Undergraduate dental students’ use perception of different endodontic instruments for mechanical – chemical preparation: a systematic review of laboratory studies

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Received: 05/31/2021. Approved: 02/12/2022.

ABSTRACT
This literature review aimed to compare undergraduate dental students’ perceptions regarding the use of nickel–titanium (NiTi) and stainless steel instruments for the mechanical-chemical preparation of root canals, focusing on quality and time. PubMed, LILACS, Scopus, Embase, SciELO, and CENTRAL electronic databases were accessed to verify and select related studies published as of January 2021. Laboratory studies comparing the use of NiTi instruments with stainless steel instruments by undergraduate dental students were evaluated. Two reviewers independently selected the studies, collected the data, and analyzed the risk of bias. Out of the 92 potentially relevant studies, 10 met the inclusion criteria for a full-text analysis and were subsequently included in the systematic review. The risk of bias was considered high in all studies. Undergraduate dental students demonstrated a greater preference for and better perception of NiTi instruments. NiTi instruments also resulted in less time for and better quality of the mechanical-chemical preparation. These were associated with a lower incidence of accidents, such as canal ledges, transportations, and deviations, as well as a higher incidence of instrument fractures.

1 INTRODUCTION

Undergraduate dentistry programs teach endodontics to help dental students develop manual skills, beginning with preclinical training in cases ranging from lower to greater complexity. Carrying out procedures in this area of dentistry is reported to be the most technically difficult¹. Out of all the stages of endodontic therapy, the mechanical-chemical preparation of root canals is reported to be the most challenging by undergraduate students².

Given the characteristics of the nitinol alloy, such as its tremendous flexibility, the use of nickel–titanium (NiTi) instruments is associated with a lower rate of transportation and better maintenance of the original shape of the canal, a lower incidence of accidents during the procedure³⁴, and less apical extrusion compared with the use of manual stainless steel instruments⁵. As such, Brazilian professionals prefer the use of NiTi instruments in their clinical practice. A recent survey found that 88% of dentists (66% specialists in endodontics) report the use of mechanized instrumentation⁶.

Therefore, with the implementation of NiTi endodontic instruments on the rise, the contributions of the continued teaching and practice of preparations with stainless steel instruments is called into question. These instruments are associated with a greater incidence of ledges, longer instrumentation times, and risk of perforations and deviations⁴⁷. Meanwhile, despite the reported advantages of NiTi instruments, their use in practical undergraduate activities remains minimal, mainly owing to their higher costs⁶⁸.

The root canal instrumentation stage for successful endodontic treatments and education that reflects technological advances are both relevant to the patient’s comfort and successful treatment and to the future professional’s informed development. This systematic review aimed to compare undergraduate dental students’ perceptions on the use of NiTi instruments and stainless steel instruments, focusing on the quality of and time spent for the mechanical-chemical preparation of root canals.

2 METHOD

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines⁹ and was registered in the International Prospective Register of Systematic Reviews (Registration no. CRD42021242066).

PICO question

The following research question was formulated to address the literature and outline the search strategy: Is there a difference in undergraduate dental students’ perceptions on the use of NiTi instruments and stainless steel instruments regarding the quality of and time for the mechanical-chemical preparation of root canals? The research question applied the PICO strategy (population [P], intervention [I], comparison [C], and outcome [O]) as follows: P = undergraduate dental students; I = use of NiTi instruments; C = use of stainless steel instruments; and O = perception of the use of the instrument with respect to the quality of and time for mechanical-chemical preparations.

Search strategy

The literature search was performed in the Medical Literature Analysis and Retrieval System Online (MEDLINE) databases via PubMed, Latin American and Caribbean Health Sciences Literature (LILACS), Scopus, Embase, Scientific Electronic Library Online (SciELO), and Central Register of Controlled Trials (CENTRAL) to verify and select laboratory studies related to the research
question that had been published by January 2021. We set no restrictions as to language or year of publication.

