Diagnosis, Restorability and Prognosis

11.12.18
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Specialist in Restorative Dentistry, Hodsoll House Dental Practice, Kent.
My Experience

- Qualified in 2002 from KCL
- VT, SHO in Rest Dent, SHO in Maxfac
- 2 years in general practice (NHS and Private)
- Pre-registrar training at St George’s Hospital
- Specialty Registrar at Sheffield Teaching Hospital
- Head and Neck Oncology Fellowship at MRI, The Christie, Liverpool Dental and Aintree Hospitals
- Locum consultant at Sheffield, Leicester/Derby, Guys, St George’s Hospitals
- Consultant at St George’s Hospital since Nov 2015
- Specialist practitioner at Hodsoll House Dental practice since Aug 2017
Aims & Objectives

Aims
- Consider diagnosis and the factors that affect restorability to include tooth factors, strategic worth and patient modifying factors.

Learning objectives
- Improve knowledge, understanding and clinical application knowledge of the area around tooth restoration and worth.
- Improve confidence in treatment planning when many options are possible – with evidence to guide discussion.
- Improve communication and messaging to patients around complex treatment planning – making them aware of their role in the decision-making.
- Understand when a natural tooth that is broken down is valuable and can be predictably restored and when the opposite applies.
Diagnosis on Demand? The Computer Will See You Now

2018

Dr Hannah Fry uncovers the inside story of a healthcare revolution, with behind-the-scenes access to Babylon Health, who want to prove that their AI is a match for human GPs.
What would diagnosis in Rest Dent look like for AI?

- Dentine hypersensitivity
- Reversible pulpitis
- Irreversible pulpitis
- Acute apical periodontitis
- Chronic apical periodontitis
- Acute apical abscess
- Chronic apical abscess
- Lateral periodontal abscess
- Pericoronitis
- Erupting 8s, dry socket
- ANUG/ANUP
- Muscular spasm / TMJD
- ORN / MRONJ
- Non-odontogenic pain
But they start from what a patient might say to the computer...

Pain

- Short, sharp, shooting
  - Elicited by hot, cold, sweet
    - Caries, dentine hypersensitivity (lost filling, recession, erosion, attrition, abrasion)
  - Elicited on biting
    - Cracked cusp, fractured tooth, loose filling, high spot

- Extreme intense lingering pain
  - Swelling, temperature, malaise
    - Acute apical periodontitis
  - Cannot locate tooth, sensitive to hot
    - Acute irreversible pulpitis

- Dull, throbbing, lingering pain
  - Localised
    - Tooth TTP
    - Apical periodontitis, sinusitis
    - Gingival inflammation
    - Periodontal (food packing), pericoronitis
    - Inflammation and necrosis
    - ANUG/ANUP
  - Generalised
    - Diffuse
    - Dry socket
    - TMJD

- Atypical pain
But then you have to look inside the mouth and find something to explain the diagnosis.

Light, mirror and periodontal probe

Recession
Abrasion
Attrition
Erosion
Cracked cusp
Caries
Fracture
Food trapping
Perio pockets
Large fillings
Exposed bone
Odd lesions

Magnification
Tooth slooth
Electric pulp tester
Hot / cold
Radiograph +/- GP point
New periodontal disease classification – BSP to release guidance on how to use it soon

Table 1A: Staging of periodontal disease (Papapanou et al., J Clin Periodontol 2018(S20):S162-170)

<table>
<thead>
<tr>
<th>Periodontal stage</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Stage III</th>
<th>Stage IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity</td>
<td>Intermal CAL at site of greatest bone loss</td>
<td>1 to 2 mm</td>
<td>3 to 4 mm</td>
<td>&gt;5 mm</td>
</tr>
<tr>
<td></td>
<td>Radiographic bone loss</td>
<td>Coronal third (15% to 33%)</td>
<td>Coronal third</td>
<td>Extending to middle or apical third of the root</td>
</tr>
<tr>
<td>Teeth loss</td>
<td>No tooth loss due to periodontitis</td>
<td>Tooth loss due to periodontitis</td>
<td>Tooth loss due to periodontitis of 5 or more teeth</td>
<td>Tooth loss due to periodontitis of 5 or more teeth</td>
</tr>
<tr>
<td>Complexity</td>
<td>Local</td>
<td>Maximum probing depth ≤6 mm</td>
<td>Mostly horizontal bone loss</td>
<td>In addition to stage II complexity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vertical bone loss &gt;6 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Periradicular involvement Class II or III</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate ridge defect</td>
<td></td>
</tr>
<tr>
<td>Patent and distribution</td>
<td>Add to stage as descriptor</td>
<td>For each stage, describe extent as localized (&lt;50% of tooth involved), generalized, or molecular pattern</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The initial stage should be determined using clinical attachment disease (CAL) if not available then radiographic bone loss (RBL) should be used. Information on tooth loss that can be attributed primarily to periodontitis if available may modify stage definition. This is the case even in the absence of complexity factors. Complexity factors may shift the stage to a higher level, for example if two or three would shift to either stage III or IV (depending on the stage of CAL). The distinction between stage III and stage IV is primarily based on complexity factors. For example, a high level of tooth mobility and/or periodontal abscesses would indicate stage IV. For any given case one or more, not all, complexity factors may be present, however generally it only takes one complexity factor to shift the diagnosis to a higher stage. It should be emphasized that these case definitions are guidelines and should be applied using sound clinical judgment to arrive at the most appropriate clinical diagnosis. For post-treatment patients, CAL and RBL are still the primary stage determinants. If a stage-shifting complexity factor(s) is eliminated by treatment, the stage should not retrogress to a lower stage since the original stage complexity factor should always be considered in maintenance phase management.

