

# Treatments for intrusive luxation in permanent teeth: a systematic review and meta-analysis

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**Abstract.** Intrusive luxation is a severe form of dental trauma and there is no consensus regarding its management for permanent teeth. A systematic review and meta-analysis was performed to identify the appropriate treatment for teeth with intrusive luxation. The PubMed/MEDLINE, Embase, US Clinical Trials, and ISRCTN Registry electronic databases were used to search for articles in English and unpublished studies without a date limit. Eligible studies evaluated periodontal results (root resorption as the primary outcome; marginal bone defects and/or pulpal changes as secondary outcomes) after spontaneous re-eruption (SRE), orthodontic repositioning (ORP), or surgical repositioning (SRP) for patients with one or more traumatically intruded permanent teeth. Risk ratios with 95% confidence intervals were used to compare treatments. The meta-analysis revealed no significant difference ( $P > 0.05$ ) between SRP and SRE for root resorption. For secondary outcomes, SRE was significantly better than SRP and ORP ( $P < 0.05$ ). Subgroup analyses showed no significant differences among treatments in teeth with completely formed roots ( $P > 0.05$ ) and a better prognosis when SRE was performed in teeth with incompletely formed roots ( $P < 0.05$ ). The available evidence does not allow us to conclude on the best treatment for traumatically intruded teeth. More reliable evidence is needed.

Key words: tooth injuries; dental trauma; dentition; permanent; meta-analysis.

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Dental trauma is a significant problem that affects approximately 25% of school-age children, and its incidence can exceed those of dental caries and periodontal disease in this population.<sup>1–3</sup> Moreover,

approximately 33% of adults suffer trauma in the permanent dentition.<sup>2</sup>

Intrusive luxation is a severe form of dental trauma, accounting for 0.5–2% of traumas affecting the permanent

dentition.<sup>4</sup> Its low incidence makes it difficult to perform research involving a large number of participants,<sup>5</sup> and makes treatment strictly empirical, even at major trauma centres.<sup>2</sup>

Intrusive luxation is defined as the axial dislocation of a tooth in its alveolus.<sup>3,6-9</sup> The injury is so severe because the root surface of the intruded tooth remains in intimate contact with the alveolar bone, resulting in the destruction of most fibres of the periodontal ligament and the cementum of the root surface.<sup>9,10</sup> Vascular compression of the periodontium and pulpal complex causes ischemia.<sup>10</sup> As a result of these characteristics, healing following intrusive luxation is associated with several complications, such as inflammatory and replacement root resorption.<sup>9,10</sup>

Currently, three treatments are available for intrusive luxation: spontaneous re-eruption, orthodontic repositioning, and surgical repositioning. However, the published evidence provides conflicting prognoses for these three treatment types.<sup>5</sup>

The protocols used by the International Association of Dental Traumatology (IADT)<sup>3</sup> and by the UK National Clinical Guidelines in Paediatric Dentistry<sup>11</sup> were developed based on literature reviews and consensus meetings. In addition, the treatment decision considers the degree of intrusion and the degree of root formation, which are important confounding variables related to the treatment outcome.<sup>10</sup>

In 2014, a systematic review concluded that spontaneous eruption yields the least complications in immature teeth, regardless of the degree of intrusion, and observed no significant differences between active treatments (surgical and orthodontic).<sup>12</sup> These conclusions were based exclusively on the results of the articles included in the review, without statistical analyses. Therefore, a further study including the statistical analysis of primary studies could produce a single estimate result and an overall conclusion, providing the best available evidence to guide the selection of the optimal treatment methods in the future.<sup>13</sup>

A systematic review and meta-analysis of interventional and observational studies—both prospective and retrospective—was thus performed to assess the periodontal effects (inflammatory and/or substitution root resorption) of the three treatments, spontaneous re-eruption, orthodontic repositioning, and surgical repositioning, used to manage patients with one or more permanent teeth that have suffered intrusive luxation.

## Materials and methods

This systematic review and meta-analysis was performed in accordance with the criteria established in the PRISMA 2009 guidelines.<sup>14</sup> It is registered in the

PROSPERO database (National Institute for Health Research) under registration number CRD42015025334.

### Selection criteria

The PICO (population, intervention, comparison, and outcomes) method was used to define the research question and to optimize the search strategy<sup>15</sup>: (1) Population: only studies on humans with one or more traumatically intruded permanent teeth were included. (2) Intervention: spontaneous re-eruption, orthodontic repositioning, or surgical repositioning of the intruded tooth/teeth were evaluated. (3) Comparison: comparisons between orthodontic and surgical repositioning, between one of the two types of repositioning and no repositioning, and between the two types of repositioning and no repositioning were evaluated. (4) Outcome: root resorption was the primary outcome evaluated, and marginal bone defects and pulpal changes were the secondary outcomes. All studies that evaluated at least one type of periodontal parameter were included.

### Search strategy to identify studies

The search strategy was developed for PubMed/MEDLINE and revised for other databases. Search terms were related to the types and populations of the studies (Fig. 1). The searches were performed systematically in April 2015 using the online databases Embase and PubMed/MEDLINE. Studies published in English were selected, without restriction on year of publication. The references of pre-selected articles were also reviewed.

- #1 Search cohort study
- #2 Search prospective study
- #3 Search clinical study
- #4 Search retrospective study
- #5 Search intervention study
- #6 Search observational study
- #7 Search treatment
- #8 Search #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7
- #9 Search intrusive luxation
- #10 Search intrusion
- #11 Search permanent tooth
- #12 Search permanent teeth
- #13 Search #9 OR #10
- #14 Search #11 OR #12
- #15 Search #8 AND #13 AND #14

Fig. 1. Search strategy.

Articles that were not available online were obtained using a bibliographic commutation program (Comut; Programa de Comutação Bibliográfica do Instituto Brasileiro de Informação em Ciência e Tecnologia). The US Clinical Trials (<http://www.clinicaltrials.gov>) and ISRCTN Registry (<http://www.isrctn.com>) websites were searched for unpublished literature (records of clinical trials) using only the term 'dental trauma', because 'intrusion' and 'intrusive luxation' did not present any results.

Two independent reviewers (LAC and LMC) identified and evaluated the titles and abstracts of the articles. When the information in the title and abstract was insufficient, the entire article was read. The two reviewers met to finalize the article selection. When there was disagreement, a third reviewer (CCCR) decided on the article inclusion. The articles included in this review had to report at least 6 months of follow-up.

### Evaluation of study quality

The quality of each study was evaluated on the basis of the risk of bias using the criteria recommended in the Cochrane Handbook for Systematic Reviews of Interventions, version 5.1.0.<sup>15</sup> The following criteria were applied: (1) random sequence generation to form intervention groups; (2) allocation concealment before grouping; (3) blinding of participants and healthcare providers; (4) blinding of the outcome evaluators; (5) incomplete outcome data (i.e., reasons for losses not reported or no corresponding data from the text and tables); (6) selective reporting (i.e., possibility of

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