The search strategy used to locate studies related to the subject was based on a search in the PubMed/MEDLINE database: (((Students, Dental[MeSH Terms]) OR (Dental Student*)) OR (Undergraduate Student*)) AND ((((titanium nickelide) OR (Ti-Ni)) OR (nickel-titanium alloy)) OR (nickel-titanium)) OR (nickel-titanium endodontic file)) OR (nickel-titanium endodontic instrument)) AND (((Stainless Steel[MeSH Terms]) OR (Stainless Steel)) OR (Stainless Steel endodontic file)) OR (Stainless Steel endodontic instrument)). This search strategy was then adapted to the other databases, and duplicates were identified and eliminated from the search results.

**Selection criteria**

Two independent reviewers (J.A.S. and B.N.P.) carefully reviewed the titles and abstracts of all the results found and then selected those that met the inclusion criteria for further review, namely laboratory studies that compared the use of NiTi instruments with the use of stainless steel instruments by undergraduate dental students. The Kappa index was utilized to calculate inter-examiner agreement, yielding a value of 0.97.

All studies meeting the inclusion criteria were selected and read in full for an evaluation based on the exclusion criteria, namely studies that did not consider the outcomes of use perception on the quality of or time for mechanical-chemical preparation in endodontic treatments and that had used deciduous teeth. Studies that were not found in full were also excluded. For both steps, the examiners evaluated the studies independently, and any disputes were first settled by discussion. If the discussion persisted, a third author (S.B.L.) was consulted.

**Data extraction**

The two reviewers (J.A.S. and B.N.P.) collected the following data from the selected studies: publication data (authors, year, and country of origin); sample characteristics (institution, graduation year and operators’ experience, number of operators, number of root canals per group, and characteristics of the experimental models); methodology (instruments used and assessment method); and outcomes.

**Risk-of-bias analysis**

The risk-of-bias assessment was performed based on the Cochrane Handbook for Systematic Reviews of Interventions version 6.2⁰. Since this review included only laboratory studies, the criteria were adapted to allow for a critical analysis. In addition to the general risk of bias, our assessment considered five domains: randomization of the groups, use of NiTi instruments according to the manufacturer’s instructions, standardization of the chemical protocol in different experimental groups, blinding, and examiners’ calibration.

Based on an adaptation of the Risk of Bias 2.0, the studies were classified as follows: low risk, some concerns, and high risk. For Higgins *et al.* (2021)⁰, studies with a “high risk of bias” in at least one domain or “some concerns” in multiple domains are classified as having a high risk of bias. For a study to be classified with a low risk of bias, all domains must be assessed as having a “low risk of bias.”

**3 RESULTS**

The results of this systematic review are based on information provided by the study authors. Additional information was requested
from seven authors\textsuperscript{11-17} for the risk-of-bias assessment. They were contacted by email, and two responded to the requests\textsuperscript{11,15}.

**Study selection**

The search strategy resulted in 92 potentially eligible studies. Figure 1 presents the PRISMA flowchart and describes the study selection process. After removing the duplicates, we selected 63 studies for analysis. We found that 52 of these did not meet the inclusion criteria, as 42 did not assess undergraduate students, 23 did not use NiTi instruments, 32 did not use stainless steel instruments, and 17 were not in vitro studies. Therefore, 11 articles were selected. One article was not found for a full-text analysis and was excluded. Thus, 10 studies were included in this systematic review.

![Figure 1. Flowchart of the study](image)

**Characteristics of the studies**

Nine of the included studies were in English and one was in Portuguese. All were published between 1995 and 2018. The studies included extracted permanent human teeth\textsuperscript{11,14,15,17,18,20} or simulated root canals\textsuperscript{12,13,16,19}.

The most often tested mechanized systems were ProTaper (Dentsply Maillefer)\textsuperscript{16,17,20} and Wave One (Dentsply Maillefer)\textsuperscript{17,20}, respectively, whereas the most often used manual instruments were Flexofile\textsuperscript{®}(Dentsply Maillefer)\textsuperscript{11-13,14} and K-files (Dentsply Maillefer)\textsuperscript{14-16,19}.

