

**SHOULD A TOOTH HAVE ROOT CANAL TREATMENT**  
*OR*  
**BE EXTRACTED AND REPLACED BY A DENTAL IMPLANT**  
*OR*  
**BE EXTRACTED AND REPLACED BY A FIXED PARTIAL DENTURE?**

**Endodontic Treatment vs Extraction**

- Should heroic efforts be made to retain all teeth through endodontic treatment modalities?
- Should all teeth that need endodontic treatment be extracted and replaced by an implant or a fixed partial denture?

**Survey of Treatment Preferences of Dental Students and General Dentistry Faculty**

- Survey of 253 fourth-year dental students and 134 general dentistry faculty
- Preferences for RCT and restoration versus extraction and implant
- RCT more frequently selected by both students and faculty
- Students selected implants more frequently than faculty
- More recently graduated faculty selected implants more often than faculty who graduated earlier
- RCT more often selected for medically compromised patients
- Implants more commonly selected to replace single missing tooth
- Implants selected more commonly as complexity of RCT increased and complexity of prosthodontic treatment increased

DiPiero, J Dent Educ 2008;72:352-357

**FACTORS TO CONSIDER**

- **SURVIVAL RATES**
- Adjunctive procedures required
- Treatment fees
- Ethical considerations
- Approximation of the ideal (esthetics, comfort, function)
- Biologic factors (caries, root fracture, periodontal status)

**RCT Survival Rates (Initial Treatment)**

- 92 - 98% of teeth without periapical lesions remain disease-free after RCT
- 74 - 86% of teeth with apical lesions completely heal after RCT

Torabinejad, J Endod 2005;31:637-646

**Root Canal Retreatment and Apical Surgery**

- 66 - 86% average retreatment survival  
Gulabivala, 2003 presentation; Friedman, 2005 presentation
- 37 - 74% survival of root canal treated teeth after apical surgery

**Implant Success - Systematic Reviews**

- ISC - 97% after 4 years
- ISC - 98% after 6 - 7 years
- IFPD - 94% after 6 - 7 years
- IFPD - 93% after 10 years  
Creugers, J Dent 2000;28:209 - 217  
Lindh, Clin Oral Impl Res 1998;9:60 - 90  
Pjetursson, Clin Oral Impl Res 2004;15:625 - 642

**Meta-Analyses Of Conventional Fixed Partial Denture Survival**

- 94% survival rate after 5 years  
Salinas, 2007
- 74% survival rate after 15 years  
Creugers, 1994
- 75% survival rate after 15 years  
Scurria, 1998

### Most Common FPD Complications

- Caries (18% abutments)
- Pulpal health (11% abutments)
- Loss of retention (7%)
- Esthetics (6%)
- Periodontal health (4%)
- Tooth fracture (3%)
- Prosthesis fracture (2%)
- Esthetic veneer fracture (2%)

### Failure Of RCT Serving As FPD Abutments

- *Sundh, 47% lost after 18 years*
- *Karlsson, 67% of failures were nonvital teeth*
- *Nyman, 6 of 8 fractures were nonvital teeth*
- *Palmquist, 24% nonvital lost vs. 10% vital*
- *Randow, 3-21% nonvital teeth fractured*
- *Reuter, 1 fractures with RCT after placement*
- *Randow, 1 fractures with RCT distal abutments*
- *Leempoel, ↓ survival with nonvital abutments*

### Systematic Review of Outcomes

Torabinejad et al, J Prosthet Dent 2007;98:285-311

- Success of RCT, fixed partial dentures, and implant-supported single crowns could not be effectively compared due to very different definitions of success in the studies
- Both implants and root canal treatments resulted in superior long-term survival, compared to fixed partial dentures
- Survival of teeth with initial RCT and survival of single implants were comparable
- Extraction and no replacement
- Fixed partial denture
- RCT and restoration
- Implant-supported single crown

