RAE Accelerated Teeth Movement

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A request was submitted by a member of the AAO for an assessment on efficacy and current evidence on accelerated tooth movement approaches by the Rapid Assessment of Evidence Panel (RAE) of the American Association of Orthodontists Foundation. The RAE panel undertook a review of current evidence on the efficacy of accelerated tooth movement approaches such as piezocision, corticotomies, photobiomodulation and a wide variety of surgically assisted approaches. The primary outcomes examined in the review included: tooth movement (typically canine retraction within the first three months) following interventions for accelerated tooth movement and duration of orthodontic treatment. In the last 5 years, a large number of clinical studies (typically single center studies) have examined these outcomes. For our assessment on the current evidence, we used the PubMed search engine to identify current literature on this topic. The search term used was “Accelerated Teeth Movement.” The initial search yielded 577 articles (as of September 10, 2020). This included 14 meta-analyses. We chose to review the meta-analyses that reported on Randomized Controlled Trials and Controlled Clinical Trials. The total number of meta-analyses we shortlisted for the final review was 11. These 11 meta-analyses included a combined total of over 100 randomized clinical trials and controlled clinical trials. The primary outcomes examined, risk of bias of studies included in the meta-analyses, key findings and conclusions are summarized in the table. Our comprehensive review indicated that: Weak evidence suggests that orthodontic teeth movement can be accelerated with approaches such as photobiomodulation, laser therapy, corticotomies, and piezocisions during the first few months (typically within the first three months). However, a vast majority of included clinical trials had a high risk of bias. Furthermore, side effects of such interventions, such as augmented root resorption, remain to be fully investigated. Consequently, the evidence for accelerated tooth movement approaches is currently weak. Further work in this area is needed for laying a stronger empirical framework for accelerated tooth movement approaches.

Summary of Findings from Review of Meta Analysis:

Number	Citation	Included Studies/Trials	Intervention	Primary Outcomes Examined	Risk of Bias	Key Findings	Conclusions
1	Mheissen S, Khan H, Samawi S. Is Piezocision effective in accelerating orthodontic tooth movement: A systematic review and meta-analysis. PLoS One. 2020;15(4):e0231492. Published 2020 Apr 22. doi:10.1371/journal.pone.0231492	14 papers and 13 unique trials	Piezoelectric device was used to perform corticisions	• Canine retraction velocity measured in mm/month in • the first two months • Duration of the orthodontic treatment in relation to tooth alignment in crowded cases • En-masse retraction Maxillary incisors' retraction	***Risk of bias randomized controlled trials*** High risk = 8 Some concerns = 3 Low risk = 1 ***Risk of bias non randomized trials*** = Serious (n = 2) Overall quality = Low	• Piezocision increases the canine retraction rate by 0.57 mm per month for the initial two months after the surgical intervention. • Piezocision was effective in minimizing the overall duration of orthodontic treatment. It decreased the overall treatment time by more than three months.	The low-quality evidence suggests that piezocision is an effective surgical procedure in accelerating orthodontic tooth movement. However, the effect is clinically small and transient for the first three months.
2	Sivarajan S, Ringgingon LP, Fayed MMS, Wey MC. The effect of micro-osteoperforations on the rate of orthodontic tooth movement: A systematic review	Total of 8 RCTs of which only 2 were included in quantitative analysis	Micro-osteoperforations (MOP)	Rate of canine retraction (4 studies examined only maxillary canine retraction, 3 examined both maxillary and mandibular canine retraction, and 1 study examined en-masse retraction)	High risk = 3 Low risk = 3 Unclear = 2 Overall quality = Low	A meta-analysis of 2 low risk of bias studies showed that MOPs do not significantly hasten the rate of orthodontic teeth movement.	Overall evidence regarding impact of MOP on accelerated teeth movement is low.

	and meta-analysis. Am J Orthod Dentofacial Orthop. 2020;157(3):290-304. doi:10.1016/j.ajodo.2019.10.009						
3	AlShahrani I, Togoo RA, Hosmani J, Alhaizaey A. Photobiomodulation in acceleration of orthodontic tooth movement: A systematic review and meta analysis. Complement Ther Med. 2019;47:102220. doi:10.1016/j.ctim.2019.102220	12 studies (RCTs and CCTs)	Photobiomodulation (PBM): Ga-Al-As diode Laser (10 studies) and Oseeopulse laser (2 studies)	The outcome is mentioned as acceleration of tooth movement. However, it is not clear from this article what the individual unit (outcome) of analysis is.	Low risk = 6 Unclear = 6	The authors observed a statistically significant difference between the photobiomodulation therapy compared to non laser group in the acceleration of tooth movement (Mean difference 0.59).	PBM may have a possible benefit in a hastening orthodontic teeth movement. However, there is heterogeneity of included studies.
4	Fu T, Liu S, Zhao H, Cao M, Zhang R. Effectiveness and Safety of Minimally Invasive Orthodontic Tooth Movement Acceleration: A Systematic Review and Meta-analysis. J Dent Res. 2019;98(13):1469-	19 studies (RCTs and CCTs)	Minimally invasive surgery (MIS): piezocision, MOP, discision, laser-assisted flapless corticotomy and interseptal bone reduction	Rate of orthodontic tooth movement (canines) and duration of treatment.	High risk = 5 Low risk = 2 Unclear = 12	No effect of MOP on teeth movement. After flapless corticotomy procedures, increased tooth movement rates were observed at 1 and 2 months (however the evidence is low-quality).	MIS has some effect on accelerating tooth movement. However, there is high heterogeneity of included studies thus the results cannot be very reliable.