Most studies observed undergraduate dental students with no experience in root canal preparation with mechanized systems who underwent training with both instruments, except for the study by Jungnickel et al. (2018)\textsuperscript{20}, which examined operators who had prior experience with ProTaper instruments. The characteristics and results of the selected studies are presented in Tables 1 and 2, respectively.
### Table 1. Summary of collected data on the characteristics of the studies included in this systematic review

<table>
<thead>
<tr>
<th>Study, country</th>
<th>No. of root canals per group</th>
<th>Experimental model</th>
<th>Number of operators</th>
<th>Operators’ experience, university</th>
<th>Applied tools</th>
<th>Method to assess preparation quality and perception</th>
<th>Assessed variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluskin, Brown and Buchanan (2001), USA</td>
<td>27</td>
<td>Extracted human teeth, no curvature information</td>
<td>27 students</td>
<td>Novice, University of the Pacific School of Dentistry</td>
<td>Greater Taper™ (Dentsply/Tulsa Dental) Flexofiles® and Gates Glidden burs (Dentsply/Maillefer)</td>
<td>Radiography</td>
<td>Quality (instrument fracture, canal transportation and changes in canal area) Preparation time</td>
</tr>
<tr>
<td>Georgelin-Gougel et al. (2008), France</td>
<td>52</td>
<td>Extracted human teeth with curvature &lt;20°</td>
<td>26 students</td>
<td>Inexperienced third-year students, Dental Faculty of Toulouse</td>
<td>HeroShaper® (MicroMega) Helitite® (MicroMega)</td>
<td>Radiography</td>
<td>Quality (apical deviation)</td>
</tr>
<tr>
<td>Leonardi et al. (2012), Brazil</td>
<td>21</td>
<td>Extracted human teeth with curvature &lt;20°</td>
<td>42 students</td>
<td>Second-year students with no experience in pre-clinical endodontics, Universidadeade Positivo</td>
<td>Flexofile® and K-file (Dentsply-Maillefer) Profile.04 (Dentsply-Maillefer)</td>
<td>Radiography</td>
<td>Quality (instrument fracture, ledge, deviation, and changes in canal cross-sectional area) Preparation time</td>
</tr>
<tr>
<td>Alves et al. (2013), Brazil</td>
<td>60</td>
<td>Extracted human teeth with moderate curvature 4 &lt; radius &lt;8</td>
<td>2 students</td>
<td>No experience preparing curved canals, Federal University of Goiás</td>
<td>K-Flex (Dentsply-Maillefer) K3 (SybronEndo) BioRace (FKG Dental)</td>
<td>Radiography</td>
<td>Quality (instrument fracture, canal transportation, and perforation) Preparation time</td>
</tr>
<tr>
<td>Alnhabib (2015), Saudi Arabia</td>
<td>90</td>
<td>Simulated canals with 40° curvature</td>
<td>30 students</td>
<td>Third-year students with no experience in root canal preparation/ Taibah University Dental College</td>
<td>K-file (Dentsply Maillefer) ProTaperUniversal (Dentsply Maillefer)</td>
<td>Photography</td>
<td>Quality (instrument fracture, ledge, and changes in canal area) Preparation time</td>
</tr>
<tr>
<td>Kwak et al. (2016), South Korea</td>
<td>81</td>
<td>Extracted human teeth with curvature &lt;20°</td>
<td>81 students</td>
<td>Second-year students with no experience in preparation with NTI, Pusan National University</td>
<td>ProTaperUniversal (Dentsply Maillefer) Wave One (Dentsply Maillefer) Stainless steel</td>
<td>Questionnaire</td>
<td>Quality (instrument fracture) Preparation time Use perception</td>
</tr>
<tr>
<td>Jungnickel et al. (2018), USA</td>
<td>20</td>
<td>Extracted human teeth with curvature &lt;20°</td>
<td>4 students</td>
<td>Fourth-year students with prior experience with PTU, Cornell University</td>
<td>ProTaperUniversal (Dentsply Sirona) ProTaperNext (Dentsply Sirona) WaveOne (Dentsply Sirona) K-flex (Kerr Dental, Orange)</td>
<td>Radiography</td>
<td>Quality (lateral sealing, instrument fracture, and working length) Treatment time</td>
</tr>
</tbody>
</table>