### Opinion – 3 Levels of Failure

- Implant single crowns (0 – 11%) (3% mean)
- Implant FPDs (2 – 13%) (6% mean)
- Initial RCT without apical lesion (2 – 8%)
- Tooth – supported FPD after 5 years (3 - 9%)
- Initial RCT with apical lesion (14 – 26%)
- RCT retreatment (14 – 34%)
- Tooth – supported FPD after 15 years (25 – 31%)
- Apical surgery (26 – 63%)

### FACTORS TO CONSIDER

- Survival rates
- ADJUNCTIVE PROCEDURES REQUIRED
- Treatment fees
- Ethical considerations
- Approximation of the ideal (esthetics, comfort, function)
- Biologic factors (caries, root fracture, periodontal status)

### Adjunctive Procedures

- Add to the cost
- Increase complexity
- May increase treatment time
- Can be the determining factor as to which treatment is best

### Adjunctive Procedures - Prior To or Concurrently With RCT

- Crown lengthening
- Orthodontic eruption
- Apical surgery
- Core buildup or post & core

### Adjunctive Procedures Required In The Presence Of Bone Loss - Prior To Or Concurrently With Implant Placement

- Sinus grafting
- Bone grafting
- Distraction osteogenesis
- Bone morphogenic proteins

### FACTORS TO CONSIDER

- Survival rates
- Adjunctive procedures required
- TREATMENT FEES
- Ethical considerations
- Approximation of the ideal (esthetics, comfort, function)
- Biologic factors (caries, root fracture, periodontal status)

### Treatment Fees

- RCT is generally less costly than extraction & implant placement
- RCT is covered by dental insurance and implants are not as widely covered
- However, the number of required adjunctive procedures can affect the cost as much or more than the basic RCT or implant and crown

### FACTORS TO CONSIDER

- Survival rates
- Adjunctive procedures required
- Treatment fees
- ETHICAL CONSIDERATIONS
- Approximation of the ideal (esthetics, comfort, function)
- Biologic factors (caries, root fracture, periodontal status)

### Ethical Considerations

- We have an obligation to provide the longest lasting, most cost effective treatment that addresses the chief complaint of the patient
- The treatment should be patient centered, not practitioner or third party payer centered

### Ethical Considerations

- Treatment should be based on scientific evidence whenever possible
- Treatment should preserve the biologic environment while maintaining or restoring esthetics, comfort, and function
- Practitioners have an obligation to present a balanced perspective regarding alternative treatments
- The capacity to achieve balance requires substantive clinical experience with available options

### Ethical Considerations

- We establish a long – term contract between ourselves and our patients
- We become “married” to many of our patients for a lifetime
- With implants, for the first time, we have also established a relationship that involves a company
- Will parts always be available?

### Ethical Considerations - Patient “Needs versus Desires”

- The preservation and restoration of oral health should always be the primary focus of our “profession”
- Patients should truly need and desire esthetic treatments rather than be sold a treatment that was not necessary or could have been provided more conservatively
- Today, I see a lot of “selling commercial products” (veneers or crowns instead of more conservative procedures)

### Ethical Considerations - Patient “Needs versus Desires”

- The preservation and restoration of oral health should always be the primary focus of our “profession”
- Patients should truly need and desire esthetic treatments rather than be sold a treatment that was not necessary or could have been provided more conservatively
- Today, I see a lot of “selling commercial products” (veneers or crowns instead of more conservative procedures)
- I also see implants being sold in place of preserving natural teeth

### FACTORS TO CONSIDER

- Survival rates
- Adjunctive procedures required
- Treatment fees
- Ethical considerations
- APPROXIMATION OF THE IDEAL (esthetics, comfort, function)
- Biologic factors (caries, root fracture, periodontal status)

### Approximation Of The Ideal

- Which treatment will provide the best esthetic result
- Which treatment will provide the highest level of sustained comfort
- Which treatment will permit the most normal function to occur

### Optimal Esthetics With Dental Implants Is Affected By

- Amount of bone / extent of bone resorption in edentulous area
- Soft tissue form, thickness, papilla form
- Unique tooth coloration / translucency and our ability to match it

### Preservation Goal

- “Our goal should be the perpetual preservation of what remains rather than the meticulous restoration of what is missing” *DeVan, 1952*
- Preservation is particularly critical when it comes to the bone, soft tissue, and papillae

