# Accelerated Orthodontics: A Systematic Review on Corticotomy and Laser Therapy

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**Abstract:** <u>*Background*</u>*: Concern about the different methods of accelerated orthodontics.* <u>*Objectives*</u>*: The aim of this systematic review is to analyse the different methods used to accelerated orthodontic tooth movement (AOTM)* <u>*Data Source*</u>*: Electronic database PubMed, Cochrane library, SemOrtho, AJO-DO science direct search (from May 1959 to May 2019)* <u>*Selection Criteria*</u>*: Abstracts that appeared to fulfil the initial criteria for accelerated orthodontics were selected. The full-text original articles were then retrieved. Their references were also hand searched.* <u>*Data Synthesis*</u>*: 21584 publications were found by database search. A total of 13 publications were included in this review*

**Keywords:** Accelerated orthodontics, Accelerated tooth movement, Low intensity laser, Corticotomy

## 1. Introduction

Prolonged orthodontic treatment duration is one of the main deterrents in orthodontics which prompts many patients, especially adults, to either avoid treatment or to seek shorter alternative solutions with compromised results. Therefore, the treatment modalities that decrease treatment time, without compromising the treatment outcome are an active area of research in orthodontics today. Fixed orthodontic treatment can last up to 2 to 3 years which further poses the risk of complications associated with the treatment such as external root resorption, periodontal problems and patient compliance.[7,3]

Numerous methods have been proposed to enhance the rate of orthodontic tooth movement so that faster and better treatment options can be provided to the patients.[3]

These including low-level laser therapy, corticotomy, pulsed electromagnetic fields, electrical currents, drugs or vibrations.

Results of earlier conducted studies have proven to be inconclusive. This may lead to bias in clinician's understandings and mislead clinical practice. Thus, a critical systematic review would be quite beneficial for clinicians in day-to-day practice.

In this study, a critical systematic review is conducted to assess the effectiveness of accelerating orthodontic tooth movement by corticotomy and low-level laser therapy.

## 2. Materials and Methods

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) reporting guidelines are followed in this systematic review. A detailed search was conducted in the following electronic database in order to prepare the study protocol: PubMed, Cochrane library, Semortho, AJO-DO science direct search (from May 1959 to May 2019)

**Information Sources:**
A comprehensive electronic database search was performed (from May 1959 to May 2019). No restrictions were imposed regarding types of study design (i.e., case controlled, randomized controlled trial). The publications were searched electronically by using controlled index terms and relevant specific free text words. The last search was performed on May 2019.

