

**AAO**

**Foundation**

**Final Report**

Type of Award : Orthodontic Faculty Development Fellowship Award

Name of Principal Investigator : Edmund Khoo

Title of Project : Orthodontic Faculty Complete Development Plan

Period of AAOF Support : 07-01-15 to 06-30-16

Amount of Funding : 20,000.00

Summary/Abstract (250 word maximum)

I embarked on a very ambitious complete development plan that would address improvements and enhancements in the four major aspects of education, teaching, clinical and research. Simply stated, without the aid of the AAOF, it would have been impossible for me to achieve so much within a span of 12 months. The AAOF funding benefited my career in the following ways:

Education – Helping to fund my attendance at the ADEA 2016 meeting, allowed me to increase my participation in ADEA, this year as the rising Chair of the ADEA Section on Orthodontics, I was able to work closer with the SOE and also had an opportunity to present at the SOE meeting in Orlando to forge a strong bond between both organizations. As according to the initial proposal I managed to achieve enrollment, participation and successful completion of the NYU Orthodontics Education track. I worked with my mentor Mitchell Lipp in initiating a program on the importance of communication and empathy in orthodontic education.

Teaching – I believe that the ability to utilize cutting edge software such as Articulate Storyline to incorporate technology based education in my lectures and enhance my powerpoint abilities created a higher dimension of delivering course material and enriching the overall experience of the class. As according to the initial proposal I successfully participated in the NYU Teaching in Dental Education (TIDE) program in conjunction with the orthodontic education track and attend the teaching enhancement and Center for Advanced Teaching (CAT) courses at NYU. I was able to use the funds to incorporate Articulate Storyline to enhance powerpoint presentations. This has also led to a program submission sponsorship for next year's ADEA meeting on enhancing PowerPoint presentations utilizing Articulate Storyline.

Clinical – As one of the members of the ABO committee, AAOF funding allowed me to obtain materials to better train and prepare our department's residents for both the ABO written and clinical examinations. I have formulated a series of lectures at all different levels of postgraduate years to prepare our residents for ABO certification. In the first year, the focus is on a review of

all the ABO scientific articles, the second focuses on written board exam preparation and culminates in the mock written ABO exam and in the third year as pre-requisite for graduation, all the residents have to participate and present 6 cases for their mock clinical ABO exam coordinated with external examiners. I have successfully attended the series on advanced orthodontics and biomechanics with Dr Mani Alikhani.

Research – AAOF funding allowed me to attend the IADR conference in Seoul this year including the council meeting. I was also able to attend seminars and workshops to improve my grant and research paper writing skills. I mentored my resident to establish a protocol for assessing the need to update systematic reviews. This method is based on the modified Ottawa method. This method was published in Seminars in Orthodontics as the article “Accelerated Tooth Movement: Do we need a new systematic review?”. I have attached the article for your perusal. Building upon this our department now has a chapter devoted to evidence-based orthodontics and systematic reviews. I am currently mentor to three residents, working with them on systematic reviews that we hope to publish in the near future.

Response to the following questions:

1. Were the original, specific aims of the proposal realized?

Yes.

2. Were the results published?

a.) If so, was AAOF support acknowledged.

There were no original intentions to publish any specific manuscripts but as the result of the support from the AAOF, I was able to as part of my research/clinical aspects publish two articles in Orthotown magazine and an article in Seminars in Orthodontics. AAOF recognition was given with my CV in the manuscript however, the magazine did not include that in the author biography due to space constraints.

b.) If not, are there plans to publish? If not, why not?

3. Have the results of this proposal been presented?

a.) If so, when and where? And was AAOF support acknowledged.

All progress has been presented to my mentors as per our weekly and biweekly meetings. They are fully aware that this plan is only possible because of the support of the AAOF.

b.) If not, are there plans to do so? If not, why not?

4. To what extent have you used, or how do you intend to use, AAOF funding to further your career?

It would have taken me significantly longer to achieve what I have in the past 12 months if I did not have the support of the AAOF. Despite this being an award targeted at junior faculty, I think it is essential that all junior faculty members consider applying for this award. The beginning of one's academic career is an epoch of profound changes, a critical phase to which any funding can make or break one's career in academia. The paradox in this is, oftentimes it is difficult for junior faculty members to achieve funding due to the lack of seniority and experience in their rank. The fact that the AAOF has set aside funding specifically for junior faculty members shows great wisdom in its foresight. To this end, I am working towards a possible future application for the biomedical research award. I am currently working on a few research projects and corresponding IRB proposals which can benefit greatly from AAOF funding.