	1479. doi:10.1177/00220 34519878412						
5	Dab S, Chen K, Flores-Mir C. Short- and long-term potential effects of accelerated osteogenic orthodontic treatment: A systematic review and meta-analysis. Orthod Craniofac Res. 2019;22(2):61-68. doi:10.1111/ocr.12272	12 articles (included parallel arm split mouth designs, RCTs and CCTs)	Corticotomy accelerated osteogenic orthodontic treatment (CAOOT)	Bone density, buccal bone thickness, anchorage loss, root resorption and retraction time	High risk = 2 Low risk = 7 Unclear risk = 3	Study reported a statistically significant reduction in overall duration of treatment time (by 2.8 months) in those who had CAOOT procedure. This reduction occurred during the first few months following the corticotomy procedure.	CAOOT appears to accelerate tooth movement during first few months. However, the quality of evidence is very low to low level. Clinical significance is questionable.
6	Santinoni CD, Oliveira HF, Batista VE, Lemos CA, Verri FR. Influence of low-level laser therapy on the healing of human bone maxillofacial defects: A systematic review. J Photochem Photobiol B. 2017;169:83-89. doi:10.1016/j.jphotobiol.2017.03.004	15 studies	Low-level laser therapy				

7	Alfawal AM, Hajeer MY, Ajaj MA, Hamadah O, Brad B. Effectiveness of minimally invasive surgical procedures in the acceleration of tooth movement: a systematic review and meta-analysis. Prog Orthod. 2016;17(1):33. doi:10.1186/s40510-016-0146-9	4 RCTs and nine ongoing studies. Meta analysis was done on 3 RCTs	Minimally invasive surgical techniques for accelerating orthodontic tooth movement [MISAO] (i.e. corticision, piezocision, microosteoperforations, laser-assisted flapless corticotomy, interspetal bone reduction or any surgical procedure which is not required raising flap)	Canine retraction (at 1 month, 2 months and 3 months)	'Unclear risk of bias' was the common feature in the four RCTs	MSIAO was associated with faster tooth movement at 1 month (by 0.65 mm) at 2 months (by 1.41 mm) post surgery.	While there was statistically significant differences in teeth movement at 1 month and 2 months post surgery, the overall quality of evidence supporting the outcome was "low".
8	Fleming PS, Fedorowicz Z, Johal A, El-Angbawi A, Pandis N. Surgical adjunctive procedures for accelerating orthodontic treatment. Cochrane Database Syst Rev. 2015;2015(6):CD010572. Published 2015 Jun 30. doi:10.1002/14651	4 RCTs	Corticotomies	Rate of tooth movement	All 4 included studies were graded to have "unclear" risk of bias.	Corticotomies hastened tooth movement at 1 month (0.61 mm) and at 3 months (2.03 mm).	Limited research indicates that corticotomis could hasten tooth movement during the first three months. However, the quality of evidence was deemed to be "low".

	858.CD010572.pub2						
9	Gkantidis N, Mistakidis I, Kouskoura T, Pandis N. Effectiveness of non-conventional methods for accelerated orthodontic tooth movement: a systematic review and meta-analysis. J Dent. 2014;42(10):1300-1319. doi:10.1016/j.jdent.2014.07.013	18 trials (included only RCTs and CCTs) in qualitative analysis. 6 trials were combined in the meta-analysis	Low-intensity laser = 8 trials Photobiomodulation = 1 trial Pulsed electromagnetic fields = 1 trial Corticotomy = 7 trials Interseptal bone reduction = 1 trial	Canine retraction rate	High risk = 8 Low risk = 2 Unclear risk = 8	There was a statistically significant faster canine retrac- tion rate with corticotomy during the first month of therapy (WMD = 0.73 mm/month, $p < 0.01$) and with low-intensity laser (WMD = 0.42 mm/month, $p < 0.001$) in a period longer than 3 months.	The authors concluded that "*there is some evidence that low laser therapy and corticotomy are effective, whereas the evidence is weak for interseptal bone reduction and very weak for photobiomodulation and pulsed electromagnetic fields*"
10	Ge MK, He WL, Chen J, et al. Efficacy of low-level laser therapy for accelerating tooth movement during orthodontic treatment: a systematic review and meta-analysis. Lasers Med Sci. 2015;30(5):1609-1618. doi:10.1007/s10103-014-1538-z	6 RCTs and 3 quasi-RCTs	Low level laser therapy (LLLT)	Distance of tooth movement and speed of tooth movement	High risk = 4 Low risk = 1 Unclear risk = 4	LLLT was shown to hasten tooth movement in 7 days (Mean difference = 0.19, $p = 0.03$) and 2 months (mean difference = 1.08, $p = 0.02$)	LLLT might speed up the tooth movement in orthodontic Treatment. However, several included trials had a high risk of bias.

11	Long H, Zhou Y, Xue J, et al. The effectiveness of low-level laser therapy in accelerating orthodontic tooth movement: a meta-analysis. Lasers Med Sci. 2015;30(3):1161-1170. doi:10.1007/s10103-013-1507-y	5 studies (4 RCTs and 1 CCT)	Low level laser therapy or low level laser irradiation	Accumulative moved distance of tooth (AMD) at 1 month, 2 months and 3 months	High risk = 4 Unclear risk = 1	Weak evidence suggests that low-level laser irradiations at the wavelength of 780 nm, the fluence of 5 J/cm2 and/or the output power of 20 mW could accelerate orthodontic tooth movement within 2 and 3 months. However, there was significant heterogeneity and the pooled estimates may not be robust.	High bias of included studies and significant heterogeneity of included studies precludes us from drawing any meaningful robust conclusions.