Table 1B: Grading of periodontal disease (Papapanou et al., J Clin Periodontol 2018(S20):S162-170)

<table>
<thead>
<tr>
<th>Periodontitis grade</th>
<th>Grade A</th>
<th>Grade B</th>
<th>Grade C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct evidence of progression</td>
<td>Longitudinal data (radiographic bone loss or CAL)</td>
<td>Evidence of no loss in the exam</td>
<td>Evidence of ≥2 mm over 3 years</td>
</tr>
<tr>
<td></td>
<td>S bone lossage</td>
<td>0.05 to 0.5</td>
<td>0.5 to 1.5</td>
</tr>
</tbody>
</table>

Primary criteria

Indirect evidence of progression

- Case phenotypes
- Heavy binocular disease with low levels of binocular disease
- Destruction of clinical parameters suggestive of periods of rapid progression and/or early onset disease (e.g., molarization pattern, lack of improved response to standard binocular control therapy)

Grade modifiers

Risk factors

- Diabetes
- Non-diabetes
- Severe or moderate smoking
- Severe or moderate tobacco use
- Severe or moderate alcohol use
- Severe or moderate drug use

Grade should be used as an indicator of the rate of periodontitis progression. The primary criteria are either direct or indirect evidence of progression. Whenever available, direct evidence is used, in its absence indirect estimation is made using bone loss as a function of age at the most affected tooth or case presentation (radiographic bone loss expressed as percentages of root length divided by the age of the subject). RBL, as PGM, should initially assume grade B disease and seek specific evidence to shift towards grade A or C if available. Once grade is established based on evidence of progression, it can be modified based on the presence of risk factors. CAL = clinical attachment loss; IBA=IA = interproximal bone loss; RBL = radiographic bone loss.
Single deep pocket and swelling/sinus in attached gingivae

Lateral periodontal abscess
Perio-endo lesion
Root fracture
Heat is good at telling you when a tooth is diseased.

Cold and EPT are good at telling you when a tooth is healthy.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (identify disease)</th>
<th>Specificity</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPT</td>
<td>72%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold</td>
<td>83%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Seltzer 1963: 97% of the time teeth negative results.
Restorability
245 teeth - assessed before and after restoration removal

56% chance of detecting caries, cracks or marginal breakdown from clinical and radiographic examinations

95% of the teeth had one or more factors that could have contributed to pulpal and periapical disease

<table>
<thead>
<tr>
<th></th>
<th>Before restoration removal</th>
<th>After restoration removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caries</td>
<td>47 (19.2%)</td>
<td>211 (86.1%)</td>
</tr>
<tr>
<td>Cracks</td>
<td>57 (23.3%)</td>
<td>147 (60%)</td>
</tr>
<tr>
<td>Marginal breakdown</td>
<td>96 (39.2%)</td>
<td>244 (99.6%)</td>
</tr>
</tbody>
</table>
Ferrule

A band that completely encircles the external dimensions of the tooth

- Resists lateral forces therefore fracture resistance
- Must be on sound tooth structure (not the core)
- Axial walls must be parallel and minimum thickness of 1mm
- The longer the ferrule the better with min 1mm
- Do not invade periodontal attachment i.e. > 0.4mm from gingival crevice

Ferrule

A band that completely encircles the external dimensions of the tooth

Compromised teeth

What is left: All may be good
Some may be compromised
All may be compromised (hopeless - extraction)

Predictors of remaining tooth tissue: Does the RD clamp retain well?
Has the crown / post crown previously de-cemented?
How many crowns have been made previously?

Restorative worth: How useful is the tooth to the patient?
Aesthetic impact?
Functional impact?
Prosthodontic impact?

Retention and resistance form?

Jorgensen 1955:

- **Retention** - the direction of the path of insertion (occlusal direction)
- **Resistance form** any other lateral direction

Both are a function of:

- Taper
- Surface area/bulk of preparation
- Surface roughness
Retention and resistance form?

