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

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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.¹ 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.² Therefore, a priority-setting approach has been suggested as more appropriate than a time-based approach.³ 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.⁴ Ultimately two methods have been proposed, the RAND and Ottawa methods, both found to provide similar indicators for the need to update systematic reviews.⁴ 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 2013.⁵ For simplicity we will refer to the aforementioned

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Table 1. Search terms and databases used to identify studies assessing methods of accelerating tooth movement

Database	Limit to publication date	Search terms	Number of citations
Pubmed	2010/01/01 to 2014/07/31	(orthodontics[Mesh] OR orthodontic*) AND (Tooth Movement[Mesh] OR mov* OR retract*) AND (rapid OR accelerat* OR short* OR speed OR rate)	405 results (382 in English)
Embase	2010–2014	(orthodontics OR orthodontic*) AND (Tooth Movement OR mov* OR retract*) AND (rapid OR accelerat* OR short* OR speed OR rate)	251 results (241 in English)
CENTRAL	2010–2014	(orthodontics OR orthodontic*) AND (Tooth Movement OR mov* OR retract*) AND (rapid OR accelerat* OR short* OR speed OR rate)	31 results (30 in English)
Web of Science	2010–2014	(orthodontics OR orthodontic*) AND (Tooth Movement OR mov* OR retract*) AND (rapid OR accelerat* OR short* OR speed OR rate)	305 results (302 in English)
OpenSIGLE		(orthodontics OR orthodontic*) AND (Tooth Movement OR mov* OR retract*) AND (rapid OR accelerat* OR short* OR speed OR rate)	1 result

Five databases were searched using the terms listed in the middle column, yielding different number of published articles.

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.⁶ 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

Table 2. Types of signals used to appraise new publications

	Type of indicators (signals)	Signal code	Operational definitions
Qualitative	Qualitative signals: studies without meta-analysis—potentially invalidating changes in evidence	A1	Opposing findings: a pivotal trial, ¹ meta-analysis, or guidelines that opposed the findings from the original review
		A2	Substantial harm: a pivotal trial, ¹ meta-analysis, or guidelines whose results called into question the use of the treatment based on evidence of harm or that did not proscribe use entirely but did potentially affect clinical decision making
		A3	A superior new treatment: a pivotal trial, meta-analysis, or guidelines whose results identified another treatment as superior to the one evaluated in the original review, based on efficacy or harm
	Qualitative signals: studies without meta-analysis—major changes in evidence	A4	Important changes in effectiveness short of “opposing findings”
		A5	Clinically important expansion of treatment
		A6	Clinically important caveat
		A7	Opposing findings from discordant meta-analysis or nonpivotal trial
Quantitative	Quantitative signals: studies with meta-analysis	B1	A change in statistical significance (from nonsignificant to significant)
		B2	A change in relative effect size of at least 50%
Other	Other Signals	n/a	“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

In order to demonstrate the need to update a systematic review on a given topic, the Ottawa method applies qualitative, quantitative, and “other” indicators to newly published studies after the search date of the latest systematic review. The definitions of these signals are summarized on the last column on the right.

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.^{7–9} Three articles were not included because they were already included in the previous systematic review.^{10–12}

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 findings¹³) and one received A3 (superior new

treatment¹⁴). 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 nonsignificant ($p < 0.08$) 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.^{15,16} Two articles received “other” signals.^{17,18} No further signals were identified from the remaining articles.^{19,20} Signal summaries with explanations can be found in Table 3.

Orthodontic impact

Several key findings were identified through our systematic search and data analysis. The article on electrical stimulation¹³ had greater than three times the number of participants than the study included in Long et al. and indicated an opposing outcome

