



**Original article**

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# Coronectomy as a treatment alternative to extraction of the lower third molars. A systematic review

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## ABSTRACT

**Introduction:** Due to the close relationship of the third molar roots with the inferior alveolar nerve (IAN), involvement of this nerve is one of the common postoperative disorders. As an alternative to the extraction, a new procedure called coronectomy was introduced in 1984. The aim of this work is to perform a systematic review of the literature in order to know the results and complications of third molar coronectomy in relation to the IAN in order to verify if it is an adequate procedure.

**Material and methods:** A literature search was conducted in the Medline, Ebsco, Cochrane, Clinicaltrials and Sigle databases from 2000 to 2017.

**Results and discussion:** After applying the inclusion and exclusion criteria, 17 articles were analyzed, with a lower percentage of IAN lesion in the coronectomy procedure, as well as a lower incidence of infection and dry socket compared to extraction.

**Conclusion:** It has been observed that the coronectomy procedure at the level of the lower third molars is a predictable procedure with few complications.

## KEYWORDS

Coronectomy; Lower third molar; Inferior alveolar nerve; Tooth extraction.

## INTRODUCTION

Extraction of the lower third molars is one of the most commonly performed procedures in dental surgery.<sup>1</sup> These must be removed when there is no space for eruption in the retromolar region, between the second molar and the mandibular branch.<sup>2</sup> If extraction is not performed, it may lead to the formation of odontogenic cysts or tumors.<sup>2,3</sup> Prophylactic extraction continues to be controversial, due to the close relationship of the root complex of these molars with the inferior alveolar nerve (IAN), the involvement of which is one of the possible postoperative complications. The incidence of permanent sensorineural alterations is between 0.1% to 1.1%<sup>4-6</sup> and the temporary alterations range between 4.5% and 22%, according to different studies.<sup>7-9</sup>

The relationship of the roots with the IAN can be interpreted by observing a series of signs on the panoramic radiograph such as deviation of the lower dental canal, narrowing and loss of continuity of the roof of the same, obscuration, narrowing and changes in the direction of the roots (Figure 1).

However, the most important radiographic test when diagnosing this relationship is Cone Beam Computed Tomography (CBCT)<sup>11-14</sup>, which shows a 3D image of the area, making it possible to show the association between the IAN and the root complex.<sup>12-14</sup>

As an alternative to the extraction of the lower third molar, a new procedure was introduced in 1984 called coronectomy.<sup>15</sup> This consists of removing the crown of the tooth, leaving the roots buried in bone, thereby avoiding damage of the IAN.<sup>15-22</sup>

The surgical technique consists of a series of steps, which following application of the usual anesthetic technique used for these extractions, a vestibular flap with lingual detachment is fashioned and the crown is completely sectioned with a fissure bur a 45° angle, being later removed using forceps. Afterwards, the remaining fragmented infraosseous root fragments are reduced 2-3 mm with round bur and, finally, the bed is irrigated with saline water and sutured<sup>16</sup> (Figure 2).

This technique, however, has a series of contraindications, and it is not possible to perform when the roots are mobilized during the intervention or if there is injury at the

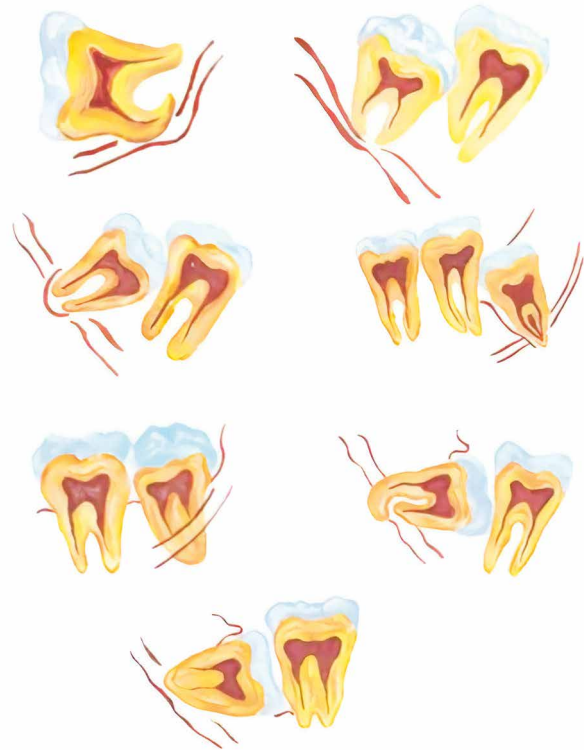


Figure 1: Relationship of the roots with the IAN (radiographic signs).



