Keywords: coronectomy, third mandibular molars, complications.

Summary
Coronectomy is a technique that involves the removal of the crown of the third molar, leaving the root in place. It is recommended when the risks of complete extraction outweigh the benefits, especially in cases where there is a high risk of inferior alveolar nerve (IAN) injury. The success of coronectomy depends on adherence to the operating protocol, which is controlled by the oral surgeon. The aim of this systematic review is to assess the incidence and nature of complications associated with the coronectomy of mandibular third molars. The systematic literature search was conducted according to PRISMA guidelines in MEDLINE (PubMed), and EMBASE (ScienceDirect) databases. A total of 287 titles were identified. 9 studies met the final inclusion criteria. The results showed that coronectomy had a low incidence of IAN sensory disturbance, with 1.6% to 4.3% of cases experiencing such complications, while other studies recorded no cases of sensitivity loss. Infection and dry socket occurred in a small percentage of cases. Coronectomy is a safe and useful technique for treating impacted mandibular third molars. Similar or lower incidence of complications compared to those from extraction were seen. Further prospective homogenous randomized controlled clinical trials are necessary to evaluate the effectiveness of coronectomy in third mandibular molars.

Introduction
Third molar surgery is a common procedure performed in oral and maxillofacial surgery clinics and hospitals, with a prevalence of 35.9%–58.7% [1]. The surgical removal of lower third molars aims to eliminate the risk of infection, cyst formation, and other complications. However, it is not without risks, and injury to the inferior alveolar nerve (IAN) is a rare but serious complication that can result in permanent nerve damage in 1% of cases [2]. Coronectomy, also known as partial odontectomy or intentional root retention, is a technique that involves the removal of only the crown of the third molar, leaving the root in place. Coronectomy is recommended when the perceived risks of complete extraction outweigh the perceived benefits, especially in cases where there is a high risk of IAN injury [3]. This technique is effective in preventing direct or indirect damage to the IAN and reducing the risk of nerve injury. Cases must be carefully selected for coronectomy, and teeth with caries into the dentine, immature teeth with wide open apices, and horizontal impactions with molars that lie along the IAN are not good candidates for this procedure [4]. The success of coronectomy depends on adherence to the operating protocol, and complications are usually easily controlled by the dental surgeon [5]. Computed tomography (CT) or cone beam computed tomography (CBCT) can be used to determine the exact relationship between the inferior alveolar nerve and the third molar [6]. These imaging techniques can provide valuable information to the dental surgeon and help in the decision-making process when deciding whether to perform a coronectomy.

The aim of this systematic review is to assess the incidence and nature of complications associated with the coronectomy of mandibular third molars.

Materials and methods
A systematic literature search was conducted according to PRISMA guidelines in search of clinical trials published in the English language between the years 2017 and 2023. Electronic and manual literature searches were performed independently by all authors in databases, such as MEDLINE (PubMed), and EMBASE (ScienceDirect). Databases were searched using different combinations of the following
The clinical question was prepared by following the Participant, Intervention, Comparison, Outcome (PICO) principle [7]. What is the incidence of complications (O) after the third molar coronectomy procedure (I) in patients who have indications for third molar removal (P) compared to complete odontectomy (C)?

**Results**

The combinations of search terms identified a total of 287 titles. After the removal of duplicates, 194 records remained. Of these, 176 did not meet the inclusion criteria (meta-analysis, systematic reviews, limited data, case reports, animal studies, publication date <6 years), leaving 18 articles for full-text analysis. 10 studies fulfilled all inclusion criteria (Figure 1.). All of the included studies were Cohort studies. None of the studies met the requirements for quantitative meta-analysis due to their heterogeneity of data.

**Patient’s data.** The mean age among patients in included studies ranged from 24.3 to 36.6 years. A total of 1643 patients participated in 9 trials. 900 teeth underwent coronectomy and 743 teeth were fully removed. All had a panoramic image or a CBCT scan that indicated close proximity of the third mandibular molars to the mandibular canal. Control groups in cohort studies included fully extracted third mandibular molars.