**Search Strategy:**
Electronic search was conducted independently in four major databases, PubMed, AJO-DO, ELSEVIER and SemOrtho at the end of May 2019 with no time restrictions. A specific search was performed to identify any relevant study, based upon various combinations of key words. The references of all retrieved full text papers were searched for relevant papers that might have been missed through the electronic search. Eligibility assessment was performed in a standardized manner. Titles and abstracts were screened first and afterwards full text review of any relevant and potential for inclusion article was conducted. A positive exclusion method was used, whereby only those publications that did not meet one or more of the inclusion criteria were excluded.
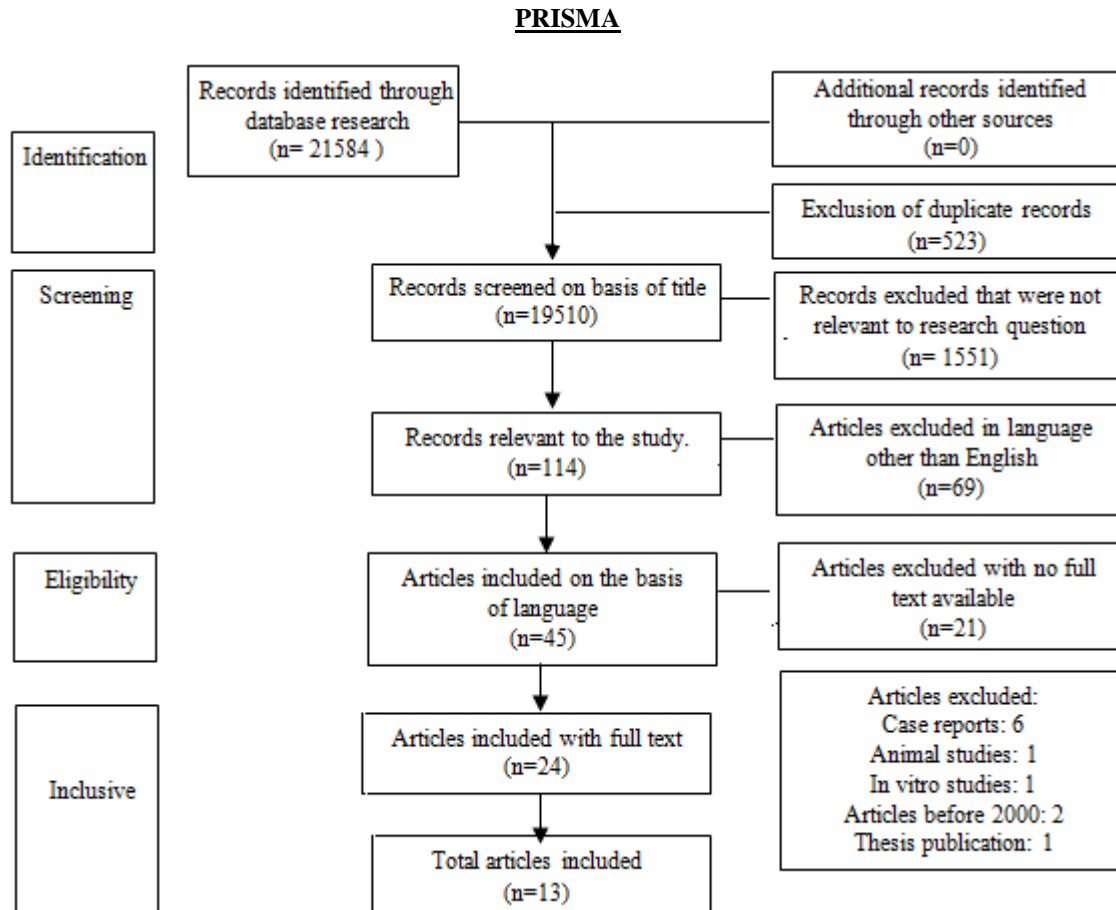
**PRISMA**



**Figure 1:** Flow diagram of the included studies according to the PRISMA[1-13]

## Eligibility Criteria

### Inclusion Criteria
Randomized controlled trials (RCTs) and controlled clinical trials (CCTs) reporting on results or treatment parameters related to accelerated orthodontic tooth movement.
1) The use of Human Specimen
2) The list of publications from Orthodontic journal.

### Exclusion Criteria:
1) In vitro and animal studies.
2) Case reports/case series.
3) Studies with sample size less than six.
4) Editorials, opinions, reviews, and technique description articles, without reported sample.
5) Studies referring to accelerated tooth movement occurring as a result of orthognathic surgery, distraction osteogenesis procedures, or pharmacological approaches.

### Types of interventions
Approaches that are considered refinements of conventional orthodontic treatment, such as selection of brackets, wires, biomechanical systems, force levels, and anchorage systems were not considered. Moreover, all the methods of accelerated orthodontics except low intensity laser and corticotomy, were excluded from the study.

### Types of participants
Healthy subjects who require orthodontic treatment with fixed appliances with no age limit. Studies including patients receiving any kind of medication, which can affect orthodontic treatment or patients receiving orthognathic surgery, syndromic patients, patients with cleft lip and palate or any systemic disease were excluded.

### Types of outcome measures
The primary collected outcome measures were rate of tooth movement or cumulative distance of movement, duration of orthodontic treatment or a predefined part of it, or time needed to complete a predefined tooth movement.

### Data extraction process
Data extraction was performed by one author, independently in the pre-determined data abstraction forms that were also used for quality assessment of the included studies. In cases of inconsistencies, the original studies were re-examined to reconcile any disagreements. In brief, the following information was obtained from each included study: (a) general information, (b) study characteristics, (c) patient sample characteristics, (d) intervention and setting, (e) outcome data/results.

## 3. Results

**Description of studies:** The literature search initially yielded 21584 records. Following review of the titles and abstracts, it was decided that 24 studies should be examined in more detail. 11 of the 24 studies were subsequently excluded following full-text reading of the article due to various reasons described in the chart. Finally, 13 papers

were included in the review for qualitative and quantitative synthesis.