Students’ use perception of endodontic instruments for mechanical-chemical preparation

Revista da ABENO • 22(2):1616, 2022 – DOI: 10.30979/revabeno.v22i2.1616
### Table 2. Results of studies included in the systematic review

<table>
<thead>
<tr>
<th>Study</th>
<th>Use perception</th>
<th>Preparation quality</th>
<th>Preparation time</th>
</tr>
</thead>
</table>
| Himel et al. (1995)          | Not applicable                   | NiTi: more working length maintenance, no ledges  
Stainless steel: ledges in 30.4%, greater structural removal | No statistically significant difference: NiTi, 32.9 min.; stainless steel: 38.8 min. |
| Gluskin, Brown, and Buchanan (2001) | Not applicable                   | NiTi: 2 instrument fractures, better canal centering  
Stainless steel: no instrument fractures, greater structural removal | NiTi: 5.9 ± 3.1 min.  
Stainless steel: 23.2 ± 9.0 min. |
| Sonntag et al. (2003)        | NiTi: easier to learn and a sense of security | NiTi: 14 instrument fractures, more working length maintenance  
Stainless steel: 2 instrument fractures, higher incidence of aberrations and canal transportations | NiTi: 12 ± 5.6 min.  
Stainless steel: 24 ± 9.1 min. |
| Faria, Rocha, and Perez (2006) | Not applicable                   | NiTi: 5 deviations  
Stainless steel: 6 deviations | No statistically significant difference for other negative events |
| Georgelin-Gurgel et al. (2008) | Not applicable                   | NiTi: 8 instrument fractures  
Stainless steel: no instrument fractures  
No significant difference for other negative events | No statistically significant difference |
| Leonardi et al. (2012)       | Not applicable                   | No statistically significant difference for root canal cross-sectional area  
No instrument fractures, ledges, deviations | NiTi: 21.2 ± 10.0 min.  
Stainless steel: 25.4 ± 9.2 min. |
| Alves et al. (2013)          | Not applicable                   | NiTi: 7 instrument fractures  
Stainless steel: no instrument fractures, higher incidence of root canal transportation | NiTi: 17 ± 6 min.  
(Bio Race)  
30 ± 11 min.  
(K3)  
Stainless steel: 43 ± 15 min. |
| Alrahabi (2015)              | Not applicable                   | NiTi: higher incidence of instrument fractures  
Stainless steel: greater incidence of ledges, structural removal, and canal transportation | NiTi: 7.33 ± 0.20 min.  
Stainless steel: 17.24 ± 0.42 min. |
| Kwak et al. (2016)           | NiTi: best results for flexibility and sense of security (PTU), 71% preference and greater sense of screw-in effect (WO)  
Stainless steel: worst results for ease of use, flexibility, cutting efficiency, sense of security, and instrumentation time | NiTi: 4 instrument fractures (PTU and WO) | NiTi: 4.75 ± 1.9 min.  
(PTU)  
2.25 ± 1.5 min.  
(WO) |
| Jungnickel et al. (2018)     | Not applicable                   | NiTi: no statistical difference for working length maintenance and no instrument fractures  
NiTi: no statistical difference in lateral sealing quality between PTU, PTN, and WO  
Stainless steel: Worst lateral sealing quality | NiTi: 9.43 min.  
(PTU)  
7.25 min.  
(PTN)  
5.64 min.  
(WO)  
Stainless steel: 10.89 min. |
All 10 studies evaluated the quality of the root canal preparation based on working length maintenance, changes in canal shape, and incidence of instrument fractures, canal ledges, or transportation. Nine studies used radiographic images\textsuperscript{11,13-15,18,20}, photographs\textsuperscript{12,16,19}, or cone-beam computed tomography\textsuperscript{14,15}. All images were captured in two moments: before and after the root canal preparation.