Figure 2: Coronectomy technique (Pogrel et al.,<sup>17</sup>).

level of the root, and in those molars that are impacted horizontally along the course of the IAN, due to the possibility of sectioning the nerve during removal of the crown.<sup>16-33</sup> This technique is not indicated in patients who are medically compromised due to diabetes, chemotherapy or previous radiotherapy, any type of immunological or bone disease, neurological disorders and craniofacial syndromes, as well as in patients who are under 16 years of age due to inadequate development of the roots.<sup>16-33</sup>

Many authors have considered coronectomy as a safe technique to avoid nerve damage of the IAN.<sup>16-31</sup>

Therefore, the objective of this work is to carry out a systematic review of the existing literature on the subject to know the results and complications of coronectomy in lower third molars in relation to the IAN and verify if it is an adequate procedure to avoid damage the nerve.

## MATERIALS AND METHODS

The PICO question we have posed is the following:

- **P (PATIENTS):** Patients with the lower third molar in close relationship with the IAN.
- **I (INTERVENTION):** Coronectomy of the lower third molar.
- **C (COMPARISON):** Coronectomy vs. Extraction
- **O (RESULTS):** Postoperative complications.

### A) Search strategy and types of studies

A systematic search of the existing literature has been carried out in the PubMed/Medline, Cochrane, Clinicaltrials, Ebsco and SIGLE information databases and information sources from January 1, 2000 to April 5 2017.

The words “Coronectomy” and “Third Molar” were used as a search algorithm, followed by a manual or pearling search of the articles included in this review.

- All articles that were Randomized Clinical Trials (RCTs), Controlled Clinical Trials (CCTs), Cohort Studies (CSs), Prospective Studies (PSs) and Retrospective Studies (RSs) where the coronectomy technique was performed on lower third molars that had a close relationship with the NDI, and had been radiographically diagnosed by orthopantomography and/or cone beam tomography, with a follow-up of patients greater than or equal to 6 months, and with a minimum of 40 Coronectomies performed were selected.
- We excluded those studies that were reviews of the literature, clinical cases, letters to the editor or expert opinions, with less than 40 coronectomy procedures, a follow-up of less than 6 months or where the radiographic diagnosis was not made by orthopantomography and/or cone beam tomography.

### B) Search strategy and types of studies

The data were extracted independently by two reviewers, with the help of a data collection sheet, designed for that purpose (Table). The variables collected were: intra-operative procedure failure, loss of sensitivity of the IAN, presence of infection, dry socket, pain, wound dehiscence, migration of the roots and the need for reintervention to extract the roots.

## RESULTS

### A) Flow chart (Figure 3)

In the review of the literature, a total of 145 initial articles found in 5 different databases were obtained (78 in Medline, 11 in Cochrane, 1 in Clinical Trials, 55 in Ebsco and 0 in Sigle). Of these 145 initial articles, 50 of them were duplicates, leaving us with 94 articles.

After reading the titles and abstracts, we were left with 19 articles that met the inclusion criteria (31 articles were excluded after reading the title and 45 articles after reading the summary).