**Insight**

**Table 1**

| Study 1 | Camacho and Cujar (2010)[1] |
|---|---|
| Subject group | Low-intensity laser(treatmentduration) |
| Main objective | Effect on duration of non-extraction orthodontic treatment |
| Study design | Prospective CCT |
| Treatments tested | Low-intensity laser vs. conventional treatment |
| Sample description (size, sex, age) | Exp.:23 control: 22 Age: 20-30 years |
| Malocclusion characteristics | Skeletal and dental Class I, crowding 5mm or less |
| Method of allocation/recruitment procedure used | Consecutive/consecutive |
| Details of the acceleration protocol | Photon Laser III(830nm,80J) for 22 sbuccally and 22 spalatally on each single tooth. Applied 24 hrs after the1st control and thereafter at every appointment |
| Definition of pre-specified main outcome | Time requiredtocompleteorthodontic treatment |
| Summary outcome data | Treatment durationexp.: 398 days ±87.8 control: 565 ± 130 days,$p < 0.00001$ |
| Additional outcomes | NA |
| Quality assessment | Unclearrisk |

**Table 2**

| Study 2 | Cruz etal. (2004)[2] |
|---|---|
| Subject group | Low-intensitylaser(maxillarycanineretraction) |
| Main objective | Effect onrateofspace closure |
| Study design | RCT (splitmouth) |
| Treatments tested | Low-intensitylaservs. conventionaltreatment |
| Sample description (size, sex, age) | Exp.andcontrol: Total 11(Age: 12–18 years) |
| Malocclusion characteristics | Crowding orbimaxillary protrusion |
| Method of allocation/recruitment procedure used | Random/unclear,basedon specificcriteria |
| Details of the acceleration protocol | Ga-Al-As laser (780nm,20mW)for 10s, 5 times buccal/ 5 times palatal, on the cervical 1/3mesial and distal,on the apical 1/3 mesialanddistalandonthemiddle, on days 0, 3, 7, 14, 30, 33, 37, 44, 51, 60 |
| Definition of pre-specified main outcome | Amount of space closure obtained after 2 months |
| Summary outcome data | Space closure in 2 months exp.: $4.4 \pm 0.3$mm, control: $3.3 \pm 0.2$ mm, $p < 0.001$ |
| Additional outcomes | NA |
| Quality assessment | High risk |

**Table 3**

| Study 3 | Limpanichkulet al.(2006)[3] |
|---|---|
| Subject group | Low-intensity laser (maxillarycanine retraction) |
| Main objective | Effect on rate of canine retraction |
| Study design | RCT (split mouth) |
| Treatments tested | Low-intensity laser vs. Conventional treatment |
| Sample description (size, sex, age) | Exp.and control:12(8F, 4M; Age: $20.11 \pm 3.4$ years) |
| Malocclusion characteristics | Unclear |
| Method of allocation/ recruitment procedure used | Random/unclear, based on specific criteria |
| Details of the acceleration protocol | Ga-Al-As laser (860nm,100mW) at three sites on buccal and on Palatal sides, and at two sites distal to the canine (23s/ site) on The 1st, $2^{nd}$ and $3^{rd}$ day after initiation of retraction. Repetition of the 3-day protocol after 1, 2 and 3 months |
| Definition of pre-specified main outcome | Amount of retraction obtained after 3 months |
| Summary outcome data | Canine retraction at 3 months exp.: $1.3 \pm 0.2$mm control: $1.2 \pm 0.2$ mm, $p = 0.77$ |
| Additional outcomes | NA |
| Quality assessment | Low risk |

**Table 4**

| Study 4 | Youssef etal. (2008)[4] |
|---|---|
| Subject group | Low-intensity laser (maxillary and mandibular canine retraction) |
| Main objective | Effect on rate of space closure |
| Study design | Prospective CCT (split mouth) |
| Treatments tested | Low-intensity laser vs. Conventional treatment |
| Sample description (size, sex, age) | Exp.and control:15(Age: 14–23 years) |
| Malocclusion characteristics | Crowding orbim axillary protrusion |

| Method of allocation/recruitment procedure used | By side (left control, right exp.)/ unclear, based on specific criteria |
|---|---|
| Details of the acceleration protocol | Ga-Al-Aslaser (809nm,100mW) For 10, 20 and 10 at cervical, middle and apical areas respectively on days 0, 3, 7, and 14 after every activation. |
| Definition of pre-specified main outcome | Rate of space closure to complete closure of the extraction space |
| Summary outcome data | Space closure rate up to complete closure (mm/month) exp.: $2.0 \pm 0.1$, control: $1.0 \pm 0.1$, $p < 0.001$ |
| Additional outcomes | Pain intensity was significantly lower in the lased group than in the control group throughout the retraction period. |
| Quality assessment | Unclear risk |

