

AAE Clinical Considerations for a Regenerative Procedure

7/31/13

Case Selection:

- Tooth with necrotic pulp and an immature apex.
- Pulp space not needed for post/core, final restoration.
- Compliant patient/parent.
- Patients not allergic to medicaments and antibiotics necessary to complete procedure.

Informed Consent

- Two (or more) appointments.
- Use of antimicrobial(s) .
- Possible adverse effects: staining of crown/root, lack of response to treatment, pain/infection.
- Alternatives: MTA apexification, no treatment, extraction (when deemed non-salvageable).
- Permission to enter information into AAE database (optional).

First Appointment

- Local anesthesia, dental dam isolation and access.
- Copious, gentle irrigation with 20ml NaOCl using an irrigation system that minimizes the possibility of extrusion of irrigants into the periapical space (e.g., needle with closed end and side-vents, or EndoVac™). Lower concentrations of NaOCl are advised [1.5% NaOCl (20mL/canal, 5 min) and then irrigated with saline (20 mL/canal, 5 min), with irrigating needle positioned about 1 mm from root end, to minimize cytotoxicity to stem cells in the apical tissues.
- Dry canals with paper points.
- Place calcium hydroxide or low concentration of triple antibiotic paste. If the triple antibiotic paste is used: 1) consider sealing pulp chamber with a dentin bonding agent [to minimize risk of staining] and 2) mix 1:1:1 ciprofloxacin: metronidazole: minocycline to a final concentration of 0.1 mg/ml.
- Deliver into canal system via syringe
- If triple antibiotic is used, ensure that it remains below CEJ (minimize crown staining).
- Seal with 3-4mm of a temporary restorative material such as Cavit™, IRM™, glass-ionomer or another temporary material. Dismiss patient for 1-4 weeks.

Second Appointment (1-4 weeks after 1st visit)

- Assess response to initial treatment. If there are signs/symptoms of persistent infection, consider additional treatment time with antimicrobial, or alternative antimicrobial.
- Anesthesia with 3% mepivacaine without vasoconstrictor, dental dam isolation.
- Copious, gentle irrigation with 20ml of 17% EDTA.
- Dry with paper points.
- Create bleeding into canal system by over-instrumenting (endo file, endo explorer) (induce by rotating a pre-curved K-file at 2 mm past the apical foramen with the goal of having the entire canal filled with blood to the level of the cemento–enamel junction).

- Stop bleeding at a level that allows for 3-4 mm of restorative material.
- Place a resorbable matrix such as CollaPlug™, Collacote™, CollaTape™ or other material over the blood clot if necessary and white MTA/CaOH as capping material.
- A 3-4 mm layer of glass ionomer (e.g. Fuji IILC™, GC America, Alsip, IL) is flowed gently over the capping material and light-cured for 40 s. MTA has been associated with discoloration. Alternatives to MTA should be considered in teeth where there is an esthetic concern.
 - **Anterior and Premolar teeth** - Consider use of Collatape/Collaplug and restoring with 3mm of RMGI followed by bonding a filled composite to the beveled enamel margin.
 - **Molar teeth or teeth with PFM crown** - Consider use of Collatape/Collaplug and restoring with 3mm of MTA, followed by RMGI or alloy.

Follow-up

- Clinical and Radiographic exam
 - No pain, soft tissue swelling or sinus tract (often observed between first and second appointments).
 - Resolution of apical radiolucency (often observed 6-12 months after treatment)
 - Increased width of root walls (this is generally observed before apparent increase in root length and often occurs 12-24 months after treatment).
 - Increased root length.
 - Pulp vitality test
- The degree of success of Regenerative Endodontic Procedures is largely measured by the extent to which it is possible to attain primary, secondary, and tertiary goals:
 - Primary goal: The elimination of symptoms and the evidence of bony healing.
 - Secondary goal: Increased root wall thickness and/or increased root length. (desirable but perhaps not essential)
 - Tertiary goal: Positive response to vitality testing. (which, if achieved, could indicate a more organized vital pulp tissue)

References

Chapters

Hargreaves KM, Law AS. Regenerative Endodontics. Chapter 16. Pathways of the Pulp 10th ed. Eds, Hargreaves KM, Cohen S. Mosby Elsevier, St Louis, MO, 2011: 602-19.

Murray PE, Garcia-Godoy F. Stem cells and regeneration of the pulpodentin complex. Chapter 5. Seltzer and Bender's Dental Pulp – 2nd ed. Eds, Hargreaves KM, Goodis HE, Tay FR. Quintessence Publishing Co Inc, Hanover Park, IL, 2012:91-108.

Articles

Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: new treatment protocol? J Endod 2004;30:196-200.