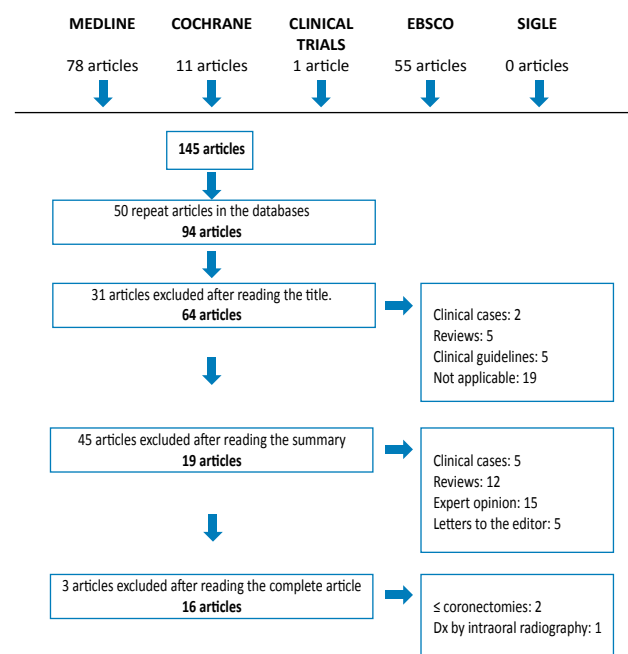


Figure 3. Flowchart.

Finally, once the complete articles were read, 2 of them were excluded for performing the coronectomy procedure in fewer than 40 patients and 1 article was excluded because the preoperative diagnosis was made using a peri-apical radiograph. The total number of articles included in this review was 16.

**B) Qualitative analysis**

Next, the results obtained will be mentioned, including in a table that includes the study variables together with the number of patients operated on, number of coronectomies performed and the follow-up of patients over time (Table).

Pogrel et al.,<sup>17</sup> conducted a study with a sample size of 41 patients who underwent 50 coronectomies. The diagnosis was by orthopantomography and follow-up was for 6 months. In 15 cases (30%) the roots migrated an average of 1.5 mm in 6 months. In 3 cases the roots had to be extracted, 2 of them due to exposure and the rest due to inadequate healing.

O’Riordan et al.,<sup>18</sup> performed 52 coronectomies in the same number of patients. The diagnosis was by orthopantomography and patient follow-up was for 24 months. 8 coronectomies failed (15.3%) during surgery, 3 patients (5.7%) had IAN paresthesia and another 3 had an

TABLE. RESULTS OF THE ARTICLES INCLUDED

AUTHORS	SAMPLE	Nº CORONECTOMIES	CORONECTOMIES FAILED	LOSS OF SENSITIVITY OF THE IAN	INFECTION	PAIN	ALVEOLAR OSTEITIS	WOUND DEHESCE	% MIGRATION OF THE WOUND	RE-INTERVENTION	FOLLOW-UP
Pogrel et al., <sup>17</sup> (2004)	41	50	-----	0	0	-----	0	1	30	3	6 months
O’Riordan et al., <sup>18</sup> (2004)	52	52	8	3	3	-----	-----	0	-----	3	24 months
Renton et al., <sup>20</sup> (2005)	128	94	36	0	3	8	7	-----	8,6	0	24 months
Leung et al., <sup>22</sup> (2009)	231	171	16	1	9	66	0	-----	62,2	1	24 months
Dolanmaz et al., <sup>23</sup> (2009)	43	47	1	0	-----	-----	-----	-----	15,7	0	24 months
Hatano et al., <sup>19</sup> (2009)	220	102	5	1	4	19	2	-----	89,6	5	12 months
Cilasun et al., <sup>21</sup> (2011)	124	88	2	0	1	1	0	-----	-----	1	30 months
Goto et al., <sup>24</sup> (2012)	161	185	-----	0	-----	-----	-----	7	100	8	12 months
Leung et al., <sup>25</sup> (2012)	108	155	0	1	6	58	-----	-----	97	4	36 months
Monaco et al., <sup>26</sup> (2012)	37	43	0	0	-----	1	1	-----	48,8	1	12 months
Kohara et al., <sup>27</sup> (2014)	92	111	-----	1	9	-----	1	10	90,9	10	36 months
Frenkel et al., <sup>28</sup> (2014)	173	185	-----	1	2	20	-----	7	22,1	6	12 months
Monaco et al., <sup>29</sup> (2015)	94	116	0	0	-----	10	5	9	48,2	4	36 months
Ajbaje et al., <sup>30</sup> (2015)	64	96	-----	0	4	4	4	4	14,6	9	12 months
Leung et al., <sup>31</sup> (2015)	458	612	-----	1	2	190	1	-----	-----	19	60 months
Kouwenberg et al., <sup>32</sup> (2015)	191	191	-----	0	-----	-----	-----	-----	79	17	6 months

infection. Three reinterventions had to be performed due to recurrent infections.