**Table 5**

| **Study 5** | **Sousa etal. (2011)[5]** |
|---|---|
| Subject group | Low-intensity laser (maxillary and/ or mandibular canine retraction) |
| Main objective | Effect on rate of space closure |
| Study design | RCT (splitmouth) |
| Treatments tested | Low-intensity laser vs. Conventional treatment |
| Sample description (size, sex, age) | Exp. And control: 10 (6F, 4M; Age: 10.5–20.2years) |
| Malocclusion characteristics | Crowding or bim axillary protrusion |
| Method of allocation/ recruitment procedure used | Random/ unclear, based on specificcriteria |
| Details of the acceleration protocol | As-Ga-Al laser (780nm, 20mW) for 10s, at 10 sites per tooth (5 bucally/ 5 lingually) on days 0, 3 and 7 after the first application (T1) and every reactivation (T2and T3) using the same 3-day Protocol |
| Definition of pre-specified main outcome | Amount ofspaceclosureobtained after3months |
| Summary outcome data | Space closureat3months exp.: $3.09 \pm 1.06$ mm, control: $1.60 \pm 0.63$ mm, $p < 0.05$ |
| Additional outcomes | No statistically significant difference in root resorption or alveolar bone height |
| Quality assessment | Unclear risk |

**Table 6**

| **Study 6** | **Doshi-Mehta et al. (2012)[6]** |
|---|---|
| Subject group | Low-intensity laser (maxillary canine retraction) |
| Main objective | Effect on rate of space closure |
| Study design | RCT (split mouth) |
| Treatments tested | Low-intensity laser vs. conventional treatment |
| Sample description (size, sex, age) | Exp.and control:20(12F, 8M; Age: 12–23 years ) |
| Malocclusion characteristics | Unclear |
| Method of allocation/recruitment procedure used | Random/ unclear, based on specific criteria |
| Details of the acceleration protocol | Ga-Al-As laser(808nm) for 10s, 5 times buccal/ 5 times palatalon the cervical1/ 3mesial and distal, on the apical 1/ 3mesial and distal, and on the middle, on days 3, 7, 14 and there after every 15th day |
| Definition of pre-specified main outcome | Space closure distance and rate upon the completion of retraction on experimental quadrant (4.5 months) |
| Summary outcome data | Space closure at the endofretraction on exp.side exp.: $5.5 \pm 1.0$ mm, control: $4.0 \pm 1.0$ mm, $p < 0.001$ Rate of retraction (mm/month) exp.: $1.1 \pm 0.2$, control: $0.8 \pm 0.2$, $p < 0.01$ |
| Additional outcomes | The pain score on the experimental side was significantly lower compared with the control side on day 3 as well as on day 30 after start of canine retraction |
| Quality assessment | Low risk |

**Table 7**

| **Study 7** | **Genc etal. (2013)[7]** |
|---|---|
| Subject group | Low-intensity laser (maxillary lateral incisor retraction) |
| Main objective | Effect on rate of retraction |
| Study design | Prospective CCT (split mouth) |
| Treatments tested | Low-intensity laser vs. conventional treatment |
| Sample description (size, sex, | Exp.and control:20(14F, 6M; Age : $17.8 \pm 4.2$ years) |

| age) | |
|---|---|
| Malocclusion characteristics | Convex profile or crowding |
| Method of allocation/ recruitment procedure used | By side (left control, right experimental)/ unclear, based on specific criteria |
| Details of the acceleration protocol | Ga-Al-As laser (808nm, 20mW) for 10s, 5 times buccal/5times palatal, on the cervical1/3 mesial and distal, on the apical 1/ 3 mesial and distal and on the middle, on days 0, 3, 7, 14, 21, 28 |
| Definition of pre-specified main outcome | Amount of retraction obtained after 35 days |
| Summary outcome data | Lateral incisor retraction after 35days (approximation based on figure)<br>exp.: 2.4mm,<br>control: 1.7mm,<br> p < 0.001 |
| Additional outcomes | NA |
| Quality assessment | High risk |

