Use of Evidence-Based Decision-Making in Private Practice for Emergency Treatment of Dental Trauma: EB Case Report

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Objective: This article illustrates the use of the evidence-based process in clinical practice to answer questions that arose when a patient presented with dental trauma.

Background: The patient had avulsion of the maxillary right central incisor and lateral luxation and alveolar bone fracture partially encasing the roots of the maxillary left central and lateral incisors. At the emergency treatment the dentist replanted the teeth but had 2 questions regarding the impending treatment for the patient regarding the optimal timing of root canal therapy and splint duration that would result in the best outcome and prognosis for healing.

Method: The evidence-based process was used to help answer the clinical queries. Two focused clinical (PICO) questions were written, and 2 separate searches were conducted for each PICO question. Four databases were searched for systematic reviews, meta-analyses, critical summaries and practice guidelines.

Results: A total of 3 systematic reviews, 8 practice guidelines, 1 critical summary, and 1 Cochrane protocol were found.

Conclusion: For replanted avulsed teeth, with closed apices, successful periodontal healing is improved when elective extirpation of the pulps occurs within 14 days. Second, guidelines recommend a flexible splint for up to 2 weeks for avulsed teeth with an extension of 2 to 4 weeks possibly needed for lateral luxation and with breakdown of marginal bone. However, evidence shows that an association between short-term splinting and an increased likelihood of functional periodontal healing, acceptable healing, or decreased development of replacement resorption, appears inconclusive and that the types of splint and the fixation period are not significant variables when related to healing outcomes. The evidence-based method was efficient, and very helpful in optimizing the management of the emergency dental treatment.
Received call from patient’s parents after dental trauma occurred

Physical examination & medical history

Luxated/avulsed teeth remained in patient’s mouth post trauma

Replanted avulsed and luxated teeth

Splinted teeth with Ribbond® and flowable composite

When do I complete the pulp extirpation?

PICO QUESTION
For a patient with replanted avulsed and luxated teeth, will early pulp extirpation (10-14 days) as compared to late pulp extirpation (past 14 days) increase the likelihood of successful tooth integration and functional periodontal healing, and decrease the likelihood of resorption and ankylosis?

Search for Answers to the Question on PubMed, DARE, National Guideline Clearinghouse, ADA

Access full text for relevant articles

Critically Appraise Research OR Find Critical Summary of Article

Incorporate Findings into Practice

See patient at 3-day check

Perform pulp extirpation on day 14

Remove splint at 4 weeks

See patient at 12-week check

How long do the teeth need to be splinted?

PICO QUESTION
For a patient with replanted avulsed and luxated teeth, will short-term splinting (7-14 days) as compared to long-term splinting (2-4 weeks) increase the likelihood of successful tooth integration and functional periodontal healing, and decrease the development of resorption and ankylosis?

Search for Answers to the Question on PubMed, DARE, National Guideline Clearinghouse, ADA

Access full text for relevant articles

Critically Appraise Research OR Find Critical Summary of Article

In Figure 1, the diagram illustrates the decision-making process for managing dental trauma, emphasizing the importance of evidence-based decision making (EBDM).

Figure 1. Diagram of decision making.

Figure 2. Initial examination of patient’s dental trauma. Printed with permission of The Center for Oral Health.

BACKGROUND
An evidence-based approach has emerged in response to the need to improve the quality of health care and to close the gap between research and practice.1,2 Evidence-based decision making (EBDM) is the formalized process of using the skills for identifying, searching for, and interpreting the results of the best scientific evidence. This information is considered in conjunction with the clinician’s experience and judgment, the patient’s preferences and values, and the clinical/patient circumstances when making patient care decisions. EBDM is not unique to medicine or any specific health discipline, but represents a concise way of referring to the application of evidence to the decision-making process. EBDM provides an approach to overcome the challenge of finding relevant clinical evidence when it is needed to help make well-informed decisions.3
The application of EBDM has been used to provide useful, current information to dental students and practitioners \textsuperscript{4,5} but there are no reports about its use in helping to guide treatment of emergency dental situations. This article demonstrates the sequence of steps used to integrate EBDM into the treatment of a patient presenting with dental trauma to the maxillary central and lateral incisors in an after office hours dental emergency.