### Results of Bone Grafting

- Can provide an excellent result, particularly with immediate implant placement and smaller bone defects

### Results of Bone Grafting

- Can provide an excellent result, particularly with immediate implant placement and smaller bone defects
- With moderate to large defects in existing edentulous areas, bone grafting can improve the esthetic result but it is usually not ideal

### Soft Tissue Results

- The soft tissue results can be compromised by mucosal thickness, mesiodistal form, and the presence or absence of a complete papilla

### Predicting Soft Tissue Results

### Esthetic Considerations When Deciding Whether to Retain Teeth Through RCT or Extract Them & Place an Implant

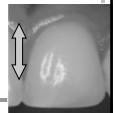
- Periodontal biotype
- Distance from interproximal bone crest to proximal contact of restoration
- Adjacent natural tooth or implant
- Long epithelial attachment present

### THE IMPACT OF PERIODONTAL BIOTYPE

- Two periodontal biotypes have been described
- The thin, scalloped biotype
- The thick, flat biotype

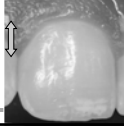
### THIN, SCALLOPED Biotype

- Thin tissue
- Limited attached gingiva
- Tall interdental papillae
- Triangular shaped maxillary central incisors



### THICK, FLAT Biotype

- Thick tissue
- Adequate attached gingiva
- Short interdental papillae
- Square shaped maxillary central incisors



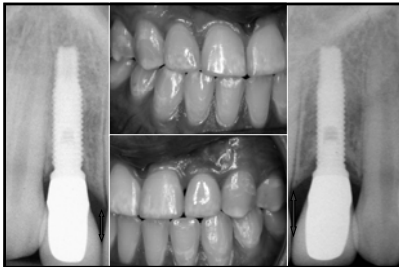
### Esthetic Considerations When Deciding Whether to Retain Teeth Through RCT or Extract Them & Place an Implant

- Periodontal biotype
- Distance from interproximal bone crest to proximal contact of restoration
- Adjacent natural tooth or implant
- Long epithelial attachment present

### Papilla Preservation Around Implants – Data that has emerged recently

- 27 single implants in anterior maxilla
- 52 papillae evaluated
- Papilla present 100% of the time when distance from proximal contact to bone was 5 mm or less
- Papilla present 50% of the time when distance was 6 mm or more

*Choquet et al, 2001*

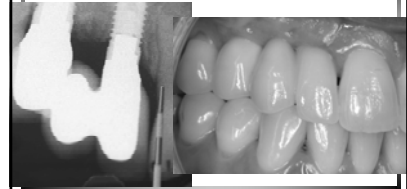


### Papilla Preservation (Thick-Thin)

- Peri-implant mucosa dimensions (bone to soft tissue crest) measured around 45 anterior single implants using bone sounding
- Interdental papillae can seldom be recreated with thin tissue when the distance from the bone to the marginal gingiva is greater than 4 millimeters

*Kan, 2003*

### Thin Biotype & 6 mm Distance



### Multiple Adjacent Implants –A Substantial Challenge Associated With Soft Tissue & Interdental Papilla Form Around Implants

- Papilla height and form
- Cervical embrasure space

### Adjacent Implants – Distance from papilla crest to bone crest

- 136 papilla heights measured in 33 patients
- Papilla height averaged 3.4 mm with a range from 1 to 7 mm
- On the average, only expect about 3 mm of tissue

*Tarnow, J Periodontol 2003;74:1785-1788*

### Esthetic Considerations When Deciding Whether to Retain Teeth Through RCT or Extract Them & Place an Implant

- Periodontal biotype
- Distance from interproximal bone crest to proximal contact of restoration
- Adjacent natural tooth or implant
- Long epithelial attachment present

### Extraction of a Tooth Adjacent to a Long – Standing Implant

- Bone remodeling occurs around implants whereby there is frequently tall, thin bone adjacent to the natural tooth with a steep apical slope from the tooth to the implant
- Clinical experience (no clinical data) suggests that extraction of the natural tooth produces substantial bone changes that result in loss of the thin angular bone and resulting papilla recession



