, and to facilitate the entire recovery of pulp tissue and the generation of new dentine. When the entire pulp tissue is lost, synthesis of new pulp must take place in order to regenerate the tissue.

Pulp tissue regeneration has been difficult so far because the tissue is encased in dentine without collateral blood supply except from the root apical end. Now, with modern tissue engineering and the discovery of dental stem cells, regeneration of pulp and dentine appears finally achievable. Several different stem cells from pulp tissue have been discovered, including dental pulp stem cells from the pulp of permanent teeth, human exfoliated deciduous teeth and apical papillae. These cells have demonstrated characteristics of mesenchymal stem cells with multiple differentiation potentials. The source of cells is an issue in cell-based therapy. The supply of dental stem cells is limited, especially when derived from autologous sources. Not every individual who needs regeneration treatment has ready-to-use cells available.

Infection or trauma can lead to a total loss of pulp tissue. In order to generate pulp tissue from scratch, pulp stem cells have to be seeded into a scaffold and implanted into the canal space. Dental pulp stem cells, stem cells from apical papillae and pulp stem cells from human exfoliated deciduous teeth demonstrate the capability to de novo regenerate pulp and the former two are also capable of generating new dentine.

Tissue engineering processes involve developing an engineered construct in the laboratory, which is preceded by isolating stem cells from the body, expanding them in a culture and seeding these cultured cells on to nano-fibrous scaffolds in culture medium supplemented with growth factors. The engineered tissue is then transplanted into the recipient site. Three elements critical to the success of tissue engineering are stem cells, morphogens/growth factors and a scaffold.

The four factors that can lead to the growth of pulp tissue within the root canal space by inducing stem cells from the adjacent site to populate the area are thorough disinfection of the root canal, the presence of a matrix within the canal on which new tissue can grow, appropriate factors or stimuli present locally in the desired concentration and for the desired period, and the bacteria impermeable seal of the access opening.

In order to replace conventional root canal treatment, regenerative endodontics should be economical, clinically practical, non-lengthy and patient conducive so that it can be performed routinely.

A list of references is available from the publisher. Prof. Beena Rani Goel is the President of the International Academy for Rotary Endodontics and a well-known endodontist from India.

**Event tip**

Insights into the field of regenerative endodontics will be given today at a SDA Masterclass Presentation by Prof. Ken Hargreaves, Professor and Chair of Endodontics at the University of Texas Health Science Center. The lecture starts at 11 a.m. in hall 406.