### Table 1. Quality assessment using Joanna Briggs Institute (JBI) scale for included cross-sectional studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Representativeness of the exposed cohort(*)</th>
<th>Selection of the non-exposed cohort(*)</th>
<th>Ascertainty of exposure(*)</th>
<th>Outcome not present at the start of the study(*)</th>
<th>Comparability of cohorts on the basis of the design or analysis(**)</th>
<th>Outcomes</th>
<th>Total score out of 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matzen LH et al. 2020 [8]</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>9</td>
</tr>
<tr>
<td>Kang F et al. 2019 [4]</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>8</td>
</tr>
</tbody>
</table>
dibular molars displaying no periapical pathology.

**Quality assessment.** The results of the risk of bias assessment for cohort studies are presented below in Table 1. Both cohort trials included in the review can be considered of high methodological quality with scores of 8 and 9 [4,8]. 6 out of 7 cross-sectional studies [9-15] show high methodological quality. Monaco G. et al. did not identify other confounding factors. 4 studies did not identify how to deal with the identified factors. [9,10,13,14]. 3 cross-sectional studies lacked proficient statistical analysis. [10,12,13]. The entire quality assessment process is represented in Table 2.

**Treatment outcomes.** Sensory loss of IAN 4 out of 9 included studies [4,8,10-11] reported the occurrence of sensitivity loss of the IAN. 2 out of 4 studies reported the IAN damage in groups where teeth were fully removed. Al-Raisi S. et al [10] and Pitros P et al. [11] reported 1.6% and 4.3% IAN sensory disturbance respectively. Other articles recorded no cases of sensitivity loss of the inferior alveolar nerve using the coronectomy technique.

**Infection and dry socket.** The occurrence of infection with the presence of pus after treatment was assessed in 3 of the studies [10-11,12]. Al-Raisi S. et al 2022 reported 9 cases (4.8%) of infection and 4 cases of dry socket (2.1%). 6 patients which had an infection received antibiotics on discharge. Two of these patients required further surgical intervention (Table 1).

Mendes, P.A. et al.[12] reported 1 case (2.9%) of infection and no dry socket cases. In Kang F et al. [4] study a higher percentage dry socket percentage was seen in EG (3.6%) than in CG (1.8%), although the difference was not statistically significant (P=0.611). Pitros P et al. [11] recorded a notably higher incidence rate of dry socket (14.6%) and infection (13.7%) compared to other studies. The author suggests that the higher complication percentages might be related to the fact that a portion of the patients was treated by their general dental practitioner for infection and subsequently reported this incidence of infection to the oral surgeon on the day of the follow-up. In 4 out of 9 studies [9,13,14,15] no dry socket nor signs of infection were found, including pulpitis, purulent discharge, fever, and swelling of the surrounding soft tissue.

**Root migration and removal.** 6 out of 9 [4,9,11-13,15] of the included articles study root migration after coronectomy. Yeung AWK et al. [15] in their long-term study noticed root migration in 94.7% of their cases. It was determined that age was the only significant influencing factor on root migration distance, and they were negatively correlated (P=0.049). Moreover, eruption status, apparent root form, gender, impaction pattern, the elapsed time after surgery, or depth of impaction did not have a significant effect on the root migration distance. On the contrary, Kang F et al. [4] found in their study that the morphology of the roots was the most relevant factor for root migration. They noted that 90.9% of roots that underwent coronectomy had migrated away at 6 months and 10.9% had to be extracted. Cosola S et al. [9] noted 23.8% of their coronectomy cases had migrated and 7.7% required to be taken out during the follow-up period due to patients’ fear of future chronic infection. Mendes, P.A. et al. [12] registered that all of their third root fragments migrated (100%) in 12-month follow-up after coronectomy of which 8.6% had to be removed due to root mobilization. Pitros P et al. [11] observed early root migration in 1.7% of

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Were the criteria for inclusion in the sample clearly defined?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Were the study subjects and the setting described in detail?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the exposure measured in a valid and reliable way?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Were objective, standard criteria used for measurement of the condition?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Were confounding factors identified?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Were strategies to deal with confounding factors stated?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Were the outcomes measured in a valid and reliable way?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Was appropriate statistical analysis used?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
cases with an average migration of 3.3 mm. and long-term root migration in 4.3% of cases with a mean migration distance of 3.3 mm of which 0.9% had to be extracted. Al-Raisi S. et al [10] indicated that 1 (0.5%) patient needed extraction after coronectomy, however, the reason was not specified.

