Bacteria in Dentinal Tubules

Extraradicular Infection

- Consensus: infection is primarily inside canal
  - good evidence from SEM and TEM studies
  - culturing is prone to false positives
- Upside: treatment rationale
  - intraradicular infection is much more accessible
  - non-surgical retreatment has high success
- When is extraradicular infection present
  - acute abscess, chronic abscess
  - special bacteria: Actinomyces, Propionibacterium
- Anatomy: where does the canal end?
  - bacteria may lodge in apical canal parts, close to the "end" of the root canal
How Do Bacteria Attack?

- With virulence!
  - They come in VERY big numbers
  - They have several unpleasant abilities

- With strategy!
  - They arrange in biofilms

(movie from Singh et al, Nature 417, 2002)
The Silver Bullet: antibiotics?

Antibiotic Myths

- Pain relief
- Bacterial spectrum
- Non-vital pulps
Antibiotic Facts

- Pain relief
  - antibiotics are no painkillers…
  - ibuprofen is the most effective pain medication

- Bacterial spectrum
  - broad-spectrum ABs should be avoided
  - oral penicillin has a good spectrum

- Non-vital pulps
  - treatment of infected root canals should normally be accomplished without ABs

Regenerative Endodontics

- What is it?
  - return of a vital response after nonvital response
  - in this context: reconstitution of functional pulp

- What are the goals and benefits
  - deposition of hard tissue for immature teeth
  - immunologically competent functional tissue

- What are the indications
  - currently: teeth with large apical foramina
  - research is underway to extend the spectrum
Regenerative Endodontics

- Stimulation vs. delivery
  - removal of cells and tissues, recruitment of undifferentiated cell populations

- autologous cells, apical papilla cells
- stem cells from other sources

- Scaffold
  - collagen, gel etc.
  - fibrin matrix

- Crucial: Blood supply
  - VEGF and other key factors
  - transportation of bacteria/debris into periapical area

- Preop
- 9m recall

Case by Dr. Patrick King
Case 1

- 10 year old female presented to the pedo clinic with pain to biting on the upper right side
- Radiograph reveals decay approximating the pulp
- Cold (-), Percussion (+), Mobility (1), throbbing pain
- PARL – possibly developmental or pathosis

Case 1

- Upon access necrotic pulp
- Irrigation w/17% EDTA
- triple antibiotic paste (minocycline/cephalexin*/metronidazole) placed to WL
- Minocycline is now substituted with cipro (staining)
- Cotton and GI temporary

Case 1

- Patient returned after 1 month. No longer symptomatic, tooth was no longer mobile
- Following re-access bleeding was induced and allowed to clot. (wait 15 minutes)
- MTA placed against the clot and tooth permanently restored with dual cure composite
Injuries to Permanent Dentition Symposium

Considerations for Regeneration Procedures

Alan S. Law, DDS, PhD

Abstract

When pulp tissue becomes necrotic in immature teeth, the prognosis of the teeth is compromised. Disinfection difficulties in cleaning and shaping large canals with open apices, obturation of canals with open apices, and potential root fractures caused by thin and/or weakened root walls present several challenges including difficulty in maintaining a functional pulp tissue to and discuss considerations for regenerative endodontic procedures and how these procedures may increase the prognosis for immature teeth with necrotic pulp tissue.

Introduction

One of the goals of endodontics is keeping the dentition in a physiologically functional state. The concept of revitalizing tissue in the canal space has been around for several decades. A case series by Nygaard-Ostby and Hjortdal in 1971 with NaOCl and filling the canals with citrated whole blood or gel foam. In 1976, Nevins and associates followed by the placement of a gel (containing collagen, calcium chloride, and di-

Mineral trioxide aggregate, necrotic, outcomes, radiographic, considerations, discoloration, immature, mineral trioxide aggregate, root canal, disinfection, obturation, regeneration, root fracture, root wall thickness, revascularization, re-establishment, fibrous connective tissue, cementum, bone, reparative dentin, mineral trioxide aggregate.

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References


Clinical steps

- indication, prognosis
- anesthesia

1st appointment
- irrigation
- disinfectant paste
- scaffold

2nd appointment
- pulp space barrier
- definitive filling

Final Rx

Case by Dr. Nick Morton
Considerations

- **Indication**
  - large apical diameter, young patients

- **Diagnosis**
  - pulp necrosis, sinus tracts

- **Expected outcomes**
  - favorable / unfavorable

- **Clinical steps**
  - disinfection, scaffold, definitive closure

Expected Outcomes

- **Apical barrier**
  - radiographically visible, apical stop for fill

- **Root Length**
  - [Graph showing data]

- **Wall Thickness**
  - [Graph showing data]

Bose 2009
Regenerative Endodontics

- Nature of the deposited hard tissue
  - strengthening effect not clear
  - hard and soft tissues are important

- Predictability
  - treatment outcome may depend strongly on conditions
  - no clear clinical recommendation for procedure

- Conclusion
  - vital pulp therapy may become attractive?
  - significant development potential

Immunohistological Characterization of Newly Formed Tissues after Regenerative Procedure in Immature Dog Teeth

Nozomi Yamashita, DDS, MS, Hideaki Negoro, DDS, PhD, Sitzuko Yamachi, DDS, MS, Fabrina B. Teixeira, DDS, MS, PhD, Patricia M. Menezes, DDS, MS, PhD, and Mário Yamachi, DDS, PhD

A B

DAMT dentin

J Endod 2011, 37:1499-1503

Human histology:

“The tissues formed in the canal of revitalized human tooth are similar to cementum- or bone-like tissue and fibrous connective tissue.”
First Appointment

- Case selection
  - post space needed, allergies, compliance?