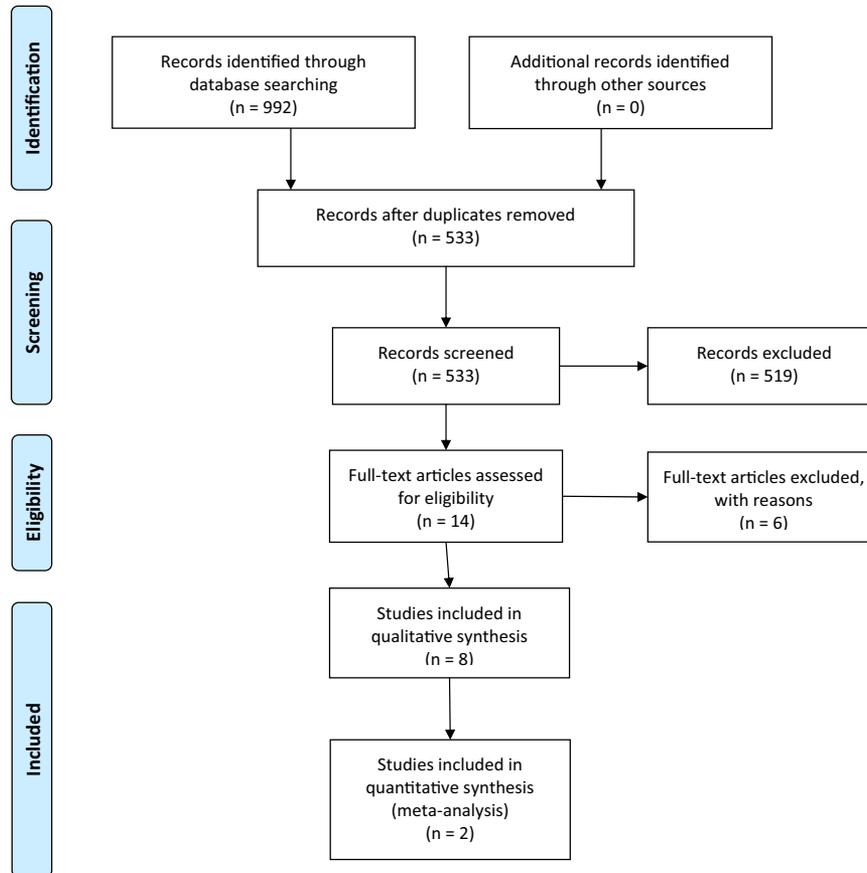


Figure 1. Flow chart of database search strategy. A total of 992 articles were identified after a systematic search and 533 articles were screened after removal of duplicates. Of those 14 articles were assessed for eligibility but only eight articles were included in final analysis.

(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

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

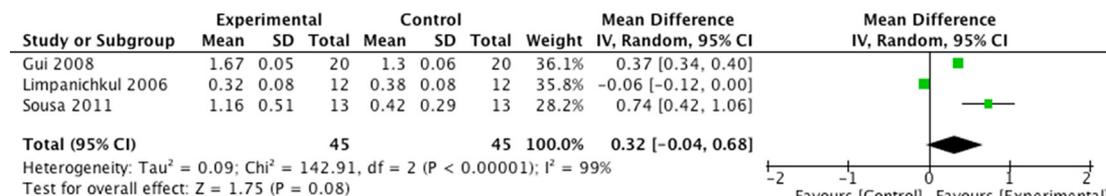
Article	Level of evidence	Type of intervention	Explanation	Signal
Falkensammer et al. ¹³	RCT	Electrical	Falkensammer et al. conducted an RCT with greater than 3× the number of participants (<i>n</i> = 26), found no significant difference in tooth movement rate. In Long et al. detected a significant difference indicating opposing findings	A1; opposing findings
Kau et al. ¹⁷	RCT	Photobiomodulation	No previous meta-analysis or RCT	Other
Alikhani et al. ¹⁴	Quasi-RCT	Micro-osteoperforations	A significant difference detected in the rate of canine retraction, treatment group was 2.3× faster compared to control. Published in pivotal journal	A3; superior new treatment, published in pivotal journal
Miles et al. ¹⁸	RCT	Vibration	No previous meta-analysis or RCT	Other
Shoreibah et al. ¹⁹	RCT	Corticotomy	Results agreed with Long et al.	No signal
Hoogeveen et al. ²⁰	Systematic review	Corticotomy	Systematic review indicating similar conclusions to Long et al.	No signal
Doshi-Mehta et al. ¹⁵	RCT	Low-level laser therapy	In Long et al., <i>p</i> = 0.08. After pooling with new data <i>p</i> = 0.008	B1; change in statistical significance
Dominguez et al. ¹⁶	Quasi-RCT	Low-level laser therapy	In Long et al., <i>p</i> = 0.08. After pooling with new data <i>p</i> = 0.008	B1; change in statistical significance

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.