In the study by Renton et al.,<sup>20</sup> with a sample size of 128 patients, the sample was divided into one group with 102 third molars for extraction and another group with 94 coronectomies. The diagnosis was made through orthopantomography and follow-up was for 24 months. Of the 94 coronectomies, 36 (38.2%) failed intraoperatively. In the extraction group, 19 (14.3%) cases of paresthesia were observed and in the coronectomy group 3 (3.1%) cases were observed. Infection occurred in 1 case from the extraction group and 3 from the coronectomy group. In terms of pain, 8 patients in the coronectomy group and 22 in the extraction group stated they had pain. Alveolar osteitis occurred in 7 patients in the coronectomy group and 10 in the extraction group. Migration of 5 roots (8.6%) of an average of 1.5 mm was observed during the first 6 months.

Leung et al.,<sup>22</sup> performed a RCT with a sample size of 231 patients with 171 coronectomies and 178 extractions. The diagnosis was by orthopantomography and follow-up was for 24 months. There were 16 failures (9.3%) during the procedure in the coronectomy group. There was one case of paresthesia (0.5%) of the IAN in the coronectomy group and 9 (5%) in the extraction group. Regarding infection, 9 cases were observed in the coronectomy group and 12 in the extraction group. 66 patients in the coronectomy group experienced pain compared to 102 patients in the extraction group. No case of alveolitis was reported in the coronectomy group versus the 5 cases of the extraction group. At 3 months, 62.2% of the roots had migrated 1.9 mm and 3.01 mm at 24 months, with the fastest migration in the first 3 months and decreasing during the following months. Finally, reoperation was necessary in only one patient due to root exposure.

Dolanmaz et al.,<sup>23</sup> in their study on 43 patients who underwent 47 coronectomies after diagnosis by orthopantomography, with a 24-month follow-up, observed only one failure (2.1%) during the intervention. 15.7% of the roots migrated from their origin, with an average of 2.3 mm at 6 months and 3.01 mm at 12 months.

Hatano et al.,<sup>19</sup> in their CCT on 220 patients performed 118 extractions (control group) and 102 coronectomies. The diagnosis was through CBCT and follow-up was for 12 months. At the time of surgery, 5 coronectomies failed (4.9%) and there were signs of IAN paresthesia in

6 patients (5.1%) in the control group and one case in the coronectomy group. Four patients (3.9%) underwent coronectomy and one (0.9%) in the extraction group. Pain was greater in coronectomies (19 cases) than in extractions (8 cases). Alveolitis was present in 10 cases in the extraction group compared to 2 in the coronectomy group. Regarding root migration, there were 87 cases (89.6%). Finally, reintervention was necessary in 5 patients in order to extract the roots, 4 due to infection and the rest due to exposure.

Cilasun et al.,<sup>21</sup> in their CCT, performed 88 coronectomy procedures and 87 extractions in 124 patients. The diagnosis was confirmed by CBCT and the follow-up was 30 months. In 2 patients (2.2%), coronectomy failed during surgery. In the extraction group there were 2 cases of paresthesia (2.3%) of the IAN and none (0%) in the coronectomy group. There was one case of infection in the extraction group and in the coronectomy group respectively. One patient had dry socket in the extraction group, none in the coronectomy group. One patient had to undergo reintervention to remove the roots.

Goto et al.,<sup>24</sup> diagnosed the patients using CBCT and performed 185 coronectomies with a follow-up of 12 months. Seven cases of wound dehiscence were observed. Migration occurred in 100% of the roots, with 3 mm of root movement at 12 months. Finally, 8 roots were reoperated, 1 due to pulpitis and the remaining 7 due to poor healing.