**HISTORY AND EXAMINATION**

The clinician received a call from the parents of a 13-year-old female patient who had been struck in the face with a softball. She was in the process of being examined by paramedics in a town 30 minutes north of the office.
building. The paramedics cleared the patient of any head or neck injury and other medical issues and informed the dentist that dental trauma was her primary injury. The dentist and his assistant met the parents and the patient at the office 45 minutes following the dental trauma. The patient’s teeth remained in her mouth following the incident. Figure 1 diagrams the pathway from call to resolution. Figure 2 shows the initial examination of the patient. The patient and her parents’ preference was to “do anything to keep the teeth.” After the site was cleaned and irrigated, complete avulsion of the maxillary right central incisor from the socket and lateral luxation of the maxillary left central and lateral incisors was observed. In addition, the alveolar bone fracture partially encased the roots of the maxillary left central and lateral incisors (Figure 3). The clinician replanted the teeth and re-approximated the gingival tissue with sutures (Figure 4). A stable and accurate Ribbond® Bondable Reinforcement Ribbon (Ribbond, Inc., Seattle, WA) and flowable composite splint was placed (Figure 5). A radiograph was taken after the splint was placed (Figure 6).

**RADIOGRAPHIC EXAMINATION**

The radiograph showed reimplantation of maxillary central incisors and left lateral incisor in correct socket location and confirmed proper re-approximation of the alveolar bone that was fractured with maxillary left central and lateral incisors. The stent splinting of the displaced teeth is also apparent in this radiograph.

**EVIDENCE-BASED METHODS**

A standard 5-step EB approach was used to integrate evidence into practice.

**TABLE 1. Search terms for each PICO question**

<table>
<thead>
<tr>
<th>PICO question 1 search terms</th>
<th>PICO component</th>
<th>PICO question 2 search terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth Avulsion (MeSH) OR Tooth Replantation (MeSH)</td>
<td>P</td>
<td>Tooth Avulsion (MeSH) OR Tooth Replantation (MeSH)</td>
</tr>
<tr>
<td>Pulp extirpation OR root canal therapy (MeSH)</td>
<td>I</td>
<td>Splints (MeSH)</td>
</tr>
<tr>
<td>(Same intervention as above, however timing is the real comparison so that is the factor in the final article selection)</td>
<td>C</td>
<td>(Same intervention as above, however timing is the real comparison so that is the factor in the final article selection)</td>
</tr>
<tr>
<td>tooth integration OR functional periodontal healing OR root resorption (MeSH) OR tooth ankylosis (MeSH)</td>
<td>O</td>
<td>These terms were used as inclusion criteria and were not used when searching PubMed because only a few number of systematic reviews and guidelines were found just using the P, I, C terms</td>
</tr>
</tbody>
</table>

1. Convert information needs/problems into clinical questions so that they can be answered (writing a PICO question, see the following paragraphs)
2. Conduct a computerized search with maximum efficiency for finding the best external evidence with which to answer the question
3. Critically appraise the evidence for its validity and usefulness (clinical applicability)
4. Apply the results of the appraisal, or evidence, in clinical practice
5. Evaluate the process and your performance

**Because of the difficulty of splint placement and not wanting to risk displacing the teeth or breaking the splint prematurely, the clinician was hesitant to proceed with endodontic treatment until he had access to dependable information.**

The dentist had 2 questions regarding the treatment of the patient. He needed to determine the optimal timing of the pulp extirpation and splinting that would result in the best outcome and prognosis for healing. The clinical questions were then formulated into 2 PICO questions. PICO refers to the first step used in EBDM, which guides clinicians in structuring specific questions that help result in patient-centered answers. A “well-built” question should include 4 parts, referred to as PICO, that identify the patient problem or population (P), intervention (I), comparison (C), and outcome(s) (O).

The following were the 2 PICO questions.

