Accelerated tooth movement: Do we need a new systematic review?


Current systematic reviews are important for health care providers in supporting their evidence-based practice decisions. Equally important is the ability to determine when a new systematic review is needed in view of the rapid publication output. The current best evidence from a 2013 systematic review suggests that certain treatments may accelerate orthodontic tooth movement. Our aim was to determine if an updated systematic review is needed on this topic by applying the modified Ottawa method. A systematic search of Pubmed, Embase, CENTRAL, and Web of Science databases, identical to the previous systematic review, was executed. Two authors performed screening for inclusion/exclusion of studies and selected full-text articles were reviewed. Qualitative and quantitative criteria were applied to assess studies describing the following types of interventions to accelerate tooth movement: electrical, photobiomodulation, micro-osteoperforations, vibration, corticotomy, and low-level laser therapy. The Ottawa method showed that studies produced since 2011 have (1) potentially invalidating evidence and description of new methods and (2) combined new data that would enhance the precision of the existing evidence on low-level laser therapy. These collectively indicate the need for a new systematic review on adjunct procedures to accelerate orthodontic tooth movement, which may offer new evidence and techniques not previously mentioned. (Semin Orthod 2015; 21:224–230.) © 2015 Elsevier Inc. All rights reserved.

Introduction

Current systematic reviews are of considerable importance to the health care and the orthodontic community in making evidence-based practice decisions. With new evidence published frequently in peer review journals, the necessity for an objective method to establish the need to update a systematic review is imperative and has not yet been established in the orthodontic literature.

The Cochrane Collaboration recommends a time-based approach in maintaining and updating systematic reviews at least every 2 years. In a study to determine when to update high-quality systematic reviews, it was concluded that indicators for updating occurred often and in a short period of time. Therefore, a priority-setting approach has been suggested as more appropriate than a time-based approach. The Agency for Healthcare Research and Quality (AHRQ) Evidence-Based Practice Center (EPC) has been developing methods to appraise the need to update evidence reviews. Ultimately two methods have been proposed, the RAND and Ottawa methods, both found to provide similar indicators for the need to update systematic reviews. In 2014 we sought to evaluate the need for an update to the most recent systematic review on the effectiveness of interventions that accelerate orthodontic tooth movement, which was published in 2013. For simplicity we will refer to the aforementioned
review as Long et al., which evaluated and compared interventions adjunct to orthodontic treatment for accelerating tooth movement, such as laser irradiation, corticotomy, and pulsed electromagnetic fields. Long et al. included nine studies in the final systematic review and three were included in a meta-analysis for low-level laser therapy. They concluded that low-level laser therapy is safe, but not able to accelerate tooth movement; corticotomies are safe and able to accelerate tooth movement; and electrical current and pulsed electromagnetic fields are effective in accelerating orthodontic tooth movement.

A year later, we decided to use an objective approach to appraise the need for an update of Long et al. using the modified Ottawa method. The modified Ottawa method has been shown to be an effective tool in previous applications in dentistry. The aim of this study was to assess the current evidence on accelerated tooth movement published since the last systematic review and apply the principles from the modified Ottawa method to determine if an update is needed.

**Search strategy**

A systematic search was first conducted for the clinical question: which methods adjunct to orthodontic treatment will accelerate orthodontic tooth movement? Upon review of the search results, the recent systematic review by Long et al. was found to address the same clinical question. Long et al. included search dates from January 1990 to August 2011 and was published in January 2013.

A literature search was performed on April 28, 2014 employing the same search strategy as Long et al. The search terms and databases are displayed in Table 1. For completeness, our search was performed from January 2010 to April 2014 utilizing the following databases: Pubmed, Embase, CENTRAL, Web of Science, and OpenSIGLE. Inclusion criteria were limited to randomized control trials or quasi-randomized control trials that evaluated or compared methods to accelerate orthodontic tooth movement. Systematic reviews related to the topic of accelerated tooth movement were also included. After primary selection, full-text articles were retrieved and analyzed further for inclusion.