Leung et al.,<sup>25</sup> conducted a 36-month study with a sample size of 108 patients who underwent 155 coronectomies following diagnosis by orthopantomography. One case (0.6%) of IAN injury was observed, 6 cases of infection and 58 cases of pain. Migration of the roots was evaluated, occurring in 97% of cases. The mean migration was 1.9 mm at 6 months and 2.9 mm from 12 months up to 36 months. 4 roots underwent reintervention due to oral exposure.

Monaco et al.,<sup>26</sup> performed diagnostic workup with CBCT in 37 patients who underwent 43 coronectomy procedures. The study was 12 months and only 2 patients experienced pain and alveolitis respectively. 48.8% of the roots migrated during the first 6 months of follow-up, with an average of 1.9 mm. One root had to be removed due to postoperative pain.

Kohara et al.,<sup>27</sup> diagnosed 111 lower third molars in 92

patients using CBCT. At the 36-month follow-up, they observed one case (0.9%) of paresthesia, 9 cases of infection, one case of alveolitis and 10 cases of dehiscence. Migration occurred in 90.9% of the roots, with an average of 1.84 mm at 3 months and 3.48 mm between 12 and 36 months. Reintervention was performed for the extraction of 10 roots, due to poor healing in 9 cases and one case of pulpitis.

Frenkel et al.,<sup>28</sup> performed a study on 173 patients who underwent 185 coronectomy procedures. The preoperative diagnosis was made with CBCT and the follow-up was 12 months. A single case of paresthesia (0.5%) of the IAN was observed, 2 cases of infection and 20 cases of pain. There was inadequate healing in 7 roots. 22.1% of the roots migrated, the average being 2.2 mm at 6 months and 3.2 mm at 12 months. It was necessary to reintervene in 6 patients (5 due to pain and one due to oral exposure).

Monaco et al.,<sup>29</sup> conducted a study on 94 patients with 116 coronectomies. The diagnosis was by CBCT and follow-up was 36 months. Among the complications observed were 10 cases of pain, 5 cases of alveolitis and 9 cases of delayed healing. 48.2% of the roots migrated, with an average of 1.85 mm at 3 months and 4.73 mm between 12 and 36 months. Reintervention of the roots was carried out in 4 cases due to exposure to the oral cavity.

In the study by Agbaje et al.,<sup>30</sup> coronectomies were performed on 64 patients after diagnosis by CBCT. The duration of the study was 12 months. There were 4 cases of infection, pain, alveolitis and dehiscence of the wound, respectively. Migration of the roots occurred in 14.6% of cases at 12 months and in 9 cases the roots were extracted.

The study by Leung et al.,<sup>31</sup> was carried out on 458 patients who underwent 612 coronectomies. The study lasted 60 months and the diagnosis was obtained by orthopantomography, observing only one case of IAN injury (0.1%), 2 cases of infection and 190 cases of pain. Migration of the roots after 24 months did not occur. In 19 cases it was necessary to reoperate to extract the roots.

Kouwenberg et al.,<sup>32</sup> conducted a study with a sample size of 191 patients and 191 coronectomies. The diagnosis was made by CBCT and follow-up was for 6 months. 79% of the roots migrated an average of 1.5 mm from their

original position at 6 months. Seventeen patients were reoperated due to eruption of the remaining roots into the mouth.

## DISCUSSION

The coronectomy procedure, described by Pogrel and cosl.,<sup>17</sup> in 2004, is an alternative to extraction of lower third molars that are in close relationship to the IAN, diagnosed by radiographic imaging.<sup>17</sup> Ideal diagnosis by imaging must be carried out using computerized tomography, after having performed a panoramic X-ray where we can observe the radiographic signs of proximity to the IAN.<sup>12-14</sup> In 8 of the studies analyzed, the diagnosis was made by orthopantomography and CBCT<sup>19,21,24,26,27,29,30,32</sup>, while in the remaining studies only employed a panoramic radiograph.<sup>17,18,20,22,23,25,28,31</sup>

The percentage of intraoperatively failed coronectomies ranges from 38.2% in the study by Renton et al.<sup>20</sup> and 2.1% in the study by Dolanmaz et al.<sup>23</sup> The studies by Leung et al.<sup>25</sup> and Monaco et al.,<sup>26,29</sup> did not have any failures. Failures during the procedure are scarce, except in the study by Renton et al.,<sup>20</sup> due to the use of a technique that is different from the one described by Pogrel et al.<sup>17</sup>, which maintains that the crown has to be completely sectioned using a hand-mounted burr, protecting the lingual nerve by means of a separator.