**Discussion**

Injury to the inferior alveolar nerve during mandibular third molar extraction is a rare but well-known complication, which can occur when the tooth is close to the nerve. Risk factors for nerve injury include radiographic proximity, surgeon experience, surgical procedures, patient age, and preexisting disease [16]. Traditionally, panoramic radiography has been used to plan third molar extractions, but cone-beam computed tomography (CBCT) is a more accurate method for determining the exact relationship between the inferior alveolar nerve and third molar roots. By using CBCT as a diagnostic tool and performing coronectomies, the risk

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of study</th>
<th>No. of patients, males(M)/females(F)</th>
<th>Mean age (years)</th>
<th>No. of teeth (months)</th>
<th>Infection</th>
<th>Dry socket</th>
<th>IAN sensory loss</th>
<th>Root migration</th>
<th>Root removal</th>
<th>AB therapy</th>
<th>Post-operative regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosola S et al. 2020 [9]</td>
<td>CSS</td>
<td>130 (66F, 64M)</td>
<td>27.57</td>
<td>130</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>31 (23.8%)</td>
<td>10 (7.7%)</td>
<td>625 mg of amoxicillin prophylaxis 875 mg for 5 days</td>
<td>Ozone therapy Corticosteroids for 5 days if necessary</td>
</tr>
<tr>
<td>Matzen LH et al. 2020 [8]</td>
<td>Cohort</td>
<td>840</td>
<td>27.8</td>
<td>688 EG 152 CG</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 (0.9%) in EG 0% in CG</td>
<td>-</td>
<td>-</td>
<td>Amoxicillin Co-amoxiclav Metronidazole</td>
</tr>
<tr>
<td>Al-Raisi S. et al 2022 [10]</td>
<td>CSS</td>
<td>153 (49M, 43F)</td>
<td>30</td>
<td>187</td>
<td>9 (4.8%)</td>
<td>6 (2.1%)</td>
<td>3 (1.6%)</td>
<td>1 (0.5%)</td>
<td>-</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Kang F et al. 2019 [4]</td>
<td>Cohort</td>
<td>92 patients</td>
<td>26.5 CG 25.3 EG</td>
<td>110 EG 55 CG 55 EG</td>
<td>-</td>
<td>-</td>
<td>6 (10.9%)</td>
<td>6 (90.9%)</td>
<td>6 (10.9%)</td>
<td>Cephadrine and metronidazole 3 days</td>
<td></td>
</tr>
<tr>
<td>Pitros P et al. 2019 [11]</td>
<td>CSS</td>
<td>124</td>
<td>34.3</td>
<td>116 &lt;3 &gt;3</td>
<td>16 (13.7%)</td>
<td>17 (14.6%)</td>
<td>5 (4.3%)</td>
<td>7 (6.0%)</td>
<td>1 (0.9%)</td>
<td>?</td>
<td>Chlorhexidine mouthwash</td>
</tr>
<tr>
<td>Menozes, P.A. et al. 2020 [12]</td>
<td>CSS</td>
<td>21 16F 5M</td>
<td>24.3</td>
<td>35</td>
<td>3 (2.9%)</td>
<td>6 (12)</td>
<td>1 (2.9%)</td>
<td>35 (100%)</td>
<td>3 (8.6%)</td>
<td>1 g amoxicillin 1 h before surgery; 8 mg dexamethasone 2 h before the procedure and repeated 12 h after the first dose; 500 mg paracetamol every 6 h for 3 days</td>
<td>0.12% chlorhexidine mouthwash</td>
</tr>
<tr>
<td>Monaco G. et al. 2019 [13]</td>
<td>CSS</td>
<td>63</td>
<td>28.99</td>
<td>76</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5 (6.6%)</td>
<td>-</td>
<td>2 g of amoxicillin/ amoxiclav prophylaxis 1 hour before surgery; Continued postoperatively for 4 days, 1 g every 8 hours</td>
<td>3 times a day with 0.2% chlorhexidine for 10 days. Ibuprofen tablets, 600 mg</td>
</tr>
<tr>
<td>EIo JA et al. 2017 [14]</td>
<td>CSS</td>
<td>78</td>
<td>29.8</td>
<td>92 60-108</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
</tr>
<tr>
<td>Yeung AWK et al. 2018 [15]</td>
<td>CSS</td>
<td>44</td>
<td>36.6</td>
<td>57 48-102</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>54 (94.7%)</td>
<td>1</td>
<td>-</td>
<td>?</td>
</tr>
</tbody>
</table>
of inferior alveolar nerve injury can be avoided for third molars that are in contact with the nerve. Studies included in this systematic review [4,8-15] concur with conclusions from the bibliographic review by Moreno-Vicente et al. [17] that coronectomy is an effective preventative technique for protecting the inferior alveolar nerve. Ayiung and Le [18] reported a lower incidence of neurosensory damage associated with dentoalveolar surgery as well. Moreover, coronectomy has fewer complications compared to complete removal [19], which can also be concluded for this systematic review [9-13]. For strong internal validity, it is best to include a control group whenever possible. Without a control group, it is difficult to ascertain whether the outcome was caused by the experimental treatment or other variables. The literature suggests an incidence of postoperative infections after a mandibular third molar coronectomy to vary between 3.2% and 5.8% [20,21], which were treated with antibiotics and debridement. Even though. Although the research on the use of antibiotics after coronectomy is divided, there is evidence that postoperative antibiotics should be administered since the pulp chamber is damaged and the remaining roots may be considered foreign entities [22]. However, some studies have reported lower rates of infection, such as 2.9% [23], while others found no postoperative infections [24]. This systematic review contained articles with considerably low rates of infections related to coronectomy 0%-13.7% [10,13] (Table 2).