**The modified Ottawa method**

The modified Ottawa method was proposed to assess whether an updated systematic review is required. The method applies qualitative, quantitative, and “other” indicators to newly published studies after the search date of the previous systematic review. A new systematic literature search was employed to identify new studies assessing interventions for accelerating orthodontic tooth movement. If a previous meta-analysis was performed then quantitative indicators were sought. Quantitative indicators (B1 and B2) were evaluated, merging of new data with the original data in a fixed-effects meta-analysis. If no previous meta-analysis were performed then qualitative or “other” indicators were sought. The appraisal of these indicators was initiated after analysis of the full-text articles. The types and description of these indicators are shown in Table 2.

**Literature search and data collection**

The database search returned 992 articles and after removal of duplicates, 533 citations were included for provisional screening. Two authors
scanned the titles and abstracts for the inclusion criteria. A total of 14 articles were assessed in full-text for eligibility in the final analysis. Subsequently, eight articles were included in the final analysis and six articles were not included based on violations of the inclusion criteria (Fig. 1). Articles were excluded due to not qualifying for true randomized control trial or quasi-randomized control trial. Three articles were not included because they were already included in the previous systematic review.

Indicator results
The following types of interventions to accelerate orthodontic tooth movement were analyzed in the final review: electrical, photobiomodulation, micro-osteoperforations, vibration, corticotomy, and low-level laser therapy. Six articles were analyzed for qualitative indicators A1–A7, a total of two qualitative indicators were detected. One article received indicator code A1 (opposing findings) and one received A3 (superior new treatment). Two articles were analyzed for quantitative indicators B1 (change in statistical significance) and B2 (change in relative effect size). The data from Long et al. on low-level laser therapy was pooled with the new data in a “random effects model.” The quantitative analysis revealed an increase in the total effect from 0.32 to 0.36 and the p value went from non-significant \((p > 0.08)\) in Long et al. to significant \((p < 0.008)\) when combined with the new data. A signal code of B1 was subsequently applied to two articles. “Other” signals were sought for key questions for which there was no prior meta-analyses or RCTs, for example, questions for which only large cohort or case control studies were identified. The criteria included a major increase in the number of new studies or a new study with at least three times the number of participants as in previous studies.

Orthodontic impact
Several key findings were identified through our systematic search and data analysis. The article on electrical stimulation had greater than three times the number of participants than the study included in Long et al. and indicated an opposing outcome.
(indicator code A1, opposing findings), suggesting potentially invalidating evidence from the review performed by Long et al. One new method of accelerating tooth movement (micro-osteoperforations) was not mentioned in Long et al. and was published in a pivotal journal (signal code A3, superior new treatment). The two major journals in orthodontics, the American Journal of Orthodontics and the Journal of Clinical Orthodontics, were considered pivotal journals. Two new treatments identified on the effect of vibration and photobiomodulation on tooth movement were not reported in Long et al. and received an “other” signal code. An article on corticotomy and a systematic review on corticotomies did not receive a signal code because it agreed with the previous findings from Long et al. Change in statistical significance (signal code B1) was found when data was combined from Long et al. and new data from the articles on low-level laser therapy. This indicates that a new review would improve the precision of the original review as demonstrated in Fig. 2 and provide orthodontists with new evidence on methods to accelerate tooth movement.

Discussion

The goal of this study was to determine if an update was necessary for the recent systematic review on methods used to accelerate tooth movement. Employing the principles of the modified Ottawa method, we have demonstrated that an updated systematic review on accelerated tooth movement is warranted. Systematic reviews are constantly produced in orthodontic literature with little emphasis on whether an update is actually needed or how the requirement for an update was derived. In this study we showed the application of the modified Ottawa method through a systematic search, data analysis, and assignment of focused signal criteria. The
orthodontic community should consider investing a small amount of time to determine whether a new update is needed prior to investing countless hours into a review that would not advance our understanding on important topics.