### Extraction of a RCT Tooth Adjacent to a Long – Standing Implant

- It may be prudent to retain the natural tooth in an esthetically critical situation even if endodontic retreatment or apical surgery is required

### Esthetic Considerations When Deciding Whether to Retain Teeth Through RCT or Extract Them & Place an Implant

- Periodontal biotype
- Distance from interproximal bone crest to proximal contact of restoration
- Adjacent natural tooth or implant
- Long epithelial attachment present

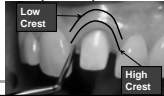
### Extraction Of Teeth With Long Epithelial Attachments

- Clinical experience (no clinical data) suggests this process can result in substantial recession of papillae as well as the midfacial mucosal crest



### Effect of Epithelial Attachment Location on Midfacial Gingival Crest Location

- Mean distance of 3 mm from midfacial gingival crest to bone crest with natural teeth but there are high bone crests with < 3 mm and low bone crests with > 3 mm  
Kois, 1994
- Midfacial peri – implant mucosa usually recedes about 0.5 to 1.0 mm when distance from midfacial gingival crest to bone of tooth to be extracted is 3 mm. There is less or no recession with high crest (< 3 mm) and more with low crest (> 3 mm)  
Kan, Clinical Experience



### Methods of Reducing the Effect of Tooth Extraction when there are Long Epithelial Attachments or Thin Biotypes / Tall Papillae

- Orthodontic eruption prior to extraction
- Connective tissue graft

### Mucosal Preservation Index (Easiest to Most Difficult)

- 1 – Thick biotype with 5 mm or less distance between bone and proximal contact
- 2 – Thin biotype with 4 mm or less distance between the proximal contact and interproximal bone crest
- 3 – Placement of adjacent single implants with 3 mm or less distance between bone and contact
- 4 – Extraction of tooth next to long – standing implant with angular bone form
- 5 – Extraction of a tooth with a long epithelial attachment
- 6 – Extraction of two adjacent teeth with long epithelial attachments and placement of 2 implants

### FACTORS TO CONSIDER

- Survival rates
- Adjunctive procedures required
- Treatment fees
- Ethical considerations
- Approximation of the ideal (esthetics, comfort, function)
- **BIOLOGIC FACTORS (caries, root condition, periodontal & pulpal health)**

### Biologic Factors – Caries Resistance

- For some patients caries is an ongoing challenge and results in a nearly continual need for treatment. These individuals are candidates for implant therapy.

### Biologic Factors – Root Condition

- With root fractures, prompt removal preserves bone whereas treatment can lead to bone loss and esthetic challenges

### Is Periodontal Treatment A Viable Alternative To Tooth Extraction And Implant Placement?

### Percentage of Periodontally Treated Teeth Extracted During Long – Term Periodontal Maintenance

- 8.4 % – Hirschfeld, 1978
- 11.4 % – McFall, 1982
- 7.1 % – Wood, 1989
- 4.2 % – Tonetti, 2000
- 2.9 % - König, 2002
- 5.5 % - Faggion, 2007

High levels of success have been attained

### Factors Identified in these Studies That Affected the Longevity of Periodontally Treated Teeth

- Amount of bone loss
- Degree of mobility
- Type of tooth (multi – rooted)
- Furcation involvement
- Pulp vitality
- Presence of Diabetes
- Patient compliance

### Periodontally questionable teeth have a poorer prognosis and they are defined as teeth with:

- Substantial furcation involvement
- Deep pockets
- Extensive bone loss
- Marked mobility Grade II or greater

*Hirschfeld, 1978*

### Longevity of Periodontally Questionable Teeth

- 15 year study
- 43 to 60% of teeth with questionable prognoses were lost in spite of periodontal therapy and proper maintenance

*McFall, 1982*

So decision to retain or extract needs to be based on level of disease

### Gingival Inflammation as a Risk Factor in Tooth Mortality

- Teeth consistently surrounded by inflamed gingiva (bleeding on probing) had a 46-times higher risk of being lost than those with minimal or no inflammation
- Only two-thirds of such teeth were retained throughout the 26-year observation period