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

*Daniel Rozen, Edmund Khoo, Hend El Sayed, Richard Niederman, Richard McGowan, Mani Alikhani, and Cristina C. Teixeira*

**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

**C**urrent 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.<sup>1</sup> 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.<sup>2</sup> Therefore, a priority-setting approach has been suggested as more appropriate than a time-based approach.<sup>3</sup> 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.<sup>4</sup> Ultimately two methods have been proposed, the RAND and Ottawa methods, both found to provide similar indicators for the need to update systematic reviews.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> 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, <sup>1</sup> meta-analysis, or guidelines that opposed the findings from the original review
		A2	Substantial harm: a pivotal trial, <sup>1</sup> 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.<sup>7–9</sup> Three articles were not included because they were already included in the previous systematic review.<sup>10–12</sup>

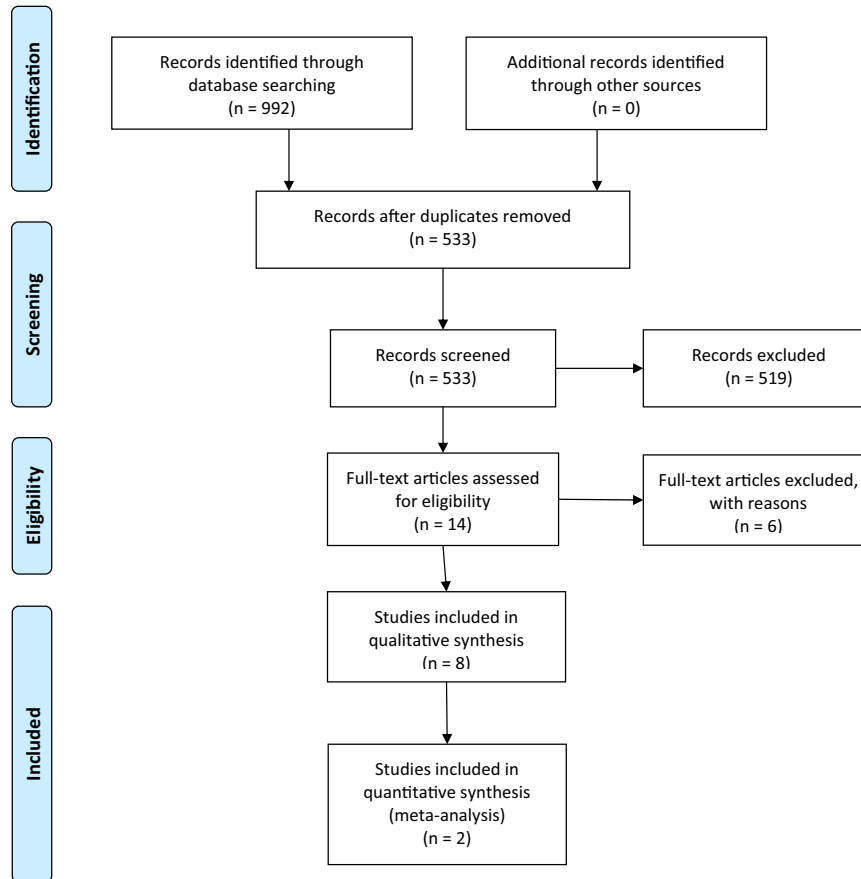
### Indicator results

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<sup>13</sup>) and one received A3 (superior new

treatment<sup>14</sup>). 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.<sup>15,16</sup> Two articles received “other” signals.<sup>17,18</sup> No further signals were identified from the remaining articles.<sup>19,20</sup> 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 stimulation<sup>13</sup> 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