1. For a patient with replanted avulsed and luxated teeth (P), will early pulp extirpation (10-14 days) (I) as compared to late pulp extirpation (past 14 days) (C) increase the likelihood of successful tooth integration
<table>
<thead>
<tr>
<th>PubMed</th>
<th>Relevant studies found Search 1 timing of root canal</th>
<th>Relevant studies found Search 2 timing of splint</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.pubmed.gov">http://www.pubmed.gov</a></td>
<td>1 Meta-analysis/Systematic Review (indexed as both in PubMed)</td>
<td>1 Meta-analysis/Systematic Review (indexed as both in PubMed)</td>
</tr>
<tr>
<td>1 Critical summary of SR</td>
<td>Stewart C. Timing of pulp extirpation for replanted avulsed teeth. Evid Based Dent 2009;10(3):72.</td>
<td>1 Systematic Review</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Gregg TA, Boyd DH. Treatment of avulsed permanent teeth in children. UK National Guidelines in Paediatric Dentistry. Royal College of Surgeons, Faculty of Dental</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Relevant studies found Search 1 timing of root canal</th>
<th>Relevant studies found Search 2 timing of splint</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 abstract in process of Database of Abstracts of Reviews of Effects (DARE) An evidence-based assessment of the clinical guidelines for replanted avulsed teeth. Part I: timing of pulp extirpation. Hinckfuss SE, Messer LB. Accession Number 12009105669 Database Entry Date 5 August 2009</td>
<td>0</td>
</tr>
<tr>
<td><strong>No clinical guidelines</strong>&lt;br&gt;<strong>No critical summaries</strong></td>
<td>Hinckfuss SE, Messer LB. Splinting duration and periodontal outcomes for replanted avulsed teeth: a systematic review. Dent Traumatol 2009;25(2):150-7</td>
</tr>
</tbody>
</table>
TABLE 3. Evidence for timing of pulp extirpation of replanted avulsed and/or luxated teeth

Hinckfuss and Messer\textsuperscript{10} and Stewart\textsuperscript{11}: There is an association between pulp extirpations performed after 14 days following replantation and the development of inflammatory resorption.

Flores et al\textsuperscript{12}: International Association of Dental Traumatology suggests pulp extirpation within 10 to 14 days of replantation to minimize inflammatory resorption.

and functional periodontal healing, and decrease the likelihood of resorption and ankylosis (O)\textsuperscript{2}.

2. For a patient with replanted avulsed and luxated teeth (P), will short-term splinting (7-14 days) (I) as compared to long-term splinting (2-4 weeks) (C) increase the likelihood of successful tooth integration and functional periodontal healing, and decrease the development of resorption and ankylosis (O)?

EVIDENCE: SEARCHING FOR RELEVANT ARTICLES

To find the best current research, the clinician and a staff member performed 2 separate searches using PubMed, the free online version of MEDLINE (www.pubmed.gov), The Database of Abstracts of Reviews of Effects (http://www.crd.york.ac.uk), the National Guideline Clearinghouse (http://www.guideline.gov), and the American Dental Association Evidence-based Dentistry Web site (http://ebd.ada.org), resulting in several relevant references (Table 1). The Medical Subject Heading (MeSH) database was used to identify the appropriate terminology for searching on PubMed. This provides the definition of terms and illustrates how the terms are indexed in MEDLINE. For example, by typing Avulsed Tooth into the MeSH Database, it is learned that the MeSH term is Tooth Avulsion and it is defined as partial or complete displacement of a tooth from its alveolar support. It is commonly the result of trauma (from Boucher’s Clinical Dental Terminology, 4th ed, p. 312). It is also learned that Tooth Luxation links to the MeSH term Tooth Avulsion. This informs the searcher that Tooth Avulsion is the best term to use for the search because it encompasses both avulsed and luxated teeth\textsuperscript{7} (Table 1).

When searching for evidence, the PICO question guides the search.\textsuperscript{36} The articles that were selected as relevant research included each aspect of the PICO question. Inclusion criteria included the following: the patient population studied had to have replanted avulsed or luxated teeth; the research studied the intervention for each of the 2 PICO questions, pulp extirpation and splint duration respectively; and measured at least one of the outcomes of tooth integration, functional periodontal healing, or the levels of resorption or ankylosis. The highest level of evidence for this prognosis question is a meta-analysis or systematic review of cohort studies.