- No retention / resistance grooves as pre-cementation retention has no relevance to cemented performance (Osman et al 2010)
- Minimal interocclusal preparation
- No ‘offsets’ / bevels
- Preservation of enamel with supra-gingival margins whenever possible
Tooth Restorability Index
McDonald & Setchell. Dental Update. 2005;32:343-348

- Height & width of axial dentine after restoration removal + crown prep
  - 0 = None (no axial dentine above finishing line)
  - 1 = Inadequate (dentine walls <1.5mm thick or more than 2x as high as their thinnest part)
  - 2 = Questionable (between 1 and 3)
  - 3 = Adequate (adequate height, thickness and distribution of axial dentine walls)

### Tooth Structure Remaining vs Clinical Decision

<table>
<thead>
<tr>
<th>Tooth Structure Remaining</th>
<th>Clinical Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teeth with a TRI of 12 and greater</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Teeth with scores of 9–12</td>
<td>Questionable and dependent on number of sextants with a score of 3. Acceptable if 2–3 sextants have achieved a comfortable 3 score.</td>
</tr>
</tbody>
</table>
| Score < 9 | Unacceptable to retain a plastic core. Consider:  
- crown lengthen;  
- cast post and core. |
The Dental Practicability Index – assessing the restorability of teeth

A. Dawood and S. Patel

**Table 1** The categories that the tooth should be assessed in: structural integrity, periodontal and endodontic treatment need as well as context are summarised in the grey shaded columns. Each row shows examples of different levels of complexity for each category. An overall DPI score of 5 or 6 indicates that treatment may be impractical, this is reduced to 4 if the tooth to be treated is to be used as a bridge abutment.

<table>
<thead>
<tr>
<th>Weighting</th>
<th>Structural integrity</th>
<th>Periodontal treatment need</th>
<th>Endodontic treatment need</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No treatment required</td>
<td>Root filled, +1.5 mm (AP: 0.0)</td>
<td>Vital pulp</td>
<td>Local: Isolated dental problems where adjacent teeth are healthy.</td>
</tr>
<tr>
<td>2</td>
<td>Simple treatment required</td>
<td>Root filled, 1.5-5.5 mm (AP: 1.0)</td>
<td>Previously successfully treated periodontal disease</td>
<td>Local: Prosthodontic treatment planned of neighbouring teeth which may influence treatment plan for tooth being assessed.</td>
</tr>
<tr>
<td>3</td>
<td>Complex treatment required</td>
<td>Root filled, 5.5-8.8 mm (AP: 2.0)</td>
<td>Previously successfully treated endodontically treated</td>
<td>Local: Periodontal treatment planned of multiple, including adjacent teeth.</td>
</tr>
<tr>
<td>4</td>
<td>Inadmissible to treat</td>
<td>Root filled, 8.8-11.8 mm (AP: 3.0)</td>
<td>Previously successfully treated endodontically treated</td>
<td>Local: Periodontal treatment planned of multiple, including adjacent teeth.</td>
</tr>
</tbody>
</table>

**In brief**

A new index is described which provides a framework for assessing teeth and planning treatment. Each aspect of the restorative need is assessed along with the local and general context of the treated tooth. Use of the index simplifies and supports planning decisions including both restoration, splinting of abutment teeth, and the need for referral.
Informed Consent

- **EBD** - Best available evidence, clinical judgment, patient choice

- Tooth may or may not be restorable
  - If restorable – want to get in there and do RCT asap, longer you leave it the more virulent the microbes may be
  - If unrestorable premature loss of tooth especially if patient is asymptomatic

- Have a denture ready for anterior teeth
Context is important

- **Context is important** – patient modifying factors?
- Depends on what the patient wants and why – motivation / caries / plaque control etc.
- Will patient want space restored following extraction?
- It has a good buccal wall, it will need some removal of lingual soft tissue vs bone removal?
- The tooth is not stand alone and protected both mesial and distal – but a fracture, unpredictable endo and poor uncontrolled perio will be the game changers
‘Adhesive’ Restorability
Stripped down anterior tooth to natural tooth tissue

- Amount of and quality of dental tissue type - % of enamel : dentine
- The amount of useable peripheral enamel
- Position of Enamel – Amount of supra-gingival coronal enamel?
- Challenges with marginal moisture control at cementation?
- If yes, are they fixable? – advanced Rubber Dam skills needed
- Can I use BisGMA – luting technology in this scenario?
‘Adhesive’ Restorability
Strip down posterior tooth to natural tooth-tissue

- Amount of and quality of dental tissue type - % of enamel : dentine
- Position of Enamel – Amount of supra-gingival coronal enamel?
- Challenges with marginal moisture control at cementation?
- If yes, are they fixable? – advanced Rubber Dam skills
- Think differently about function of cores – block out undercuts rather than structural support and provide retention for crown
Restorability of posterior teeth

- Bitewing radiographs

- Strategic value - Is it opposed?
  Is it going to be an abutment?
Endo Crowns: we can use cast metal and resin-active cements to help avoid undertaking procedures with which we can struggle (e.g. posts)

Intra-radicular resin-bonded gold hats
Endo Crowns – all ceramic
Where does amalgam fit with the vital compromised tooth with thin walls? – does it still have a place in 2018 and beyond?
Does amalgam have advantages with difficult compromised teeth over crowns?
Prognosis

- How long will a composite last compared to an amalgam?
- Pulp death under crowns and bridges
- Endodontics vs. Implants?
- What about bridges?
- What about posts?
- Why not dentures?
- How do I motivate the patient?
- Why not dentures?
Prognosis

Depends on what you are measuring...