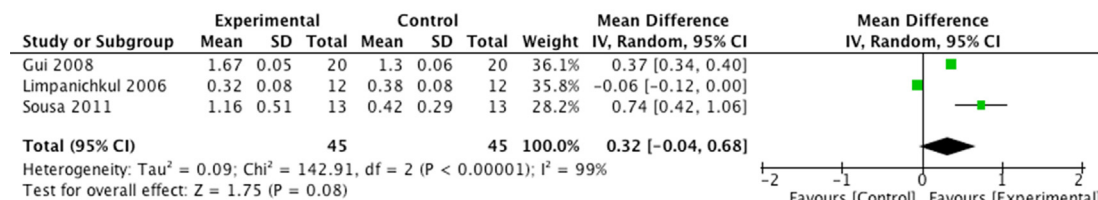
Article	Level of evidence	Type of intervention	Explanation	Signal
Falkensammer et al. <sup>13</sup>	RCT	Electrical	Falkensammer et al. conducted an RCT with greater than 3× the number of participants ( <i>n</i> = 26), found no significant difference in tooth movement rate. In Long et al. detected a significant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

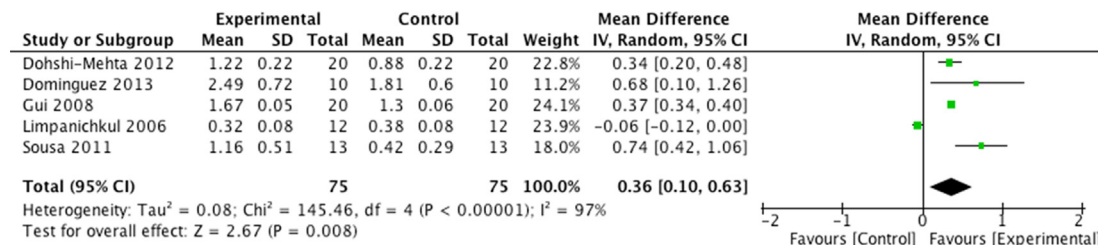
orthodontic community should consider investing a small amount of time to determine whether a new update is needed prior to investing countless hours into a review that would not advance our understanding on important topics.

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

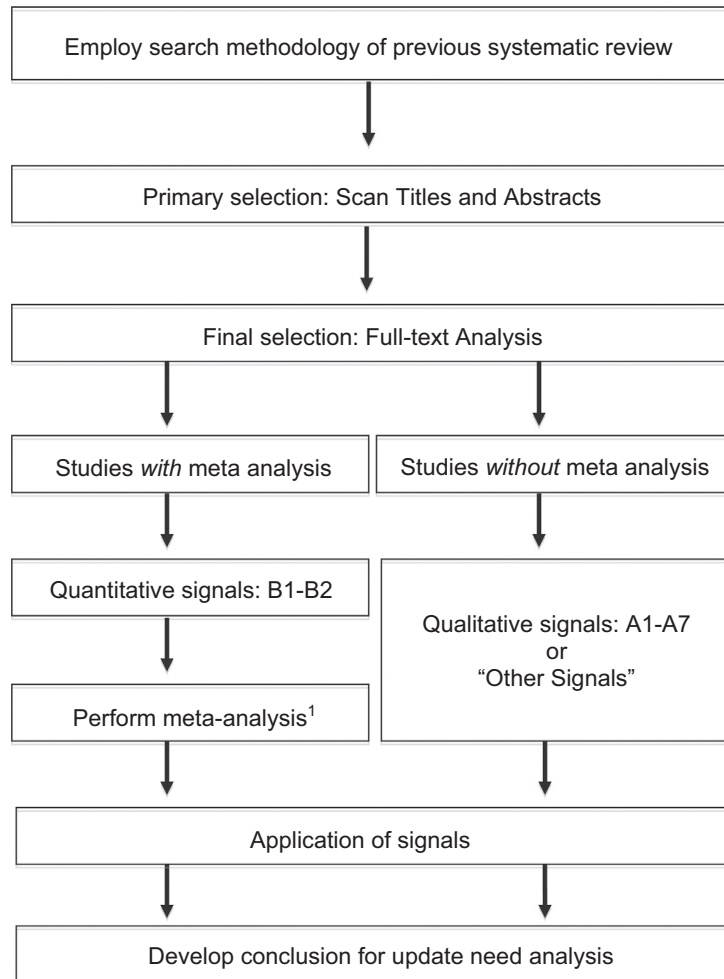


**B** Combined Data: tooth movement (mm)/month



**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. <sup>1</sup>Obtained by pooling data extracted from new trials with data from the original systematic review and performing a fixed-effects analysis meta-analysis. <sup>6</sup>

(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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