- Consent
  - mostly minors
  - discoloration of the crown possible: TAP, MTA

- Access

- Disinfection
  - no instrumentation
  - irrigation with 1.5% NaOCl
  - place Ca(OH)$_2$ or TAP/DAP

- Temporary filling

Issues

- TAP/DAP
  - 1:1:1 minocycline, ciprofloxacin, metronidazole
  - staining due to minocycline, remove or seal dentin

- Ca(OH)$_2$
  - recent data shows less cytotoxic compared to TAP
  - readily available, place with lentulo spiral

- Temporary filling
  - should avoid recontamination
  - e.g., 4mm layer Cavit plus IRM
Basic Research

Direct Effect of Intracanal Medicaments on Survival of Stem Cells of the Apical Papilla

Nikita B. Ruparel, DDS, MS, PhD, Caio C.R. Ferraz, DDS, MS, PhD

Abstract

Introduction: an alternative treatment for immature teeth with necrotic pulps. Typically, intracanal medicaments such as triple antibiotic paste (TAP) or double antibiotic paste (DAP) are used for disinfection. However, their effect on human stem cells of the apical papilla (SCAP) is not well understood. It has been hypothesized that intracanal medicaments at high concentrations are toxic to SCAPs. To test this hypothesis, a cell culture assay was used.

Material & Methods

SCAP were isolated from third molars and characterized. Human root segments were subjected to irrigation with either 17% EDTA; 6% NaOCl/EDTA; EDTA/2%CHX or NaOCl/EDTA/NaOCl/alc/CHX. Root segments were filled with SCAP and PRP, cultured for 21 days and then processed for immunohistochemistry. Viable stem cells were counted using Trypan blue staining.

Results:

Conclusions: Toxicity

- TAP in the currently used way has high concentration
- this is toxic to stem cell, impacting proliferation and differentiation
- lower concentrations and Ca(OH)₂ are preferred

Second Appointment

Timing
- after 3-4 weeks, longer not advisable

Anesthesia
- no vasoconstrictor

Reaccess and irrigation
- EDTA rather than antimicrobials

Scaffold
- overinstrument to create bleeding, alt. collagen plug

Tissue barrier
- collagen app. 3mm below CEJ, MTA fill, alt. GIC

Effect of Irrigants on the Survival of Human Stem Cells of the Apical Papilla in a Platelet-rich Plasma Scaffold in Human Root Tips

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Material & Methods

- SCAP were isolated from third molars and characterized
- human root segments were subjected to irrigation with either 17% EDTA; 6% NaOCl/EDTA; EDTA/2%CHX or NaOCl/EDTA/NaOCl/alc/CHX
- root segments were filled with SCAP and PRP, cultured for 21 days and then processed for immunohistochemistry
- cell viability was determined
Effect of Irrigation on SCAP

Follow-up

- Clinical
  - no pain or tissue swelling
  - between the two primary appointment and at 6m recall

- Radiographic
  - apical lesion resolves (6-12m)
  - root wall thickness increase (12-24m)
  - root lengthening, apical closure (variable)

- Discoloration
  - sometimes esthetically compromising

What to Expect:

- Public health impact
  - patient population currently small
  - extension to mature apices possible?

- Research impact
  - expect to broaden biological knowledge base
  - will establish molecular methods in the clinic

- Strategies
  - vital pulp therapy may become attractive and feasible
  - significant development potential
MTA pulp caps
- success rate varies from >90% to about 50%

Immature root development
- reasonable alternative to RCT
- MTA material of choice

Strategies
- avoiding pulp exposure preferable
- few well-done clinical studies

Vital Pulp Therapy

Predictable?
- for adults depends on pulpal status
- tests insufficient: cold, electric

Introduction
Physiology
Microbiology
Regeneration
Research in RegEndo

- Clinical treatment is effective
  - for a select patient pool
  - potential to extend the spectrum

- Stimulate research environment
  - towards understanding endodontic biology
  - validation of current treatment modalities?

- Unintended consequences
  - developments of new pulp testing methods
  - disruptive strategies?

Conclusions

- Long-range: two pillars
  - vital pulp therapy
  - minimal invasive conventional endodontics

- Transition period
  - gradual R & D for both
  - special cases: define indications and techniques

- Cognitive framework
  - establish best practices, currently insufficient evidence
  - socioeconomics and access to care

Conclusions

- Elimination of microbes is key to success
  - presence of organisms linked to disease symptoms
  - both counts and virulence of colonies are important

- Efficacy of antimicrobial regime can vary
  - understanding chemical and biological interactions
  - assessing cases and their individual challenges

- Clinical strategies must vary
  - wide range of possibilities
  - technical and biological details
A Break?

False Summit, Mt. Tam