Close all spaces vs. make the canines look less pointy

Separated instrument LR7)  Nayyar core amalgam (May 2016)  Review (May 2018)
PESH & SHEEP

- Perio
- Endo
- Structure
- History
- Experience (and Skill) of the operator
- Perio

Consider: Required Function of Tooth / Teeth / Strategic Importance? / Cosmetic and Biological Implant Risk of patient?

Parafunction might be highest risk for well maintained dentitions
The more destructive and ‘belts and braces’ the restoration – the more significant will be the mechanical and biological price at failure.
- Lasted 22 years
- Presented with 8mm pockets around the mesial implant

- Can I fix it?
- Can I achieve what the patient wants?
- How long will it last?
- How will it fail?
- Can I fix it when it fails?
Complication rate over 10 year period:

- Smokers with Perio = 40%
- Smokers without Perio = 6%

For Smoking and Perio = 20% greater failure & 7 times greater complications when compared to smokers without perio

Smokers with a history of Periodontitis = **Survival rate: 80% compared with 100%** for smokers with no history of periodontitis over a 10 year period

**Long-term prognosis in patients with and without a history of periodontitis: a 10-year prospective cohort study of the ITI dental implant system.**

Roccuzzo et al 2012

- Total number of implants 146
- Implants lost during the study period = 18 – 12.3%
During the 10-year SPT, 129 teeth were extracted, corresponding to 6.0% of the 2143 teeth – compared to 12.3% of implants lost over the same time period.
Predicting the prognosis of periodontally involved teeth

Prognostication in Periodontics – Science or Art?

Abstract: It has long been assumed that clinicians are able to predict longevity of individual teeth; the evidence challenges this concept. Periodontal therapy can be highly effective in the long term and some important implications when deciding whether or not to remove a tooth and dental implants has further complicated this decision making process. Patients is not as predictable as it is in the periodontally healthy.

CPD/Clinical References: This paper highlights the difficulties clinicians teeth in terms of whether to extract or retain such teeth. It also exami...
Patients must ‘earn’ their RSD (professional therapy) if lots of inflammation (means poor OH) - it is a waste of time providing RSD for long term change. No use starting with the scaling!

Patients must earn their right to RSD
Crowns are usually over-contoured compared to natural teeth and therefore tend to deflect toothbrush bristles over and away from the gum – we do not usually need to replace them to resolve this problem, even when they are far from perfect.
Outcome – surrogate end points

- Do not reassess too soon – greatest changes occur over 3 months but maturation of tissues can take 9-12 months (Morrison et al 1980, Badersten et al 1981, Cugini et al 2000)
- BOP is not a good indicator of disease but absence is a criteria for disease stability (Lang et al 1986)

<table>
<thead>
<tr>
<th>Study</th>
<th>Baseline</th>
<th>At end of active perio Tx</th>
<th>At end of supportive Tx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Konig et al 2002 (SPT 8yrs)</td>
<td>&lt;4mm 17%</td>
<td>&lt;4mm 83.7%</td>
<td>&lt;4mm 64.4%</td>
</tr>
<tr>
<td></td>
<td>&gt;4mm 83%</td>
<td>&gt;4mm 16.3%</td>
<td>&gt;4mm 35.6%</td>
</tr>
<tr>
<td>Carnevale et al 2007 (SPT 3-17 yrs)</td>
<td></td>
<td></td>
<td>&lt;3mm 98.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;3mm 1.5%</td>
</tr>
</tbody>
</table>
Periodontal Maintenance

- Fardal et al 2004 – 100 patients in rural Norway, 1.5% of teeth were lost over SPT period of 9-11yrs

- Lindhe and Nyman 1984 – 61 patients, only 2.3% of teeth were lost over 14yrs

- Hirschfeld & Wasserman 1978 – 600 pts lost 7.1% of teeth over 15-53yrs
  83.2% well maintained (lost 0-3 teeth)
  12.6% downhillers (lost 4-9 teeth)
  4.2% extreme downhillers (lost 10-23 teeth)

- McFall 1982 – 100 pts, 9.8% were lost over 15-29yrs
  77% well maintained, 15% downhillers, 8% extreme downhillers
**Hirschfeld & Wasserman 1978**

- 17% of teeth with questionable prognosis were lost in WM group
- In ED group almost all of teeth with questionable prognosis were lost
- 20% of all teeth lost included teeth that were not deemed questionable (were maintained for many years and suddenly developed periodontal destruction)