*Schätzle and Löe, J Clin Periodontol 2004;31:1122-1127*

### Does The Pulpal Status Of Adjacent Natural Teeth Affect The Prognosis Of Dental Implants?

### Implant Failure Associated with Asymptomatic RCT (Reported in Multiple Papers)

- Patient treatment reports with no incidence data
- Tooth causes implant problems
- Caused by developing apical lesion on adjacent tooth or reactivation of a prior apical lesion
- Inhibits osseointegration
- After implant failed and was removed, sinus tracts were traced from the implant site to adjacent RCT in some reports

### FACTORS TO CONSIDER (Con't)

- **FPD SPAN LENGTH** 
- Alignment of the tooth / abutment teeth (tipping)
- Ability to restore the tooth is compromised
- Psychologic factors
- Other considerations

### Span Length

- Higher failure rate with longer spans (12% with 3 units and 31% with 4 units)  
*Morant, 1956*
- 5 units or more failed more often  
*Reuter, 1984*
- 5 units or more (35% failed after 20 years)  
*Lindquist, 1998*
- Tooth fracture incidence as high as 25% with long span cantilever prostheses  
*Carlson, 1989*

### Long Span Cantilevers & Nonvital Abutments

- Significantly more failures when abutments were nonvital  
*Decock, 1986*
- Higher failure with nonvital distal abutment  
*Karlsson, 1989*
- Higher caries risk on nonvital abutments  
*Hämmerle, 2000*  
*Valderhaug, 1997*  
*Glantz, 1993*

### FACTORS TO CONSIDER

- FPD span length
- **ALIGNMENT OF THE TOOTH / ABUTMENT TEETH (tipping)**
- Ability to restore the tooth is compromised
- Psychologic factors
- Other considerations

### Tooth Alignment

- Inclined teeth (potential FPD abutments) are more prone to loss of retention and tooth fracture
- Mesially and lingually inclined mandibular molars are particularly problematic
- Tipped abutments are also problematic in the presence of long spans and / or heavy occlusal forces

### FACTORS TO CONSIDER

- FPD span length
- Alignment of the tooth / abutment teeth (tipping)
- **ABILITY TO RESTORE THE TOOTH IS COMPROMISED**
- Psychologic factors
- Other considerations

### Compromised Ability To Restore The Tooth

- Caries / fracture leaves little tooth structure or a weakened tooth
- Minimal or no ferrule can be formed
- Post length or diameter will be inadequate

### Ferrule Dimensions

- Crown ferrules are more effective than core ferrules
- What is an effective crown ferrule height?  
*Hoag, 1982 - 1 to 2 mm*  
*Sorensen, 1990 - 1 to 2 mm*  
*Milich, 1992 - 1 mm*  
*Assif, 1993 - 2 mm*  
*Libman, 1995 - 1.5 to 2 mm*  
*Isidor, 1999 - 1.25 to 2.5 mm*  
*Yue, 2003 - 2.0 mm*  
*Mezzomo - 2.0 mm*  
*Tan, 2005 - 2.0 mm*



### Ferrule Uniformity

- A 2 mm uniform crown ferrule (2 mm on all 4 surfaces) was compared with a non-uniform ferrule (a 2 mm facial and lingual ferrule but only 0.5 mm on the proximal surfaces)
- A uniform ferrule produced significantly greater fracture resistance than a non-uniform ferrule
- A non-uniform crown ferrule, while not as good as a uniform ferrule, still produced significantly greater resistance to fracture than no ferrule

Tan, 2005

### Amount Of Tooth Structure Required For Ideal Restorability

- Need 2.0 mm ferrule for crown to grasp tooth structure
- 2 mm for biologic width
- 0.5 – 1.0 (finish line above attachment)
- Total of ~5 mm of tooth structure occlusal to the bone or bone removal / orthodontic eruption will be necessary

### FACTORS TO CONSIDER

- FPS span length
- Alignment of the tooth / abutment teeth (tipping)
- Ability to restore the tooth is compromised
- PSYCHOLOGIC FACTORS
- Other considerations