Meta-analysis is a systematic review that uses the statistical process that combines the data from multiple individual studies into a single pooled estimate or analysis. A systematic review is a critical assessment and evaluation of 2 or more primary research studies that have investigated the same specific phenomenon or question and uses explicit predefined criteria for article retrieval, assessment, and synthesis of evidence from the individual studies to reduce bias. In the event that a systematic review or meta-analysis of cohort studies was not found, individual cohort studies are the next highest level of evidence. A cohort study is defined as a prospective investigation of the factors that may cause a disorder in which a group of individuals with a common characteristic or set of characteristics are exposed to a cause compared with a group that is not exposed. Both cohorts are then followed to compare the results.\textsuperscript{8}

To reduce the requirement of critical appraisal by the clinician, the search also looked for critical summaries of the systematic reviews. Critical summaries are concise assessments of the original research that include appraisals and a summary and written by an expert trained in critical appraisal of the scientific literature.\textsuperscript{9}

Search 1 used the terms (tooth avulsion OR tooth replantation) AND (pulp extirpation OR root canal therapy). This resulted in 590 articles. Studies were limited to meta-analyses, systematic reviews, and practice guidelines. Search 2 used the terms (tooth avulsion OR tooth replantation) AND splints. This resulted in 340 articles. Studies were limited to meta-analyses, systematic reviews, and practice guidelines. One systematic review was excluded

\begin{table}
\centering
\caption{Evidence for timing of pulp extirpation of replanted avulsed and/or luxated teeth}
\begin{tabular}{|p{12cm}|}
\hline
\textbf{Hinckfuss and Messer\textsuperscript{10} and Stewart\textsuperscript{11}: There is an association between pulp extirpations performed after 14 days following replantation and the development of inflammatory resorption.} \\
\textbf{Flores et al\textsuperscript{12}: International Association of Dental Traumatology suggests pulp extirpation within 10 to 14 days of replantation to minimize inflammatory resorption.} \\
\hline
\end{table}

\begin{table}
\centering
\caption{Evidence for splint duration of replanted avulsed and/or luxated teeth}
\begin{itemize}
\item \textbf{American Academy on Pediatric Dentistry Guideline\textsuperscript{13}:} Flexible splint for 1 wk for avulsed teeth. An additional 2-4 wk may be needed for lateral luxation and with breakdown of marginal bone.
\item \textbf{Hinckfuss and Messer\textsuperscript{14}:} The evidence for an association between short-term splinting and an increased likelihood of functional periodontal healing, acceptable healing, or decreased development of replacement resorption, appears inconclusive.
\item \textbf{Kahler and Heithersay\textsuperscript{15}:} The types of splint and the fixation period are generally not significant variables when related to healing outcomes.
\item \textbf{Flores et al\textsuperscript{12}:} International Association of Dental Traumatology recommends a flexible splint for up to 2 weeks for avulsed teeth and to stabilize the laterally luxated tooth with a flexible splint for 4 weeks.
\end{itemize}
\end{table}
Figure 7. Critical appraisal of the Hinkfuss/Messer systematic review using the CASP critical appraisal tool for systematic reviews.14

1. Did the review ask a clearly-focused question?  X Yes  □ Can’t tell  □ No
   Consider if the question is ‘focused’ in terms of:
   – the population studied: **138 replanted avulsed teeth**
   – the intervention given or exposure: **short-term and long-term splinting**
   – the outcomes considered: **functional healing, acceptable healing, decreased development of replacement resorption**

2. Did the review include the right type of study?  X Yes  □ Can’t tell  □ No
   Consider if the included studies:
   – address the review’s question: **For a replanted avulsed permanent tooth is short-term splinting compared with long-term splinting associated with an increased likelihood of successful periodontal healing?**
   – have an appropriate study design: **yes-prospective or retrospective clinical studies**

Is it worth continuing?

