Restorative Decision Making for Endodontically Treated Teeth

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I) Restorative Solutions

A) Endodontic Success
   1) Initial Treatment: Fonzar 93% 10 year Survival
   2) Re-Treatment: Salehrabi 85% 5 year Survival
   3) Surgical Re-Treatment: Toribinejad 63% 6 year Survival

B) Crown and Bridge Success – 3 unit FxPP; 4 unit FxPP
   1) DeBacker Studies – Endodontic Therapy Decreases Lifespan of Restorative Dentistry
      (a) Single Tooth: DeBacker 90% @ 10 years, 79.4% at 18 years
      (b) 3 Unit Fixed Bridge: DeBacker 60% at 20 years
      (c) 4 Unit Fixed Bridge: DeBacker 25% at 20 years

C) Removable Prosthodontics
   1) Loss of RPD Abutment Teeth
   2) Endo Treated RPD Abutment Teeth

D) Implant Success
   1) Single Tooth: Howe: 96.4% at 10 years Meta Analysis
   2) Single Tooth: Bahat: 99.3% at 3 years Private Practice

E) Cost Considerations
   1) Endo, Post and Core, Crown AND Crown Lengthening vs Single Tooth Implant
   2) Avoid CL if Net Remaining Bone to Vital Structure is < 10 mm for Future Implant
   3) Patil: CL Increases Failure Rate by 25%. If Poor C:R then Increases Failure Rate 60%
   4) 85% of Endo Treated Posterior Teeth Extracted had no Clinical Crown (1.4 mil Delta)
   5) 83% of Endo Treated Anterior Teeth Extracted had no Clinical Crown (1.4 mil Delta)

F) Long Term Success Rates:
   1) Single Crown: 93% at 10 Years
   2) Single Crown: 80% at 18 Years
   3) 3 unit FxPP: 60% at 20 Years
   4) 4 Unit FxPP: 25% at 20 Years
   5) Implants: 96% at 10 Years

A) So…where is the best place for Implants?

II) Reasons for RCT Failure

A) Restorative Based Reasons:
   1) Lack of Remaining Tooth Structure
   2) Lack of Proximal Contacts
   3) Use as Abutment for RPD or Fixed Bridge
   4) Molars more than Any Other Tooth
   5) Lack of Full Coverage Restoration
   6) Post Space Preparation
   7) Occlusal Load
   8) Functional Habits

B) Endo Based Reasons:
   1) Access Size
   2) File System
   3) Irrigation
   4) Sealer and Obturation
   5) Access Restoration

C) RCT Access Restoration Outcomes
   1) Biomimetic Goals – Preservation of Tooth by Allowing for Failure of Restoration

2) Frankenberger Biomimetic Study (Excellent Study)
   (a) Bonded Composite: Substandard
   (b) Fiber Reinforced Bonded Composite: Substandard
   (c) Gold Onlay, Gold Crown (Cemented with Glass Ionomer – All others Bonded)
   (d) Ceramic Onlay, Ceramic Crown: Zirconia, Lithium Disilicate, Zr Reinforced LD
   (e) Partial Coverage vs. Full Coverage: Full is Better
   (f) EndoCrown with Core/Crown as one solid piece
   (g) FGC > GO > Zr CC (Imagine Better Outcomes Yet if Bonded Gold Restorations)

D) Crowned vs. Not Crowned
   1) Posterior Crowns are HUGE Benefits
   2) Molars > PM in Both Arches
   3) Anteriors: Salehrabi: 85% Post Ext had no Crown Code; Same for 83% of Ant Ext

E) Posts vs. No Post
   1) Post Diameter: Wider isn't Better
   2) Post Length: Zhou & Wang: FEA – Longer is Much Better: 12 mm vs 7 mm

F) Crown Lengthening
   1) Patil: CL Increases Ext Rate 25%
   2) Crown:Root Ratio > 1 (longer crown than root in bone) Has Higher Extraction Rate

III) <u>Cracked Tooth Diagnosis</u>

A) Not what it used to be – No longer can we rely upon Probe to Apex – That's a late finding

B) Cracked Tooth Syndrome
   1) Chew & Thermal Sensitivity
   2) Cuspal Coverage Solves CTS

C) AAE Cracking Cracked Tooth Code 2008
   1) Craze Line: Not Through Dentin
   2) Fractured Cusp: Mostly Restorable if Supra-Boney
   3) Cracked Tooth: CTS
   4) Split Tooth: Mesial-Distally: Can be Restorable if Supra-Boney
   5) Vertical Root Fracture: Starts at Apex, not Coronally
   6) Then We need a Name for Crack that starts Coronally and Extends onto the Root

D) PAs don't help Finding Cracks– or do they?
   1) Lucency at apex of Post

E) Fayad: Five Focused CBCT Findings
   1) Bone, No Bone, Bone
   2) Buccal Bone Loss
   3) Lucency at Post Apex
   4) Space Surrounding Root at Anticipated Fracture
   5) Visualization of Actual Root Fracture