### Psychologic Factors

- Some patients have a fear of surgery (implant or apical)
- Some patients have a fear of root canal treatment
- There are patients who want to retain their own teeth
- There are patients who are frustrated with recurring biologic problems such as caries or periodontal disease

### FACTORS TO CONSIDER

- FPD span length
- Alignment of the tooth / abutment teeth (tipping)
- Ability to restore the tooth is compromised
- Psychologic factors
- OTHER CONSIDERATIONS

### Other Considerations – Potential Causes of Implant Complications and Higher Implant Failure Rates

- Therapeutic maxillary radiation (25% implant loss rate)
- Type IV bone (16% implant loss rate)
- Smoking (11% implant loss rate)
- Implant length - 10 mm or less had higher failure rate in initial studies. Recent studies of short implants are promising but I feel we need more data

### Other Considerations – Potential Causes of Implant Complications and Higher Implant Failure Rates

- Proximity to vital structures and neurosensory disturbance potential (7% incidence with implants)
- Use of Bisphosphonates for cancer or osteoporosis requires long – term data to determine the possible negative affect on dental implants but there are concerns

### What Are The Most Common Dental Causes Of BIS-associated osteonecrosis (BON)

- Number One is tooth extraction
- Active periodontal disease
- Endo surgery
- Ill-fitting dentures
- Trauma to tori
- Any procedure that exposes bone – implants?
- It may occur spontaneously

### American Dental Association Report of Expert Panel and 2008 Recommendations

- 3,607 adverse events reported to FDA as of 2007
- 93% associated with IV use
- Incidence of ONJ in oral bisphosphate users in one study was 1 in every 2,260 patients
- Another study determined the frequency was about 4%

### Characteristics of Individuals Who Have An Increased Risk Of BON

- Older than age 65
- Periodontitis present
- Using oral steroids for chronic conditions
- Using bisphosphonate for more than 2 years
- Presence of diabetes

### Considerations for “At Risk” Individuals

- Retain teeth rather than extract them but avoid manipulation beyond root apex relative to RCT
- Consider the use of FPDs rather than extraction and implants
- My suggestion – use pulpally kind procedures and materials with FPDs)

### Considerations For “At Risk” Individuals If Implants Are Used

- Information and informed consent (discuss risks, benefits, and alternatives such as retention of teeth through periodontal and / or endodontic treatment or replacement using conventional fixed partial dentures
- Conservative surgical procedures (avoid simultaneous placement of a large number of implants) (avoid guided bone regeneration)

### Considerations for “At Risk” Individuals

- Sterile surgical technique
- Use of oral disinfectants (Peridex 2 times per day for 2 months or more if healing is slow)
- Good oral hygiene and regular care
- Use of antibiotics (based on risk of infection and not the potential for preventing BON)

### CONCLUSIONS

- Success / failure data alone does not provide a balanced perspective regarding the most appropriate treatment modality
- Each tooth and patient must be individually evaluated to determine which treatment will provide the best result in terms of esthetics, comfort, function, and cost - effectiveness

### CONCLUSIONS

- The number of adjunctive procedures required with a specific treatment modality may determine the preferred treatment
- In esthetic locations, retaining a tooth through RCT or even completing adjunctive endodontic procedures such as retreatment or apical surgery may be advantageous in the presence of a thin biotype, unfavorable bone to proximal contact distances, adjacent implant, or long epithelial attachments

### CONCLUSIONS

- Implants are often the treatment of choice for patients with recurring caries or periodontal disease, or where there is limited tooth structure occlusal to the bone
- Retaining natural teeth may be advantageous in the presence of therapeutic doses of maxillary radiation, very poor quality bone, or when vital structures are located in proximity to potential implant sites

### CONCLUSIONS

- Implants are often preferred over tooth – retained fixed partial dentures when potential abutment teeth are intact or minimally restored, where the span length is extended and when the abutments are not well aligned with each other
- The patients feelings about a particular treatment can have a profound affect upon the treatment modality selected