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

A Original Data: tooth movement (mm)/month



B Combined Data: tooth movement (mm)/month

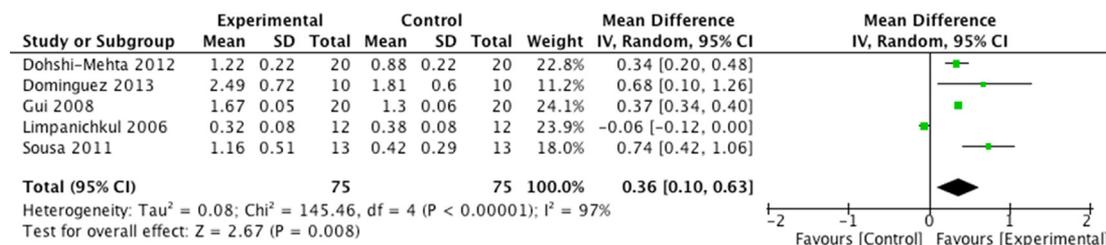


Figure 2. Quantitative analysis of studies on the effect of low laser therapy in accelerating tooth movement. Meta-analysis from the original systematic review displaying the pooled mean difference for low-level laser therapy vs. control (A). Data from newly published studies on low-level laser therapy was combined with data from the original systematic review, displaying the increased precision in results with the combined new data (B).

New York University Checklist: Based on Modified Ottawa Method

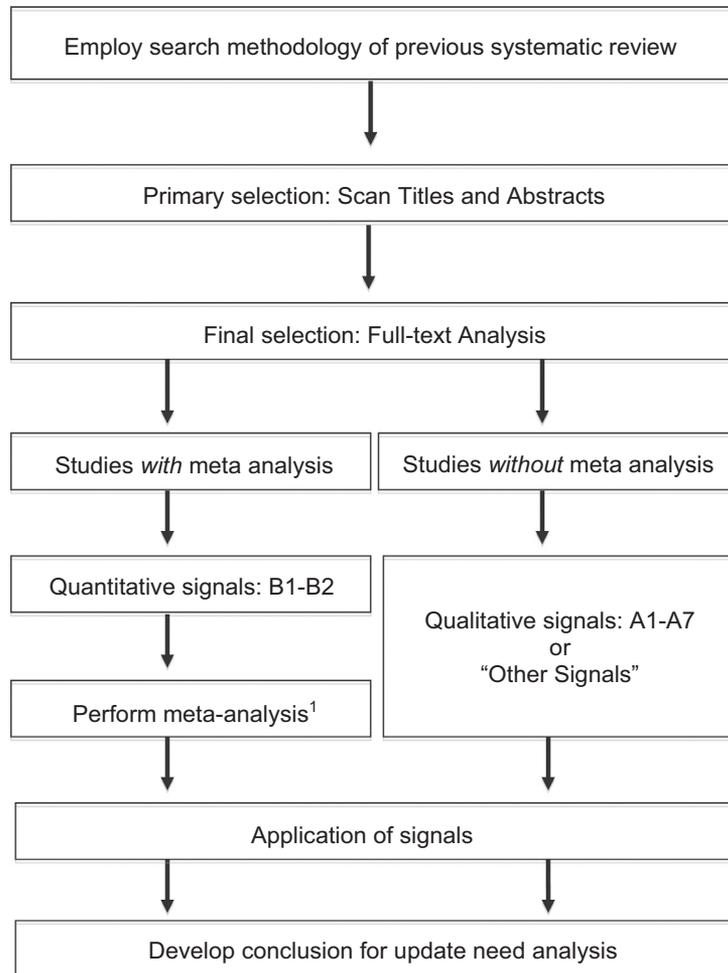


Figure 3. Flow chart displaying the steps for the application of the modified Ottawa method. We created a checklist to guide researchers on the application of this method to newly published studies after the search date of the previous systematic review, to help determine need for an updated review. ¹Obtained by pooling data extracted from new trials with data from the original systematic review and performing a fixed-effects analysis meta-analysis. ⁶

(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.

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