F) Fayad: Focused CBCT Findings Related to Root Cracks Past CEJ
   1) Root Fracture Appearance: Tight Space; Cortical Outline; Not Diffuse Bone Loss
   2) Necrotic Appearance: Diffuse Bone Loss
   3) Comparison to PAs: Hindsight Can Provide some Insight

G) Clinical View of Cracks internally
   1) Still being finely determined…
   2) Width of Crack Much More predictive than Length of Crack

H) Visualizing Cracks with Focused CBCT
   1) Azevado: Diagnosis is End Product of Interpretation
   2) Azevado: Can Visualize Damage from Cracks as well as Cracks Themselves
   3) Focused CBCT: Higher mA and Higher kV

I) RCT is Not Sole Source of Crack onto Roots

1) Chan: 58% Endo Treated
2) 41% of Cracks on Roots are Vital
3) Hilton and Farracane: Bonding May Help some Teeth (PM>Molars) Mn PM the Most
4) Full Coverage Onlays, Overlays and Full Crowns All Help in Limiting Progression
5) Krell: 20% of Cracked Teeth with Reversible Pulpitis Need RCT within 1 year

J)Treatment Cascade:

1) Cracked Tooth – Vital
2) Cracked Tooth – Reversible
3) Cracked Tooth – Irreversible
4) Cracked Tooth – Non-Vital
5) Root Fx Beyond CEJ => Ext (all?) vs Try to Save some Subset of these Findings

K) Alternative Thoughts

1) Decades of Ignorance => Treatment with GO and Crowns in MNSDDSMS Office
   (a) Handful of Ext due to Vertical Root Fractures
   (b) Some MUST have been cracks Past CEJ – But Completely Unknown
2) UIC Treatment Cascade is Negative Event Based
   (a) Extraction of Tooth => Retrospective Evaluation of CBCT to Detect Bone Pattern
   (b) No Evaluation of Successful Teeth for Same Bone Pattern Completed to Date
3) Davis & Shariff: Preservation of RCT Teeth with Known Internal Crack; No CBCT to Corroborate; RCT Completed; Immediately Internally Bonded Past Known Crack; Restored with Speed; Followed 53 Teeth for 4 years with 90% success – but no CBCT done to follow progress of cracks. Personal Communication – More Failures post pub.

IV) Final Restoration

A) Gold Overlay, Ceramic Overlay, Crown

1) Longevity of Emax, Zirconia, Ceramic Overlay or Gold Overlay
2) Donovan & RVT: 52 Year Retrospective: Gold Overlay 3% failure rate
3) Longevity of Ceramic Overlay – Compression Dome – Above Height of Contour (B & L)
4) Collares: Ceramic Overlayus MUST be Enamel Etched for Long Term Success
   (a) Failure Rate with Self Etching Cements Increases 142%

B) Replacement or Restoring Access

1) Who Decides
2) Requires Tooth Structure
3) Closed Sandwich with Dual Cure into Chamber

C) Overlay Preparation

1) Gold Overlay – Boxes and Occlusal Reduction with Counter Bevels (hence Overlay)
2) Ceramic Onlay/Overlay – Much more Smooth Rounded Boxes and Occlusal Reduction
   (a) Must Be Above the Buccal and Lingual Height of Contour

V) <u>Post and Core Research Findings</u>

A) Direct vs Indirect (cast) Post & Cores

B) Ferrule – Preserve for the Crown, Don't "waste" on the core

C) Length of Post in Dentin

1) Length of Post compared to Length of Root in Bone: Some Core Tooth Structure Helps
2) Zhou & Wang: Short Length Posts Result in More Catastrophic Failures

D) Tested for Years

1) Retention Studies: Threaded Posts Have Highest Retention; Length & Diameter Helps
2) Fracture Resistance: Threaded Posts Always Lose: Crown is Great Equalizer; Resin Cement on Crown Increases Fracture Resistance of All Posts
3) Photoelastic: Threads and Shoulders Have Stresses; Active Threading Causes Stress

E) Impact of Resin Cement is HUGE.

1) Resin Cement Makes ALL Crowns and ALL Posts Better
2) Resin Cement Makes Cast P&C Fracture 2-3X Higher Than Human Functional Load

F) My Masters Research Findings – Corroborated Through the Years with Published FEA
1) Stress from Shoulders and Threads and Stress at Material Changes
2) Dowel Takes Stress; However, Dentin Takes Stress When No Dowel
3) Parallel Dowels were More Favorable Than Any Other Shape
4) Cast Parallel and Cast Tapered Dispersed Stresses Most Favorably into Dentin
5) Appears as though Cast P&C Designs Transferred Less Stress to Dentin

G) Clinical Recommendations:
1) Avoid a Post Whenever Possible. Use Tooth Structure to Retain Core
2) When a Post is Absolutely Needed: Cast Gold Post & Core with Resin Cement
3) When the Case is On the Fence…Fiber Post with Bonded Composite Core