**Detailed Questions**

3. Did the reviewers try to identify all relevant studies?  X Yes  □ Can’t tell  □ No
   Consider:
   – which bibliographic databases were used: **Ovid Medline, Cochrane Library, PubMed, ISI Web of Science**
   – if there was follow-up from reference lists: **Yes, added one paper from reference list**
   – if there was personal contact with experts: **Yes, attempts made to contact authors**
   – if the reviewers searched for unpublished studies: **Not stated**
   – if the reviewers searched for non-English-language: **No studies**

4. Did the reviewers assess the quality of the included studies?  X Yes  □ Can’t tell  □ No
   Consider:
   – if a clear, pre-determined strategy was used to determine which studies were included. Look for: **Clear inclusion/exclusion criteria (Table 1.)**
   – a scoring system: **Four appraisal tools used**
   – more than one assessor: **Not stated**

**Figure 7.** Critical appraisal of the Hinkfuss/Messer systematic review using the CASP critical appraisal tool for systematic reviews.14
because it studied transplantation of canines. Results are outlined in Table 2.

The results of the first PICO question are summarized in Table 3. The first research study found that answered the PICO question was a well-conducted systematic review published in *Dental Traumatology* in 2009, which presented an association between pulp extirpations performed after 14 days following replantation and the development of inflammatory resorption. Its corresponding critical summary was also found. This evidence was consistent with the 2007 clinical guidelines from the International Association of Dental Traumatology for pulp extirpation within...
10 to 14 days of replantation that were also found as a result of the search strategy used to answer this question.\textsuperscript{12}

Table 4 summarizes the relevant evidence found for the second PICO question. The evidence-based Guideline on the Management of Acute Dental Trauma from the American Academy of Pediatric Dentistry, recommends a “flexible splint for 1 week” (AAP Guideline on Management of Acute Dental Trauma p. 178) for avulsed teeth. For lateral luxation, “splinting an additional 2 to 4 weeks may be needed with breakdown of marginal bone” (p. 177)\textsuperscript{13}. In addition, a recent well-conducted systematic review about splinting duration stated, “The evidence for an association between short-term splinting and an increased likelihood of functional periodontal healing, acceptable healing, or decreased development of replacement resorption, appears inconclusive” (Splinting duration and periodontal outcomes for replanted avulsed teeth: a systematic review. pg. 155). The study found no evidence to contraindicate the current guidelines and suggests that the likelihood of successful periodontal healing after replantation is unaffected by splinting duration. This study was appraised using the Critical Appraisal Skills Programme (CASP) form for appraising reviews (Figure 7). Although this systematic review excluded studies of luxated teeth, this study is still applicable to the patient. The study concluded that dentists continue to use the currently...
recommended splinting periods when replanting avulsed permanent teeth pending future research to the contrary. Another systematic review about splinting luxated, avulsed, and root-fractured teeth reported that, “the types of splint and the fixation period are generally not significant variables when related to healing outcomes” (An evidence-based appraisal of splinting luxated, avulsed and root-fractured teeth, p. 2, 8). This study was also appraised using the CASP form for appraising reviews.

**FOLLOW-UP FINDINGS**

There were several relevant resources that could be incorporated in decision making and into the treatment of this patient. The clinician performed pulp extirpations on the avulsed and luxated teeth within the recommended time period of 10 to 14 days (Figure 8). He also removed the splint within the recommended time frame for luxated teeth of 2 to 4 weeks (Figure 9).

The evidence, in combination with clinical experience, helped provide care for his patient that resulted in the best possible prognosis given the extent of the patient’s dental trauma.

This evidence-based supplementation of the doctor’s clinical skills and experience also allowed the patient to keep her own teeth (Figures 10 and 11), which incorporated the patient preferences aspect of the evidence-based decision-making process.

**SUMMARY**

Evidence-based decision making proved to be a valuable tool that guided practice decisions to achieve optimal results. In the case of tooth avulsion, the key PICO questions were established to identify research that studied
the outcomes of reducing the risk of root resorption and tooth ankylosis and increase periodontal healing. In using the best available research, clinicians can be confident that they have provided the best informed treatment to improve the possibility of a successful outcome.

REFERENCES