**Table 8**

| Study 8 | Dominguez et al.(2013)[8] |
|---|---|
| Subject group | Low-intensity laser (maxillary1st premolar retraction) |
| Main objective | Effect on rate of space closure |
| Study design | Prospective CCT (split mouth) |
| Treatments tested | Low-intensity laser vs. conventional treatment |
| Sample description (size, sex, age) | Exp.and control:10<br>(5F, 5M; Age: 13.7 ± 1.3 years) |
| Malocclusion characteristics | Lack of space in the upper arch |
| Method of allocation/ recruitment procedure used | By side (left control, right experimental)<br>Consecutive, based on specific criteria |
| Details of the acceleration protocol | Diode laser (PeriowaveTM;670 nm, 200mW) partially inserted into the periodontalpocket and moved all along the sulcus, applied distally, buccally, and lingually, 3 minon each surface (total 9 min) on days 0, 1, 2, 3, 4, and 7 |
| Definition of pre-specified main outcome | Amount of space closure obtained after 45days |
| Summary outcome data | Space closureafter 45days<br>exp.: 3.7 ± 1.1 mm,<br>control: 2.7 ± 0.9 mm,<br>p < 0.00001 |
| Additional outcomes | No significant difference in plaque index and bleeding index. Slight pain reduction (though not significant) and slightly increased levels of RANKL and RANKL/ OP Gratioin the gingival crevicular fluid of the laser group |
| Quality assessment | Unclear |

**Table 9**

| Study 9 | Aboul-Ela etal. (2011)[9] |
|---|---|
| Subject group | Corticotomy perforations (maxillary canine retraction) |
| Main objective | Effect on rate of canine retraction |
| Study design | RCT (split mouth) |
| Treatments tested | Corticotomy vs. conventional treatment |
| Sample description (size, sex, age) | Exp. And control:13 (8F, 5M; mean age 19 years) |
| Malocclusion characteristics | Class IIdiv.1with increased over jet |
| Method of allocation/ recruitment procedure used | Random/ unclear, based on specific criteria |
| Details of the acceleration protocol | Scattered corticotomy perforations (No2 roundbur, low-speed hand piece) that approximated the width of the buccal cortical bone and extended from the lateral incisor to the first premolar area. |
| Definition of pre-specified main outcome | Rate ofretractionafter 4 months |
| Summary outcome data | Canine retraction rate(mm/month)<br>1st month - exp.: 1.9,control:0.7<br>2nd month - exp.: 1.8,control:0.9<br>3rd month - exp.: 1.1,control:0.9<br>4th month – exp.: 0.9,control:0.8<br>p , 0.01 for total observation time |
| Additional outcomes | No statistically significant difference in plaque index, probing depth, attachment level, and gingival recession. Gingival index was slightly higher on the operated side |
| Quality assessment | Unclear |

**Table 10**

| Study 10 | Alikhani etal. (2013)[10] |
|---|---|
| Subject group | Corticotomy perforations (maxillary canine retraction) |
| Main objective | Effect on rate of canine retraction |
| Study design | RCT (and split mouthin exp.group) |
| Treatments tested | Corticotomy vs. conventional treatment |
| Sample description (size, sex, age) | Exp.: 10 (5F, 5M; mean age: 26.8years) control: 10 (7F, 3M; mean age : 24.7years) |
| Malocclusion characteristics | Class II div.1 with overjet , 10 mm |
| Method of allocation/recruitment procedure used | Random/ unclear, based on specific criteria |
| Details of the acceleration protocol | Three corticotomy perforations (1.5mm wide and 2–3mm deep) performed along avertical line at equal distances from the canine and the 2nd premolar before the retraction using a disposable device (PROPELOrthodontics,Ossining, NY), without any flap |
| Definition of pre-specified main outcome | Rate of retraction after 1 Month |
| Summary outcome data | Canine retraction after 28 days: exp.: $1.1 \pm 0.2$mm, control: $0.5 \pm 0.2$ mm, $p < 0.05$ |
| Additional outcomes | No difference between groups in pain and discomfort 1, 7, and 28 days after retraction. Inflammatory markers in gingival cervicular fluid were increased in the exp.group |
| Quality assessment | Unclear risk |