Bose R, Nummikoski P, Hargreaves K. A retrospective evaluation of radiographic outcomes in immature teeth with necrotic root canal systems treated with regenerative endodontic procedures. J Endod 2009;35:1343-9.

de Paz S, Pérez A, Gómez M, Trampal A, Domínguez Lázaro A. Severe hypersensitivity reaction to minocycline. J Investig Allergol Clin Immunol. 1999;9(6):403-4

da Silva LAB, Nelson-Filho P, da Silva RAB, Flores DSH, Heilborn C, Johnson JD, Cohenca N. Revascularization and periapical repair after endodontic treatment using apical negative pressure irrigation versus conventional irrigation plus triantibiotic intracanal dressing in dogs' teeth with apical periodontitis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109:779-87.

Galler KM, D'Souza RN, Federlin M, Cavender AC, Hartgerink JD, Hecker S, Schmalz G. Dentin conditioning codetermines cell fate in regenerative endodontics. J Endod 2011;37(11):1536-41.

Geisler TM. Clinical considerations for regenerative endodontic procedures. Dent Clin North Am 2012;56:603-26.

Hargreaves KM, Geisler T, Henry M, Wang Y. Regeneration Potential of the Young Permanent Tooth: What Does the Future Hold? J Endod 2008;34:S51-S6.

Hargreaves KM, Diogenes A, Teixeira F. Treatment options: biological basis of regenerative endodontic procedures. J Endod In press.

Huang GT-J. Apexification: the beginning of its end. Int Endod J 2009;42:855-66.

Huang GTJ. A paradigm shift in endodontic management of immature teeth: Conservation of stem cells for regeneration. J Dent 2008;36:379-86.

Law A. Considerations for regeneration procedures. J Endod In press.

Lovelace TW, Henry MA, Hargreaves KM, Diogenes A. Evaluation of the delivery of mesenchymal stem cells into the root canal space of necrotic immature teeth after clinical regenerative endodontic procedure. J Endod. 2011 Feb;37(2):133-8.

Martin DE, Henry MA, Almeida JFA, Teixeira FB, Hargreaves KM, Diogenes AR. Effect of sodium hypochlorite on the odontoblastic phenotype differentiation of SCAP in cultured organotype human roots. J Endod 2012 Mar(3):e26

Nosrat A, Seifi A, Asgary S. Regenerative endodontic treatment (revascularization) for necrotic immature permanent molars: a review and report of two cases with a new biomaterial. J Endod. 2011 Apr;37(4):562-7. Review.

- Petrino JA, Boda KK, Shambarger S, Bowles WR, McClanahan SB. Challenges in regenerative endodontics: a case series. *J Endod*. 2010 Mar;36(3):536-41.
- Reynolds K, Johnson JD, Cohenca N. Pulp revascularization of necrotic bilateral bicuspid using a modified novel technique to eliminate potential coronal discolouration: a case report. *Int Endod J*. 2009 Jan;42(1):84-92.
- Rodríguez-Lozano FJ, Bueno C, Insausti CL, Meseguer L, Ramírez MC, Blanquer M, Marín N, Martínez S, Moraleda JM. Mesenchymal stem cells derived from dental tissues. *Int Endod J*. 2011 Sep;44(9):800-6.
- Ruparel NB, Teixeira FB, Ferraz CC, Diogenes A. Direct effect of intracanal medicaments on survival of stem cells of the apical papilla. *J Endod* 2012 Oct(10);38:1372-5.
- Ruparel NB et al, Direct Effect of Intracanal Medicaments on Survival of Stem Cells of the Apical Papilla. *J Endod* 2012;38:1372–1375
- Thibodeau B, Teixeira F, Yamauchi M, Caplan DJ, Trope M. Pulp revascularization of immature dog teeth with apical periodontitis. *J Endod* 2007;33:680-9.
- Thibodeau B, Trope M. Pulp revascularization of a necrotic infected immature permanent tooth: case report and review of the literature. *Pediatr Dent* 2007;29:47-50.
- Torabinejad M, Turman M. Revitalization of tooth with necrotic pulp and open apex by using platelet-rich plasma: a case report. *J Endod*. 2011 Feb;37(2):265-8.
- Trevino EG, Patwardhan AN, Henry MA, Perry G, Dybdal-Hargreaves N, Hargreaves KM, Diogenes A. Effect of irrigants on the survival of human stem cells of the apical papilla in a platelet-rich plasma scaffold in human root tips. *J Endod*. 2011 Aug;37(8):1109-15.
- Wang XJ, Thibodeau B, Trope M, Lin LM, Huang G. Histologic characterization of regenerated tissues in canal space after the revitalization/revascularization procedure of immature dog teeth with apical periodontitis. *J Endod* 2010;34:56-63.
- Wigler R, Kaufman AY, Lin S, Steinbock N, Hazan-Molina H, Torneck C. Revascularization: A Treatment for Permanent Teeth with Necrotic Pulp and Incomplete Root Development. *J Endod* In press.
- Yamauchi N, Nagaoka H, Yamauchi S, Teixeira FB, Miguez P, Yamauchi M. Immunohistological characterization of newly formed tissues after regenerative procedure in immature dog teeth. *J Endod*. 2011 Dec;37(12):1636-41.