The application of the modified Ottawa method in evaluating new evidence on the effect of different procedures to accelerate tooth movement resulted in interesting and exciting new findings. We found that the amount of literature produced on the topic during our search

Table 3. Overview of articles used in the Ottawa method analysis

<table>
<thead>
<tr>
<th>Article</th>
<th>Level of evidence</th>
<th>Type of intervention</th>
<th>Explanation</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falkensammer et al.13</td>
<td>RCT</td>
<td>Electrical</td>
<td>Falkensammer et al. conducted an RCT with greater than 3 × the number of participants \ (n = 26), found no significant difference in tooth movement rate. In Long et al. detected a significant difference indicating opposing findings</td>
<td>A1; opposing findings</td>
</tr>
<tr>
<td>Kau et al.17</td>
<td>RCT</td>
<td>Photobiomodulation</td>
<td>No previous meta-analysis or RCT</td>
<td>Other</td>
</tr>
<tr>
<td>Alikhani et al.14</td>
<td>Quasi-RCT</td>
<td>Micro-osteoperforations</td>
<td>A significant difference detected in the rate of canine retraction, treatment group was 2.3× faster compared to control. Published in pivotal journal</td>
<td>A3; superior new treatment, published in pivotal journal</td>
</tr>
<tr>
<td>Miles et al.16</td>
<td>RCT</td>
<td>Vibration</td>
<td>Results agreed with Long et al.</td>
<td>Other</td>
</tr>
<tr>
<td>Shoreibah et al.19</td>
<td>RCT</td>
<td>Corticotomy</td>
<td>No previous meta-analysis or RCT</td>
<td>Other</td>
</tr>
<tr>
<td>Hoogeveen et al.20</td>
<td>Systematic review</td>
<td>Corticotomy</td>
<td>Systematic review indicating similar conclusions to Long et al.</td>
<td>No signal</td>
</tr>
<tr>
<td>Doshi-Mehra et al.15</td>
<td>RCT</td>
<td>Low-level laser therapy</td>
<td>In Long et al., p = 0.08. After pooling with new data p = 0.008</td>
<td>B1; change in statistical significance</td>
</tr>
<tr>
<td>Dominguez et al.16</td>
<td>Quasi-RCT</td>
<td>Low-level laser therapy</td>
<td>In Long et al., p = 0.08. After pooling with new data p = 0.008</td>
<td>B1; change in statistical significance</td>
</tr>
</tbody>
</table>

Table summarizes articles reviewed and includes type of study, intervention evaluated, and findings when qualitative, quantitative, and “other” indicators were applied, with a brief explanation.

The application of the modified Ottawa method in evaluating new evidence on the effect of different procedures to accelerate tooth movement resulted in interesting and exciting new findings. We found that the amount of literature produced on the topic during our search

A Original Data: tooth movement (mm)/month

B Combined Data: tooth movement (mm)/month

Figure 2. Quantitative analysis of studies on the effect of low laser therapy in accelerating tooth movement. Meta-analysis from the original systematic review displaying the pooled mean difference for low-level laser therapy vs. control (A). Data from newly published studies on low-level laser therapy was combined with data from the original systematic review, displaying the increased precision in results with the combined new data (B).
(4 years from January 1, 2010 to July 31, 2014) produced as many papers as Long et al. identified (11 years from January 1990 to August 2011) in a much shorter time span. This indicates the popularity of accelerated tooth movement in recent years and the drive in our field to find ways to shorten treatment duration. The Ottawa method has shown that the studies produced since 2011 have potentially invalidating evidence and description of new methods. Furthermore, our meta-analysis on low-level laser therapy demonstrates that the combined new data increases the precision of the results. These collectively indicate the need for a new systematic review on adjunct procedures to accelerate orthodontic tooth movement.

**Conclusion**

The results of this study indicate that based on the modified Ottawa method, there is a need for an updated systematic review on accelerated...
tooth movement. These signals identified in this study suggest an updated systematic review would be beneficial in identifying new and superior treatments and would increase the precision of the previous meta-analysis. This method could be applied to further investigations within the orthodontic field. To assist in this endeavor we have created a worksheet for orthodontic researchers, residents, educators, and practitioners (Fig. 3) to facilitate the application of the modified Ottawa method to other important questions in orthodontics.

References