**Table 11**

| Study 11 | Abed and Al-Bustani (2013)[11] |
|---|---|
| Subject group | Corticotomy perforations (maxillary canine retraction) |
| Main objective | Effect on rate of canine retraction |
| Study design | Prospective CCT (split mouth) |
| Treatments tested | Corticotomy vs. conventional Treatment |
| Sample description (size, sex, age) | Exp. Andcontrol:12(8F, 4M; Age 17–28years) |
| Malocclusion characteristics | Unclear |
| Method of allocation/recruitment procedure used | By the size of space (experimental on the largest space)/ unclear |
| Details of the acceleration protocol | 3–4 corticotomy perforations performed mesially and distally to the canine,with a1.5mm round bur, spaced 2mm apart |
| Definition of pre-specified main outcome | Rate of retraction after 1 month |
| Summary outcome data | Canine retraction after 1 month: exp.: $1.74 \pm 0.47$mm control: $1.22 \pm 0.40$ mm, $p < 0.005$ |
| Additional outcomes | No difference in an chorageloss between surgical and non-surgical sides. No difference on gingival sulcus depth and tooth vitality pre-and post-surgery |
| Quality assessment | High risk |

**Table 12**

| Study 12 | Fischer et al (2007)[12] |
|---|---|
| Subject group | Corticotomy (positioning of palatally impacted canines) |
| Main objective | Effect on time needed for positioning of palatally impacted canines on dental arch |
| Study design | RCT ( split mouth) |
| Treatments tested | Corticotomy vs.conventional treatment |
| Sample description (size, sex, age) | Exp. And control: 6 (4F, 2M; Age :11.1–12.9 years) |
| Malocclusion characteristics | Bilateral palatally impacted canines |
| Method of allocation/ recruitment procedure used | Random/consecutive |
| Details of the acceleration protocol | Corticotomy perforations (11/2 mm round bur) along the bone mesial and distal to the impacted tooth, approximately 2 mm apart and extended into the edentulous area into which the tooth was to be moved |
| Definition of pre-specified main outcome | Canine movement rate until the tips of both canine crowns were properly positioned |
| Summary outcome data | Canine movement rate (mm/week) exp.: $0.26 \pm 0.04$ control: $0.19 \pm 0.01$, $p < 0.001$ |
| Additional outcomes | NA |
| Quality assessment | Unclear |

**Table 13**

| Study 13 | Cassetta et al. (2012)[13] |
|---|---|
| Subject group | Corticotomy using piezovs. Round burs (surgery duration and quality of life) |
| Main objective | Duration of surgery and oral health-related quality of life (OHRQoL) in Piezoelectric surgery and rotatory osteotomy |
| Study design | RCT |
| Treatments tested | Piezoelectric surgery vs. conventional rotary osteotomy |
| Sample description (size, sex, age) | Exp.:12 (6 piezo,6 rotatory) (8F,4M; Age :13–17years) |
| Malocclusion characteristics | Bilateral Class I molar occlusion with a moderate-severe crowding or/ and unilateral crossbite |
| Method of allocation/recruitment procedure used | Random/ based on specific criteria |
| Details of the acceleration protocol | Piezoelectric group: vertical cuts (insert 511) mesial and distal along each tooth root from 7 to 7 and corticotomy perforations (insert 514) spread between them. Conventional group: same protocol applied with around multi-blade burand a high speed hand piece |
| Definition of pre-specified main outcome | Time required for intervention. Effect on the OHRQoL 3 and 7 days after surgery |
| Summary outcome data | Mean time<br>Piezo: 34.3(32.6–35.3)min,<br>Rotator: 28.2(27.1–29.2)min,<br>$p > 0.05$<br>OHRQoL baseline: 6.3(0–14) , 3 days;<br>Piezo:22.7(7–45), rotator: 21.33(16–26), $p = 0.86$ ,7 days;<br>Piezo:16.3 (2–25), rotator: 10.7(5–22)<br>$p = 0.35$ |
| Additional outcomes | NA |
| Quality assessment | High risk |

## 4. Discussion

Reduction of orthodontic treatment time by means of accelerated tooth movement has attracted the interest of the orthodontic community in the recent years. The aim of this systematic review was to analyse the different methods used to accelerated orthodontic tooth movement (AOTM) with major focus on corticotomy and laser therapy.

A larger number of studies (Table 1-8) demonstrate a summary of the effectiveness of low intensity laser. The majority of the studies report a favourable effect on orthodontic treatment by means of either reduced treatment durationor increased rate of tooth movement[1-2, 4-8]except the study by Limpanichkul et al, who concluded that energy density was too low to express either stimulatory or inhibitory effect on rate of tooth movement.