**McFall 1982**

- about 27% (in WM group) - 91.8% (in ED group) of teeth we deem questionable are lost during maintenance
- 56% of teeth with a favourable prognosis also lost
- 57% of questionable teeth with furcations lost
Periodontally involved molars tend to survive well.
The ultimate guide to restoration longevity in England and Wales. Part 1: methodology

P. S. K. Lucarotti¹ and F. J. T. Burke*¹

Table 1. Survival to re-intervention by type of treatment

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>1 year</th>
<th>5 years</th>
<th>10 years</th>
<th>15 years</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amalgam</td>
<td>91</td>
<td>66</td>
<td>51</td>
<td>41</td>
<td>7,292,564</td>
</tr>
<tr>
<td>Composite resin</td>
<td>87</td>
<td>59</td>
<td>43</td>
<td>34</td>
<td>3,504,225</td>
</tr>
<tr>
<td>Glass-ionomer</td>
<td>84</td>
<td>53</td>
<td>37</td>
<td>28</td>
<td>1,592,566</td>
</tr>
<tr>
<td>Crown</td>
<td>93</td>
<td>77</td>
<td>63</td>
<td>53</td>
<td>1,202,005</td>
</tr>
<tr>
<td>Inlay</td>
<td>90</td>
<td>67</td>
<td>48</td>
<td>37</td>
<td>86,189</td>
</tr>
<tr>
<td>Veneer</td>
<td>90</td>
<td>69</td>
<td>52</td>
<td>42</td>
<td>66,509</td>
</tr>
<tr>
<td>Multiple types</td>
<td>88</td>
<td>59</td>
<td>41</td>
<td>30</td>
<td>151,990</td>
</tr>
<tr>
<td>All restorations</td>
<td>89</td>
<td>64</td>
<td>48</td>
<td>39</td>
<td>13,896,048</td>
</tr>
</tbody>
</table>
The ultimate guide to restoration longevity in England and Wales. Part 1: methodology

P. S. K. Lucarotti and F. J. T. Burke

Table 2  Survival to extraction by type of treatment

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Survival (%) at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
</tr>
<tr>
<td>Amalgam</td>
<td>98.5</td>
</tr>
<tr>
<td>Composite resin</td>
<td>98.7</td>
</tr>
<tr>
<td>Glass-ionomer</td>
<td>97.5</td>
</tr>
<tr>
<td>Crown</td>
<td>98.7</td>
</tr>
<tr>
<td>Inlay</td>
<td>98.9</td>
</tr>
<tr>
<td>Veneer</td>
<td>99.7</td>
</tr>
<tr>
<td>Multiple types</td>
<td>98.1</td>
</tr>
<tr>
<td>All restorations</td>
<td>98.4</td>
</tr>
</tbody>
</table>
Metal v Ceramic: we know what we would have in our own mouths – survival v aesthetics

Controlled, prospective clinical split-mouth study of cast gold vs. ceramic partial crowns: 5.5 year results

MARIANNE FEDERLIN, DMD, PhD, KARL-ANTON BELLER, DMD, PhD & GOTTFRIED SCHMALZ, DMD, PhD

ABSTRACT: Purpose: To investigate the long-term clinical performance of cast gold partial crowns (CGPCs) as compared to partial ceramic crowns (PCCs). The null hypothesis tested was that CGPCs and PCCs would show similar clinical outcomes. In the present evaluation, the 5.5 year results are reported. Methods: This was a controlled, prospective, clinical split-mouth study. In each patient, one CGPC (Degadur C) and one PCC (Vita Mark II ceramic/Cerac 3) had been inserted at baseline. After 5.5 years, 22 CGPC and 22 PCC restorations in 22 subjects attending the recall visit were clinically assessed using modified United States Public Health Service (USPHS) criteria. Kaplan-Meier survival rates were calculated for CGPCs and PCCs of the 29 subjects who had been originally enrolled in the study. Results: 22 subjects (8 male, 14 female) participated in the 5.5-year recall with a total of 44 restorations. 22 CGPCs and 11 PCCs were placed in molars; 11 PCCs were placed in premolars. The median patient age was 37 years (32-44 years). All subjects revealed a papilla bleeding index (PBI) of ≤ 20% (median: 7%). After 5.5 years, PCCs revealed a statistically significant, time dependent decrease of Alfa ratings for criteria anatomic form, marginal adaptation and marginal discoloration. Furthermore, PCCs as compared to CGPCs showed a statistically significant material-related decrease of Alfa ratings for criteria anatomic form and marginal discoloration. Kaplan-Meier survival analysis revealed a 93.3% cumulative survival rate for CGPCs and an 88.8% cumulative survival rate for PCCs after 5.5 years. Survival functions did not differ significantly across groups. At 5.5 years, CGPCs and PCCs exhibited satisfactory clinical outcomes. For PCCs, Bravo ratings increased significantly over time, however this did not compromise clinical survival of the restorations as compared to CGPCs. (Am J Dent 2010;23:161-167).