IAN injury in the cases of coronectomy was low. In the studies by Leung et al.<sup>22</sup>, Hatano et al.<sup>19</sup>, Renton et al.<sup>20</sup>, and Cilasun et al.<sup>21</sup>, the percentage of IAN lesion did not exceed 0.6% of coronectomies, whereas in the cases of extraction it was placed between

2.2% and 5.1%. Therefore, the coronectomy procedure decreases the risk of IAN injury compared with extraction.

The presence of infection and dry socket is between 0% and 5.7%, with the study by Leung et al.<sup>22</sup> having the greatest number of cases of infection, which may be related to the fact that no postoperative antibiotic was prescribed. In studies comparing extraction with coronectomy, a higher percentage of infection and dry socket was observed in patients undergoing extraction, except in the study by Renton et al.<sup>20</sup> where there was a higher percentage of infection and dry socket in cases of coronectomy.

Postoperative pain is low in patients where coronectomy is performed, with the study by Leung et al.<sup>22</sup> recording the most cases of pain. In studies comparing pain in patients undergoing tooth extraction and coronectomy<sup>19-22</sup>, the results show that the incidence of pain is similar in both groups.

Wound dehiscence has been recorded in a few studies<sup>17,18,24,27,28,29,30</sup>, with the highest percentage of cases occurring in the study by Kohara et al.<sup>27</sup>

Regarding the root migration, all of the studies evaluated it except O'Riordan et al.<sup>8</sup> and Cilasun et al.<sup>21</sup>

The percentage of migrated roots was high, reaching close to 100%.<sup>19,24,25,27</sup> The average number of millimeters of migration away from the IAN was approximately 1.5 to 3.09 mm, being greater in the first 6 months and decreasing after 12 months.<sup>17,22,23,24,28,31</sup> However, Monaco et al.<sup>26,29</sup> observed that the root migration after 12 months was maintained, not coinciding with the other authors, and especially with Leung et al.<sup>31</sup>, who verified that migration decreased and after 24 months it stopped completely.

Some authors observed that migration occurred more frequently in females and in younger patients ( $\leq 30$  years).<sup>24-31</sup> Regarding the shape of the roots, Goto et al.<sup>24</sup> observed that conical roots had greater migration potential, while Kohara et al.<sup>27</sup> and Leung et al.<sup>22,31</sup> did not find differences. Finally, regarding the depth of impaction, Kohara et al.<sup>27</sup> and Kouwenberg et al.<sup>32</sup> observed that the third molars in position A on the Pell and Gregory classification migrated a greater distance, contrary to

the findings of Leung et al.<sup>22,31</sup> who obtained a similar migration.

Reintervention to extract the roots is quite infrequent and, in the event it is necessary, the possibility of damaging the IAN during the procedure decreases due to migration of the roots. The great majority of the cases were due to the exposure of the roots in the oral cavity, inadequate wound healing<sup>19,24,27</sup>, or pulpitis.<sup>24,27,29</sup>

Some authors find that there is a relationship between failure of the coronectomy and the experience of the surgeon, observing that this was a key factor due to the longer time required to perform the procedure in novel surgeons compared to experts.<sup>29,32</sup> This factor should be included in future studies because it is considered a cause of subsequent complications.

## CONCLUSIONS

Coronectomy as treatment for third molars in close relationship with the IAN is a safe and effective procedure if performed using the technique described by Pogrel et al. in 2004. Postoperative complications after coronectomy treatment (IAN lesion, infection and dry socket) are less frequent than after extraction, with pain being the only similar value in both procedures. In case of reintervention for extraction of the roots, the risk of injuring the NDI is lower, due to the migration of the roots away from the surgical bed.



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