The outcome is believed to be due to biomodulation effect of low level laser.[2] This method enhances the effect on fibroblast growth, wound healing and bone remodelling.

No consensus has been reached on the most effective laser application regimens and irradiation doses. Unfortunately, this cannot be investigated at this time due to the heterogeneity of the available studies.

However, authors who applied low level laser therapy only for separate canine retraction obtained an average of 20-50% reduction in overall treatment duration [2-8] whereas retraction of a dental arch segment reduces the treatment duration by 30% as compared to the control.[1]

Low intensity laser appears to be less prone to adverse effects. Although adverse effects were tested only in two studies, significant unfavourable outcomes were not reported and are not expected.[5-6] There is one favourable parallel effect regarding the reduction of orthodontic pain achieved by the use of low-intensity laser.[4]

Hence this type of intervention has an advantage of being non-invasive and has minimal side effects.

As frequent application of the low-intensity laser irradiation is probably needed to achieve significant acceleration, more appointments would be required. The ideal laser settings, timing, frequency, and time lapse between serial laser applications remains to be determined. Portable devices have already been developed and if made widely available and affordable they may expand the applicability of this method in orthodontics. Thus, the application of this intervention in everyday practice could be suggested in patients that are willing to attend the practice multiple times and at short intervals. At present, the cost/benefit ratio for the patient and the doctor needs further clarification, although current results are promising.

Corticotomy assisted acceleration of orthodontic tooth movement has been investigated in five included studies, at varying level of risk of bias. Corticotomy was reported to accelerate the rate of canine tooth movement significantly during the first two month after the application of the intervention. However, the effectiveness of this intervention was questionable over time, since a sharp decline of the tooth movement rate was apparent after the second month of observation.[9,11,12]

This transient nature of the intervention might be overcome if a second surgery was to be performed. No studies were found to assess this treatment strategy.

The intervention was reported to have a negative impact on the oral health quality of life, with partial recovery after 7 days.[10]

This surgical method is more invasive in comparison to the non-surgical interventions, and thus the patients need to be pre-informed about the post-surgical condition and potential risks from surgery. Flapless methods seem quite promising in these terms and partly overcome these limitations.[13]

The overall quality of evidence supporting this intervention is low. The number of studies is moderate and clinically heterogeneous.

The majority of included studies have a split-mouth design, where the possibility of carry across effect or contamination or spilling of the effects of one intervention to another cannot be excluded. Most studies evaluate part of the treatment and not the effect on the entire treatment duration and technique specific aspects of interventions are not investigated. Adverse effects are investigated in a limited number of studies and no attempt to assess interventions in terms of cost–benefit analysis is reported.

There is moderate evidence on low laser therapy and low evidence on corticotomy regarding their effectiveness in acceleration of orthodontic tooth movement.

Overall, the results should be interpreted with caution given the small number, quality, and heterogeneity of the included studies. There is a need for larger, high quality RCTs.

Further research is required on the field of accelerated orthodontics with additional attention paid to application protocols, overall treatment duration, adverse effects and cost–benefit analysis, based on the specific characteristics of each method.

## 5. Summary and Conclusion

Accelerated tooth movement during orthodontic treatment is the need of the hour, keeping in mind the long duration and multiple visits required by the patient. In the present study surgical and non-surgical methods of acceleration were used, i.e., Corticotomy and Laser therapy respectively. In total, 13 articles were included in the study .

Following salient conclusions can be drawn from the study,
1) Surgical techniques are more invasive and costly, but are more beneficial with fewer side effects.
2) The application of surgical intervention in everyday practice could be suggested to patients that are willing to attend the practice multiple times and at short intervals.
3) There is moderate evidence on low level laser therapy and low evidence on corticotomy, regarding their effectiveness in acceleration of orthodontic tooth movement.
4) With increasing patient compliance, less invasive surgical techniques can be safely used to accelerate tooth movement.

There is an obvious need to investigate in more depth the molecular mechanisms underlying accelerated orthodontic tooth movement, to elucidate the key factors that make the procedure most effective with the fewest side effects, shortest times, and lowest cost to patients. New knowledge in this field will empower us to revolutionize orthodontic therapy and its practice in the future.

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