CLINICAL SIGNIFICANCE: After 5.5 years observation time, partial ceramic crowns (PCCs) reveal favorable survival rates similar to those of cast gold partial crowns (CGPCs). However, PCCs, as compared to CGPCs, show a significant decrease of marginal adaptation over time. At 5.5 years, these changes did not compromise the clinical function; however, critical monitoring of marginal deterioration is mandatory in future recall examinations.
Additive Extra-Coronal Composite

Survival analysis of composite Dahl restorations provided to manage localised anterior tooth wear (ten year follow-up).

Abstract:
OBJECTIVE: To evaluate ten year survival and clinical performance of resin-based composite restorations placed at increased vertical dimension as a Cam type appliance to manage localised anterior tooth wear. Design: A retrospective survival analysis of restorations provided at a single centre. Setting: UK NHS hospital and postgraduate institute.

METHODS: The clinical performance of 293 composite resin restorations on 26 patients with localised anterior tooth wear was reviewed at a ten year follow-up period. The study used modified United States Public Health Service (USPHS) criteria for assessing the restorations. Survival of the restorations was analyzed using Kaplan-Meier survival curves, the log-rank test, and the Cox proportional hazards regression analysis.

RESULTS: The results indicated that the median survival time for composite resin restorations was 5.8 years and 4.75 years for replacement restorations when all types of failure were considered. The restorations commonly failed as a result of wear, fracture and marginal discoloration. The factors that significantly influenced the survival of these restorations were the initial relationship, anatomy, material used, and the nature of opposing dentition. The biological complications associated with this treatment regime were rare. Patient satisfaction remained high despite the long term deterioration of the restorations.

CONCLUSION: With some degree of maintenance, repeated use of composite resin restorations to treat localised anterior tooth wear at an increased occlusal vertical dimension is a viable treatment option over a ten year period.

Survival – De-Novo 5.8 years - Replacement 4.75 years
Avoiding and Managing the Failure of Conventional Crowns and Bridges

Abstract: The replacement of crowns and bridges is a common procedure for many dental practitioners. When correctly planned and executed, fixed prostheses will provide predictable function, aesthetics and value for money. However, when done poorly, they are more likely to fail prematurely and lead to irreversible damage to the teeth and supporting structures beneath. Sound diagnosis, assessment and technical skills are essential when dealing with failed or failing fixed restorations. These skills are essential for the 21st century dentist. This paper, with treated clinical examples, illustrates the areas of technical skill and clinical decisions needed for this type of work. It also provides advice on how the risk of premature failure can, in general, be further reduced. The article also confirms the very real risk in the UK of denovo legal problems when patients experience unexpected problems with their crowns and bridges.

Clinical Relevance: This paper outlines clinical implications of failed fixed prosthodontics to the dental surgeon. It also discusses factors that we can all use to predict and reduce the risk of premature restoration failure. Restoration design, clinical execution and patient factors are the most frequent reasons for premature problems. It is worth remembering (and informing patients) that the health of the underlying supporting dental tissue is often irreversibly compromised at the time of fixed restoration failure.

Direct Resin Repair of # Ceramic:
Cojet – sandblasting (30microns)
Hydrofluoric Acid
Silane-Coupling
Resin Retained Bridges

- Retraction cord
- Sandblast wing and tooth (RD)
- Alloy primer
- Etch tooth + A&B
- Cement with Panavia Opaque
- Remove excess and hold in place for 4 minutes
- Remove retraction cord and excess with ultrasonic

Durey 2015 (EJPRD)
- Can bond to composite without losing bond strength

King 2015 (BDJ)
- 771 bridges in 621 patients
- 10 year survival 80% (95%CI 77.6-83.2%)
Can we predict if our Endo is going to work?

**Pre-operative:**
- Presence of periapical lesion (49% lower)
- Size of periapical lesion (14% lower for every 1mm)
- Presence of sinus (48% lower)
- Presence of root perforation (56% lower)

**Intra-operative:**
- Achieving patency (Two-fold increase)
- Canal prepared short of terminus (12% lower for every 1mm short)
- Long root filling (62% lower odds of success)
- Using Chlorhexidine as irrigant (53% lower)
- Using EDTA (Re-RCTx) (Two-fold increase)
- Inter-appointment swelling/pain (47% lower)

**Post-operative:**
- Good coronal restoration (Eleven-fold increase in odds of success)

Ng, Mann & Gulabivala; International Endodontic Journal, 2011
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**Post-operative:**
- Good coronal restoration (Eleven-fold increase in odds of success)
- We ideally want to treat vital cases – no bugs
- We need to get to the end of the real root canal(s) and achieve apical patency
- We need to cleanse in 3D
- We need to obturate well
- We need to be able to place conservative & predictable coronal restoration