Five\textsuperscript{11,12,15,16,18} of the eight studies that observed instrument fractures reported a higher incidence of the event in preparations with rotary NiTi systems. Meanwhile, two\textsuperscript{14,20} did not observe fractures in the analyzed groups, which can be explained by the students’ previous experience with the ProTaper Universal system\textsuperscript{20}. There was a higher incidence of fractures in root canals prepared with the ProTaper Universal system compared with the reciprocating system (WaveOne)\textsuperscript{17}.

Four studies investigated ledge formation during root canal preparation. A higher incidence of the event was detected in canals prepared with stainless steel instruments in two studies\textsuperscript{16,19}. However, Sonntag \textit{et al.} (2003)\textsuperscript{12} and Leonardi \textit{et al.} (2012)\textsuperscript{14} found no statistically significant difference between groups.

NiTi instruments demonstrated a higher percentage of working length maintenance in the evaluations by Himel \textit{et al.} (1995)\textsuperscript{19} and Sonntag \textit{et al.} (2003)\textsuperscript{12}. This was analyzed by four studies, and two\textsuperscript{18,20} did not find differences between groups.

Canal centering was assessed in 50% of the studies. Preparation with NiTi instruments resulted in more centralized canals in three studies\textsuperscript{11,12,15}, whereas two did not find a statistical difference for apical foramen displacement\textsuperscript{13-18}. Greater removal of dentin structure and widening of the root canal toward the risk zone were identified by three studies\textsuperscript{11,16-19} in manual instrumentation. Leonardi \textit{et al.} (2012)\textsuperscript{14} observed that the preparations followed the original canal shape with both systems.

Preparation time was analyzed in 80% of the studies\textsuperscript{11,12,14-17,19,20}. Preparing root canals took less time with rotary and reciprocating NiTi instruments, except in one study\textsuperscript{19}, which found no statistically significant difference between groups.

Questionnaires were applied to assess the operators’ use perception\textsuperscript{11-17}. The evaluation criteria included ease of use and teaching, sense of security, flexibility, cutting efficiency, and screw-in effect. Dental students with no experience with NiTi instruments presented better evaluations for mechanized preparations than for manual preparations with stainless steel. NiTi offered greater ease of learning and use, as well as a greater sense of security, flexibility, and cutting efficiency. The students also noted shorter instrumentation times compared with manual preparation.

\textbf{Risk-of-bias analysis}

Table 3 summarizes the risk-of-bias assessment of the included studies. All of the 10 articles presented a high risk of bias.

\section*{4 DISCUSSION}

The mechanical-chemical preparation involves cleaning and modeling root canals and determining factors for a successful endodontic treatment\textsuperscript{21}. Assessing \textit{in vivo} endodontic therapy is made complex by different factors that influence clinical and radiographic success, such as pulp condition, presence of apical periodontitis, extent of lesion, tooth group and number of canals, complications, and apical extension of obturation\textsuperscript{22}. In addition, \textit{in vitro} studies may provide more objective information about the quality of root canal preparation without the influence of factors related to the patient, the clinical situation, or the treatment itself (number of sessions). Therefore, this systematic review only included studies that examined \textit{in vitro} root canal preparations.
Students’ use perception of endodontic instruments for mechanical-chemical preparation

Table 3. Risk-of-bias assessment according to an adaptation of the Cochrane risk-of-bias tool for randomized trials

<table>
<thead>
<tr>
<th>Study</th>
<th>Randomization of teeth or root canals</th>
<th>Use of NiTi instruments per the manufacturer’s instructions</th>
<th>Standardization of auxiliary chemical protocol in the different experimental groups</th>
<th>Blinding of examiners</th>
<th>Examiners’ calibration</th>
<th>General risk of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Himel et al. (1995)</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Gluskin, Brown, and Buchanan (2001)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Sonntag et al. (2003)</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Faria, Rocha, and Perez (2006)</td>
<td>High risk</td>
<td>High risk</td>
<td>Low risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Georgelin-Gurgel et al. (2008)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
<td>Low risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Leonardi et al. (2012)</td>
<td>High risk</td>
<td>High risk</td>
<td>Low risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Alves et al. (2013)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Alrahabi (2015)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
<td>High risk</td>
<td>High risk</td>
</tr>
<tr>
<td>Kwak et al. (2016)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>High risk</td>
</tr>
<tr>
<td>Jungnickel et al. (2018)</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk</td>
</tr>
</tbody>
</table>