H) Direct Technique – Faster. Better for Esthetics, Compromised Strength Comparatively,
1) Determine Length – Leave 5 mm GP for Apical Seal
2) Prep & Modify Remaining Dentin to Butt Joint the Core – minimum 1 mm width
3) Re-Asses Post Length to Prepped & Modified Butt Joint
4) Remove GP with heat and files as Drills are easily deflected outside the canal
5) Shape Canal to Desired Diameter (Implant Driver Handles Work Wonderfully)
6) Total Etch into Entire Canal – 30 seconds with Water Irrigation
7) Chlorohexidine 2% with Peso Brush
8) Alternative (or optional) Step: Ethanol Wet Bonding
(a) Irrigate with 190 or 200 Proof Ethanol – 60 seconds
(b) Wick Excess with Paper Points – Do Not Desiccate
9) Bonding Agent – Contact Resin Cement Manufacturer to Make Recommendation
10) Cement Direct Post with Resin Cement with Intra-Canal Cannula
(a) Leave some Excess
11) Place Core Material Directly into Matrix before Post Cement Cures
(a) Burgess: Choose Composite Core Material with Higher Fill Rates
(b) Burgess: Choose Dual Cure Composite Core Materials over LC
12) Light Cure, Time Cure before Prepping Final Restoration

I) Indirect Technique – Strongest, Best For Limited Tooth Structure
1) Determine Length – Leave 5 mm GP for Apical Seal
2) Prep & Modify Remaining Dentin to Butt Joint the Core – minimum 1 mm width
3) Re-Asses Post Length to Prepped & Modified Butt Joint
4) Remove GP with heat and files as Drills are easily deflected outside the canal
5) Shape Canal to Desired Diameter (Implant Driver Handles work Wonderfully)
6) Impress with PE or PVS (scanning as a future option)
(a) Use impression post and roughen and/or heat to mushroom the top for pick up
7) Provisionalize with Conventional Techniques with Temporary Post
(a) Cement with Non-Eugenol Provisional Cements
(i) Dias: Eugenol RCT Liners Resulted in Resin Cements having Less Retention that ZnPO4 Cements
8) Final Cement Protocols (same as Direct Technique)
9) Total Etch into Entire Canal – 30 seconds with Water Irrigation
10) Irrigate Chlorohexidine 2% - 30 second with Peso Brush
11) Alternative (or optional) Step: Ethanol Wet Bonding – See Above
12) Bonding Agent – Contact Resin Cement Manufacturer to Make Recommendation
13) Cement with Resin Cement with Intra-Canal Cannula
(a) Remove Excess at 90-120 second
(b) Light Cure for Dual Cure action before Polishing Prep
14) Complete C&B as Planned

VI) Resorptions

A) Lindskog 2006: Three Causes: Trauma, Infection, Hyperplastic Tissue
B) Apical vs. Internal vs. External
C) Replacement Resorption
    1) Dentinal Replacement with Bone
    2) Results in Ankylosis => Clinically in Infra-Occlusion
    3) Any Root Surface
    4) Irregular Outline
    5) Variations of Radiodensity
D) Internal Replacement Resorption
    1) Aplastic Tissue
    2) Similar to Extracanal Invasive
    3) No Spider Leg Source
    4) Uncertain Etiology
    5) Treatment: RCT
E) Inflammatory Resorption
    1) Internal Resorption
        (a) Pulp Canal Balloons
        (b) Smooth Sided
        (c) Uniform Density to Lucency
        (d) Shifted Radiograph
        (e) Test Vital
        (f) Tx: RCT
    2) External Inflammatory Resorption
        (a) Not All Require RCT
        (b) Heithersay Classification
        (c) Class I – Small with Shallow Penetration
        (d) Class II – Reaching the Coronal Pulp Chamber
        (e) Class III – Traveling Apically into the Coronal 1/3 of the Root (likely untreatable)
        (f) Class IV – Extending Beyond the Coronal 1/3 of the Root (untreatable)
    3) Treatment Options
        (a) Extraction
        (b) Observation before Future Extraction – Protect Future Implant Site
        (c) Treatment of Class I or Class II
            (i) Schwartz, Robbins, Rindler 2010
            (ii) Surgical Exposure
            (iii) Debride Bleeding Points
            (iv) Cauterization
                - Trichloracetic Acid
            (v) Restore with Glass Ionomer or Composite
            (vi) RCT first if Debridement would enter canal (Class II)
            (vii) RCT first if Attempting to Save Class III
F) Modify Radiographic Follow Up
    1) Patients with one Tend to have more than one

About this handout: This handout isn't meant to follow along slide for slide to the program today. This is more meant to be a resource in the future as you encounter these cases. This handout is written in such a manner that it can be used as a step-by-step guide when treating removable cases in your office. Please feel free to direct any other questions or comments you may have to Dr. Sharifi's personal Email address at MNSDDSMS@AOL.com.