Any thing that stops these objectives – will reduced success

Ng, Mann & Gulabivala; International Endodontic Journal, 2011
How long do you wait until restoration after RCT?
Can always consider cuspal-protection with either amalgam or direct composite or definitive core and resin provisional crown


Results:
• Type of restoration after RCT significantly affected the survival of ETT (P = .001).
• ETT that received composite/amalgam build-up restorations were 2.29 times more likely to be extracted compared with ETT that received crown (hazard ratio, 2.29; confidence interval, 1.29–4.06; P = .005).
• Time of crown placement after RCT was also significantly correlated with survival rate of ETT (P = .001).
• Teeth that received crown 4 months after RCT were almost 3 times more likely to get extracted compared with teeth that received crown within 4 months of RCT (hazard ratio, 3.38; confidence interval, 1.56–6.33; P = .002).
## What type of Post?

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of post</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weine 1991</td>
<td>Cast post and cores</td>
<td>99% at 10 years</td>
</tr>
<tr>
<td>Mentink 1993</td>
<td>Cast post and cores</td>
<td>82% at 10 years</td>
</tr>
<tr>
<td>Creugers 1993 (meta analysis)</td>
<td>Screw post and composite Cast post and cores</td>
<td>75-87% at 6 years 88-94% at 6 years</td>
</tr>
<tr>
<td>Singore 2008</td>
<td>Glass fibre posts and all ceramic crowns</td>
<td>98% at 8 years (root fracture)</td>
</tr>
<tr>
<td>Tidehag 2004</td>
<td>Carbon fibre posts</td>
<td>90% at 7 years</td>
</tr>
<tr>
<td>Segerstrom 2006</td>
<td>Carbon fibre posts</td>
<td>65% at 6.7 years</td>
</tr>
<tr>
<td>Nauman 2005</td>
<td>Glass fibre posts</td>
<td>87% over 2 years (post fracture)</td>
</tr>
</tbody>
</table>
The Kaplan-Meier survival graphs for all groups are displayed in Figure 9. The log-rank test showed significantly higher survival of groups with a ferrule.

Ferrule-Effect Dominates Over Use of a Fiber Post When Restoring Endodontically Treated Incisors: An In Vitro Study

P Magne • PC Lazari • MA Carvalho • T Johnson • AA Del Bel Cury
The ‘Moshonov’ Gap to be avoided

No Gap - 83.3% PAH normal
GAP 0-2mm - 53.6% PAH normal
GAP greater than 2mm - 29.4% PAH normal

Greater risk of periapical infection when there is a radiographic space between the root filling and the post

(Moshonov et al 2005)
Survival Rates: Endodontic Tx

Quality of RCT and the Outcome:

- Taiwan: Good quality obturation 34.8%  Tooth retention rate 92.9%
- USA: Good quality obturation 42%  Tooth retention rate 94.4% & 97%
- UK: Good quality obturation 26.4%  Tooth retention rate 90%

<table>
<thead>
<tr>
<th>Study</th>
<th>No of teeth included</th>
<th>Years data collected</th>
<th>Survival rates</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lazarski et al 2001</td>
<td>109,542</td>
<td>1993-1998</td>
<td>94.4% at 3.5 years</td>
<td>USA</td>
</tr>
<tr>
<td>Salehrabi &amp; Rotstein 2004</td>
<td>1,462,936</td>
<td>1995-2002</td>
<td>97% at 8 years</td>
<td>USA</td>
</tr>
<tr>
<td>Chen 2007</td>
<td>1,557,547</td>
<td>1998</td>
<td>91.1% - 95.4% at 5 years</td>
<td>Taiwan</td>
</tr>
<tr>
<td>Lumley et al 2008</td>
<td>30,843</td>
<td>1991-2001</td>
<td>74% at 10 years</td>
<td>UK (NHS)</td>
</tr>
<tr>
<td>Tickle et al 2008</td>
<td>174</td>
<td>1998-2003</td>
<td>90.8% at 5 years</td>
<td>UK (NHS)</td>
</tr>
<tr>
<td>Ng et al 2010</td>
<td>(Meta analysis of 14 studies)</td>
<td></td>
<td>86% (95% CI: 75%, 98%) at 2–3 years 93% (95% CI: 92%, 94%) at 4–5 years 87% (95% CI: 82%, 92%) at 8–10 years</td>
<td>(Review - pooled success)</td>
</tr>
</tbody>
</table>
## Endodontics vs. other tx modalities