Of the various methods employed in the studies to assess preparation quality, radiography and photography are similar in that they provide two-dimensional images of the analyzed structures. Computed tomography is believed to allow for a better assessment of the internal morphology of the root canal before and after preparation as the area of interest can be observed in three dimensions²³. The ability to diagnose errors during mechanical-chemical preparation via radiography and computed tomography was compared, and no significant difference was found. One case classified as a canal transportation based on a periapical radiograph was identified as a perforation on the tomographic image¹⁵. Among the adverse events that occurred during root canal preparation, the fracture of NiTi instruments is reported as one of the greatest limitations of the system. Fractures may be caused by cyclic fatigue or torsion related to the operator’s lack of knowledge and experience¹¹⁻¹⁵⁻¹⁸. The results of the studies in this systematic review corroborate this argument: fracture was the most frequent error in rotary instrumentation. Furthermore, only two studies¹²⁻¹⁶ reported fractures in stainless steel instruments. Sonntag et al. (2003)¹² found that the
fracture rates of rotary instruments exceed the clinically acceptable level due to the improper use of the instruments. They evaluated manual instrumentation prior to preparation with rotary instruments and compared it with rotary instrumentation followed by manual instrumentation. Given the incidence of the event in both groups, they concluded that prior experience with the manual system does not improve the quality of preparation with NiTi rotators. The use of simulated canals with accentuated curvatures may also have contributed to this result; any unfavorable anatomy of the root canal system makes mechanical-chemical preparation difficult. NiTi instruments fracture with less use as the radius of curvature decreases and the angle increases²⁴. The lack of adverse events in the study by Leonardi et al. (2012)¹⁴ was explained by instrumentation limited to incisors without curvatures. Preparing canals with greater curvature is more complex, and the probability of accidents during instrumentation increases. Therefore, the degree of curvature of the canals analyzed by the studies of this systematic review must be considered²⁵. Four studies¹⁴,¹⁷,¹⁸,²⁰ used dental samples with curvatures less than 20º, and another four¹²,¹³,¹⁶,¹⁹ analyzed preparations performed in simulated root canals with a curvature of 40º²⁶. In the studies that evaluated the instrumentation for canals with an accentuated curvature, the authors reported greater ledge formation, canal transportations, loss of working length, and excessive removal of dental structures with the use of stainless steel instruments.

Stainless steel instruments are more rigid compared with NiTi instruments, resulting in more difficulty when preparing curved canals²⁷. The formation of ledges with stainless steel instruments can occur because of the use of non-precurved instruments or files under the working length, which cause canal blockages that result in incomplete cleaning and preparation, thus impairing the results of the endodontic treatment¹⁶.

The results regarding root canal transportation and structural wear of the dentin after instrumentation¹¹,¹²,¹⁵,¹⁶,¹⁹ confirm previous results⁵,²⁸ that found a higher incidence of root canal transportations and excessive wear in manual stainless steel instrumentation. Mechanical-chemical preparation with NiTi instruments, even by inexperienced operators, allows for greater maintenance of the original canal shape and does not cause excessive removal of structural dentin¹¹,¹².

The root canal is widened so that it can be cleaned and prepared for the purpose of adequate obturation; however, excessive wear of the dentin weakens the root and can cause accidents, such as perforations¹⁹,²⁹. Stainless steel instruments are more rigid and have a greater tendency to straighten canal curvature, resulting in greater widening toward the inner wall of the root canal¹¹,¹⁵,¹⁶.

