

## Past and Present of Regeneration in Endodontics

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Regenerative endodontics is defined as “biologically based procedures designed to replace damaged tooth structures, including dentine and root structures, as well as cells of the pulp-dentine complex” [1]. Based on this definition, regenerative endodontic therapy (RET) is aimed to regenerate the pulp-dentine complex damaged by infection, trauma or developmental anomaly of immature permanent teeth with necrotic pulp. Regenerative endodontics is an important part of endodontic therapy today. It has many burning [2] but also unanswered questions. The treatments and outcomes of regenerative endodontics are so different from traditional endodontic therapy; therefore, it has attracted enormous interest and attention in the field of endodontics in recent years. Immature permanent teeth with necrotic pulp/apical periodontitis are traditionally treated with apexification procedure using calcium hydroxide to induce apical hard tissue barrier formation or apical MTA plug before root canal filling [3] an apical MTA plug is able to shorten the treatment time. The treatment outcome of calcium hydroxide apexification and apical MTA plug appears to be compatible [3,4]. In the year 2001, a new treatment option termed ‘revascularization’ was introduced in endodontics to manage an immature permanent tooth with apical periodontitis and sinus tract [5]. The term ‘revascularization’ was first used by Iwaya., *et al.* (2001). Later, revitalization instead of revascularization was proposed as a more applicable term as the tissues regenerated in the canal space were not only blood vessels but also hard and soft tissues [6]. The term ‘regenerative endodontics’ was adopted by the American Association of Endodontists in 2007 [7], based on a tissue engineering concept. Regenerative endodontics applies the concept of the triad of tissue engineering, stem cells, biomimetic scaffold, and bioactive growth factors in the canal space to regenerate the pulp tissue damaged by infection, trauma or developmental anomalies. The term ‘revitalization’ was used by the European Society of Endodontology (ESE) position statement in 2016 (ESE 2016). In the endodontic literature, revascularization, revitalization, and regenerative endodontics are used synonymously and interchangeably. The protocol of revascularization was proposed by Banchs and Trope (2004) [8], based on the experiments observed from revascularization of reimplanted teeth [9], root canal disinfection [10] and induction of blood clot in the canal space [11]. Banchs and Trope (2004) added the antibiotic minocycline to that used by Iwaya., *et al.* (2001) and has become known as triple antibiotic paste. Furthermore, mineral trioxide aggregate (MTA) was used as an intracanal barrier instead of glass ionomer cement. This protocol has been broadly adopted in many subsequent studies in the literature and the Clinical Considerations for a Regenerative Procedure (AAE 2016). Their treatment also showed elimination of clinical symptom/sign and apical periodontitis in addition to promoting thickening of the canal walls and apical closure of immature permanent teeth with apical periodontitis. Therefore, regenerative endodontics was consequently recommended as a treatment alternative to traditional apexification for immature permanent teeth with necrotic pulp [11].

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