(Torabinejad 2007)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>RCT</th>
<th>Accepting a space or placing a Denture</th>
<th>Bridges</th>
<th>Implant supported single crowns</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of papers</td>
<td>24 papers</td>
<td>?</td>
<td>31 papers</td>
<td>46 papers</td>
</tr>
<tr>
<td>Survival</td>
<td>97%</td>
<td>?</td>
<td>82%</td>
<td>97%</td>
</tr>
<tr>
<td>Success</td>
<td>84%</td>
<td>?</td>
<td>80%</td>
<td>95%</td>
</tr>
<tr>
<td>PA radiograph</td>
<td>+/- Immediate denture</td>
<td>+/- immediate denture</td>
<td>Cone beam CT</td>
<td>+/- bone grafting</td>
</tr>
<tr>
<td>2-3 visit RCT</td>
<td>5-6 visits</td>
<td>+/- long term temps</td>
<td>+/- soft tissue grafting</td>
<td>2-3 surgical stages</td>
</tr>
<tr>
<td>Imp for crown</td>
<td>Long term review</td>
<td>Imps</td>
<td>Imp for crown</td>
<td>Long term review</td>
</tr>
<tr>
<td>Fit crown</td>
<td>Long term review</td>
<td>Fit</td>
<td>Long term review</td>
<td></td>
</tr>
<tr>
<td>Long term review</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Financial Cost**

££ | £ | £££ | ££££
- 196 implant restorations vs 196 matched RCTs (follow up of 1yr)
- Implant success 74% (survival without intervention 2.6%, with intervention 17.9%)
- Primary RCT success 82% (survival without intervention 8.2%, with intervention 3.6%)

Hannahan 2008  J Endod 2008;34:1302–1305
- Retrospective (129 implants, 143 RCTs, follow up 15-59 months)
- Success: Implants 98% vs RCTs 99%
- Success when uncertain healing added: Implants 88% vs RCTs 90%
**Doyle 2006**  
* J Endod 2006;32:822–827
* 196 implant restorations vs 196 matched RCTs (follow up of 1yr)
  * Implant success 74% (survival without intervention 2.6%, with intervention 17.9%)
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**Weighted success and survival rates of a systematic review comparing implant supported single crowns; tooth borne fixed-partial dentures (bridges) and root filled teeth (Torabinejad et al., 2007)**

<table>
<thead>
<tr>
<th>Years of follow-up</th>
<th>Implant supported single crown</th>
<th>Fixed-partial dentures (tooth borne bridges)</th>
<th>Root filled teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Success</td>
<td>Survival</td>
<td>Success</td>
</tr>
<tr>
<td>2-4 years</td>
<td>99%</td>
<td>96%</td>
<td>78%</td>
</tr>
<tr>
<td>4-6 years</td>
<td>98%</td>
<td>97%</td>
<td>76%</td>
</tr>
<tr>
<td>6+ years</td>
<td>95%</td>
<td>97%</td>
<td>80%</td>
</tr>
</tbody>
</table>
Clinical Outcome of Non-Surgical Root Canal Treatment Using a Single-cone Technique with Endosequence Bioceramic Sealer: A Retrospective Analysis

Elizabeth A. Chybinski, DDS, Gerald N. Glickman, DDS, MS, Yogesh Patel, DDS, Alex Fleury, DDS, MS, Eric Solomon, DDS, MS, and Jianing He, DMD, PhD

Abstract

Introduction: One of the important steps in root canal treatment is to create a well-sealed root canal system. EndoSequence BC Sealer (BC; Brasseler USA, Savannah, GA) has several beneficial properties and thus has been incorporated into the practitioner’s armamentarium. No studies to date have evaluated the clinical success of using BC. The purpose of this study was to evaluate the outcome of nonsurgical root canal treatment using a single-cone and BC technique and to identify factors associated with success or failure. Methods: This retrospective cohort study included patients treated in a private practice environment between 2009 and 2015. All cases, including initial and retreatment, were obturated with BC using a single-cone technique with a minimum of a 1-year recall. Patient and treatment factors were analyzed to determine their significance as prognostic

Unlike conventional base/catalyst sealers, BC Sealer™ utilizes the moisture naturally present in the dentinal tubules to initiate its setting reaction. This highly radiopaque and hydrophilic sealer forms hydroxyapatite upon setting and chemically bonds to both dentin and to our bioceramic points (EndoSequence® BC Points™). BC Sealer is anti-bacterial during setting due to its highly alkaline pH and unlike traditional sealers, BC Sealer exhibits absolutely zero shrinkage!

Try this Award-Winning product today and learn how BC Sealer is a part of Restorative Endodontics.

U.S. Patent Nos.: 7,553,362, 7,575,628, 8,343,271, 8,475,811
European Patent Nos.: 1861341 A4, 2142225 B1

<10% failed at a review period of mean 30 months
UL1 with a history of trauma and possible fracture or resorption of the apical third of the root, with associated peri-radicular pathology.

**Is an implant inevitable?**

Completed over two visits. In between appointments buccal swelling and sinus resolved.
Summary

- Break diagnosis down to simple parts
- If things do not add up, think differently!
- Understand what and why it happened
- Might need to start treatment/dismantle before seeing the full picture
- Patient motivation may determine the prognosis/outcome
- Informed patient consent – their role in outcome?