Although coronectomy may result in symptoms and pain over time due to retained roots, it can significantly decrease the risk of neurosensory disturbances, which can offset the potential need for a second surgery in the future [23]. According to this systematic review, there was a low percentage of secondary surgery. Coronectomy is typically performed on healthy teeth without pathology, which poses less of an issue compared to teeth with some form of pathology that is frequently observed in erupted teeth. Nevertheless, some patients and oral surgeons may still hesitate in selecting this treatment [25]. The incidence of dry sockets after coronectomy is relatively low due to small wounds, little exposed alveolar bone, and primary wound closure [26]. Any high incidence of alveolitis observed after coronectomy might be due to the lack of a ‘water-tight’ closure or a high proportion of patients treated for difficult, deeply impacted teeth with pericoronitis [21].

Conclusions

1. The long-term results of included studies reveal that a well-planned coronectomy is a valid oral surgical procedure that may aid the clinician in difficult cases of mandibular wisdom tooth extraction to prevent inferior alveolar nerve damage.

2. Within its limitations, this study concludes that coronectomy results in a smaller risk of inferior nerve damage, than full mandibular third molar extraction. Due to a lack of data and present heterogeneity between studies, quantitative analysis was unavailable.

3. Further well-documented, homogenous clinical trials are necessary to evaluate the incidence of complications of coronectomy in third mandibular molars.

References


KOMPLIKACIJŲ PASIREIKŠKIMO DAŽNIS PO TREČIŲJIŲ APATINIŲ KRŪMINIŲ DANTŲ KORONEKTOMIJOS

P. Hosseinzadehfar, I. Micicëvičius, V. Guzevičienë

Raktazodžiai: koronektomija, apatiniai tretieji krūminiai dantys, komplikacijos.

Santrauka

Koronektomija yra metodas, kurio metu pašalina trečiojo krūminto danties vainikus, paliekant šaknį. Jos rezultatai, kaip danties šalinimo rizika yra didesnė už naudą, ypač tais atvejais, kai yra didelė apatinio alveolinio nervo (IAN) pažeidimo rizika. Koronektomijos sėkmė priklauso nuo operacijos protokolo ir operacijos skirtingų pajėgumų, kurių kontroluojama. Rezultatai parodė, kad atliekant koronektomiją IAN sutrikimų dažnis buvo mažas – 1,6–4,3 proc. atvejų tokios komplikacijos pasireiškė, o kituose tyrimuose jautrumo praradimo atvejų neužfiksuota. Infekcija ir alveolitas su didesne rizika. Koronektomijos sėkmė priklauso nuo operacijos protokolo ir operacijos skirtingų pajėgumų, kurių kontroluojama. Rezultatai parodė, kad atliekant koronektomiją IAN sutrikimų dažnis buvo mažas – 1,6–4,3 proc. atvejų tokios komplikacijos pasireiškė, o kituose tyrimuose jautrumo praradimo atvejų neužfiksuota. Infekcija ir alveolitas su didesne rizika.

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Gauta 2023-03-29