One of the most common methods for assessing the success of the technical aspects of endodontic therapy is by maintaining the working length between 0 and 2 mm below the radiographic apex, as observed in most canals prepared with NiTi instruments in the studies by Himel et al. (1995)¹⁹ and Sonntag et al. (2003)¹². Although prior experience with manual preparation does not have an impact on improving the quality of preparation with NiTi instruments, maintaining the working length is associated with enhancing the students’ experience¹². Since more experience has a positive impact on quality and on reducing preparation time¹⁵,²⁰, intensive preclinical training with rotary instrumentation is required for dental students¹⁸.

Alves et al. (2013)¹⁵ and Jungnickel et al.
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(2018) used samples with a smaller number of operators; however, they prepared a greater number of canals compared with the other studies in this systematic review. Mechanical-chemical preparation for a greater number of canals may be influenced by the operators’ experience relative to quality and preparation time.

Performing root canal preparation in less time results in less operator fatigue and better patient comfort, in addition to streamlining care and improving the cost–benefit ratio. The results found in the studies in this systematic review revealed that NiTi instruments reduce preparation time, which may be caused by the greater ease in cutting the dentin. Additionally, systems with fewer instruments resulted in faster preparations.

The results found in relation to the students’ usage perception of NiTi instruments corroborate the findings of Abu-Tahun et al. (2016), in which 100% of the students reported a preference for rotary instruments, indicating the ease these offered in completing the preparation as a possible reason for their satisfaction. Moreover, they pointed to the need to introduce rotary NiTi instruments in undergraduate education. Root canal preparation techniques must be updated to ensure continued education. However, many universities are slow to recognize the need to teach new technologies. Furthermore, greater experience has a positive impact on the quality and reducing instrumentation time, thus requiring intense preclinical training prior to the introduction of rotary NiTi instruments in the clinical practice of an undergraduate education in dentistry.

Despite the better results with NiTi instruments, manual files can provide a better tactile sensation, and a combination of manual and rotary instruments should be recommended. In addition, the results presented in this systematic review should be considered with caution as all the studies presented a high general risk of bias. This indicates that greater methodological attention should be applied in relation to the randomization of groups and calibration and blinding of examiners.

5 CONCLUSION

Undergraduate dental students reported greater ease of use and learning and a greater sense of security with NiTi instruments compared with stainless steel instruments. Moreover, preparations with NiTi instruments are made in less time with a lower incidence of accidents, such as canal ledges, transportations, and deviations, but are also associated with a higher incidence of instrument fracture.

RESUMO

Percepção de uso e preparo químico mecânico realizado com diferentes instrumentos endodônticos por estudantes de graduação em Odontologia: uma revisão sistemática de estudos laboratoriais

O estudo revisou a literatura existente com o objetivo de comparar a percepção de uso, qualidade e tempo do preparo químico mecânico de canais radiculares realizado por estudantes de graduação em Odontologia com instrumentos de níquel-titânio (NiTi) e aço inoxidável. Para isso, as bases de dados eletrônicas PubMed, LILACS, Scopus, Embase, SciELO e CENTRAL foram acessadas para verificar e selecionar estudos relacionados com a questão de pesquisa publicados até janeiro de 2021. Estudos laboratoriais que compararam o uso de instrumentos de NiTi com aço inoxidável por alunos de graduação em Odontologia foram avaliados. Dois revisores independentemente selecionaram os estudos, coletaram os dados e analisaram o risco de viés. Dos 92 estudos potencialmente relevantes, 10 atenderam aos critérios de inclusão para análise de texto completo e, posteriormente, incluídos na revisão sistemática. O risco de viés foi considerado alto em todos os estudos. Instrumentos de NiTi apresentaram maior preferência e melhor percepção por estudantes de graduação em Odontologia, menor tempo e melhor...
Students’ use perception of endodontic instruments for mechanical-chemical preparation

qualidade do preparo químico mecânico, com menor ocorrência de acidentes como degraus, transporte e desvios de canal, apesar de estarem associados à maior ocorrência de fratura de instrumentos.


REFERENCES


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