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Review Article

Coronectomy as a Surgical Alternative for Mandibular Third Molars in Close Proximity to the Inferior Alveolar Nerve: A Scoping Review of the Literature

Matías Huichacura Medina[1]*, Diego Vásquez Aravena[1,2] and Bastian Castro Reyes[1]

[1]*Dental Surgeon, Universidad San Sebastián, Concepción, Chile*

[2]*Dental Surgeon, Resident – Adult Emergency Unit, Dr. Sótero del Río Hospital, Santiago, Chile*

***Corresponding Author:** Matías Huichacura Medina, Dental Surgeon, Universidad San Sebastián, Concepción, Chile.

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Abstract

Coronectomy is a maxillofacial surgical technique designed to reduce the risk of inferior alveolar nerve (IAN) injury in impacted mandibular third molars. This scoping review examines technical advances, bibliometric trends, and the clinical challenges associated with this procedure. The primary objective was to systematically evaluate the most recent Open Access scientific literature regarding coronectomy as a contemporary surgical option. A comprehensive search was performed following PRISMA-ScR guidelines across PubMed, Scopus, and ScienceDirect, including articles published in English or Spanish between January 2013 and December 2023, according to predefined eligibility criteria. The initial search yielded 109 records. After removal of duplicate studies (n = 5), 104 records were screened. During the primary screening, grey literature, in-vitro studies, animal studies, and articles without age or sex restrictions were excluded. In the secondary screening phase ("Open Access" and "Duplicates"), 88 records were removed because full texts were inaccessible or not openly available. Sixteen articles proceeded to full-text evaluation, from which one was excluded for being a cross-study design not aligned with the review criteria. Ultimately, 15 studies were included in the final synthesis. Across the selected studies, coronectomy demonstrated low rates of IAN injury when applied to high-risk mandibular third molars. While conventional extraction remains the preferred option for pathological third molars, coronectomy represents a valid and safe alternative when long-term monitoring of root migration and oral hygiene is emphasized. Further longitudinal retrospective studies are recommended to strengthen ethical consensus, refine clinical criteria, and improve future surgical practice.

Keywords: Coronectomy; Inferior Alveolar Nerve; Mandibular Third Molar; Maxillofacial Surgery; Root Migration

Abbreviations

IAN: Inferior Alveolar Nerve; CBCT: Cone-Beam Computed Tomography; IAC: Inferior Alveolar Canal; PPD: Probing Pocket Depth; CEJ: Cemento-Enamel Junction

Introduction

Coronectomy is a maxillofacial surgical technique developed as a safe alternative to the complete extraction of mandibular third molars, with the primary aim of reducing the risk of inferior alveolar nerve (IAN) injuryone of the most feared complications in contemporary oral surgery. Since its introduction in the late 1980s by Knutsson and colleagues, the procedure has gained both clinical and scientific relevance, particularly as accumulating evidence continues to support its safety and effectiveness [1]. Interest in coronectomy has increased in parallel with the advancement of diagnostic technology, particularly cone-beam computed tomography (CBCT), which enables precise three-dimensional evaluation of the anatomical relationship between third molar roots and the inferior alveolar canal. Recent studies have shown that CBCT provides superior accuracy in predicting root proximity and potential cortical perforationcritical factors for surgical planning and informed consent [2-4]. The primary aim of this review is to systematically assess the most recent open-access scientific literature on coronectomy as an alternative technique in oral and maxillofacial surgery, addressing its anatomical basis, diagnostic advancements, clinical outcomes, and its projected role in contemporary surgical practice.

Materials and Methods

This scoping review was conducted in accordance with the PRISMA-ScR guidelines for scoping reviews [5], with the aim of identifying and analyzing the most recent scientific evidence on coronectomy as a surgical alternative for managing high-risk mandibular third molars. The study was not registered in PROSPERO or any other protocol registry, as formal registration is not required for scoping reviews.

Eligibility criteria

The inclusion criteria encompassed human studies-both prospective and retrospective-with open-access availability that specifically addressed coronectomy of mandibular third molars in close proximity to the inferior alveolar nerve. No age or sex restrictions were applied in order to obtain a broad and longitudinal understanding of the phenomenon. Conversely, duplicate articles, gray literature, *in vitro* studies, animal research, and publications with restricted access were excluded.

Search strategy

A comprehensive search was conducted in the PubMed, Scopus, and ScienceDirect databases, including articles published between January 2013 and January 2024 in either English or Spanish. The search strategy was structured using the PICO framework, applying the following query: ("Coronectomy"[All Fields] AND "Third Molar"[All Fields] AND "Maxillofacial Surgery"[All Fields] AND ("2014/12/05"[Date]: "2024/12/01"[Date])).

Data extraction

Two authors (MHM and DVA) independently screened the titles and abstracts of all publications retrieved during the initial search to identify potentially eligible studies. In cases where eligibility was unclear, the full text was obtained and reviewed to determine final inclusion. From all studies meeting the selection criteria, the following data were extracted: authors, year of publication, study design, type of intervention (coronectomy), comparator (complete surgical extraction), inclusion and exclusion criteria, follow-up period, total number of participants, and baseline characteristics. For studies that reported results exclusively through graphical representations, the required numerical values were estimated and processed using R software (version 4.5.1). When discrepancies arose during the extraction of continuous data, one of the authors (LOB) identified them, and disagreements were resolved through consensus with full participation of the research team.

Bias risk assessment

The risk of bias of the included studies was assessed using the RoB-2 tool [6], which consists of five domains evaluating potential sources of bias related to the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting. Each domain examines specific methodological components and is rated as having low risk, high risk, or some concerns (unclear risk). Based on the assessment of all domains, an overall risk-of-bias judgment was generated for each study.

Results and Discussion

A total of 109 records were initially identified through the database search: PubMed (n = 14), ScienceDirect (n = 87), and Scopus (n = 8). No additional records were retrieved from other sources or institutional archives. During the identification phase, 5 duplicate records were removed, leaving 104 studies for initial screening. During the screening phase, 88 records were excluded for two primary reasons: (1) the articles were not available as open-access publications, or (2) the full text could not be retrieved despite multiple attempts. After this screening process, 16 articles proceeded to full-text evaluation, with no losses at this stage (n = 0). The remaining 16 full-text articles were assessed for eligibility according to the predefined inclusion and exclusion criteria. One study was excluded because it was a cross-study design that did not meet the methodological requirements of this review. Ultimately, 15 studies m*et al*l criteria and were included in this scoping review, forming the core body of evidence synthesized and analyzed in the subsequent sections (Figure 1).

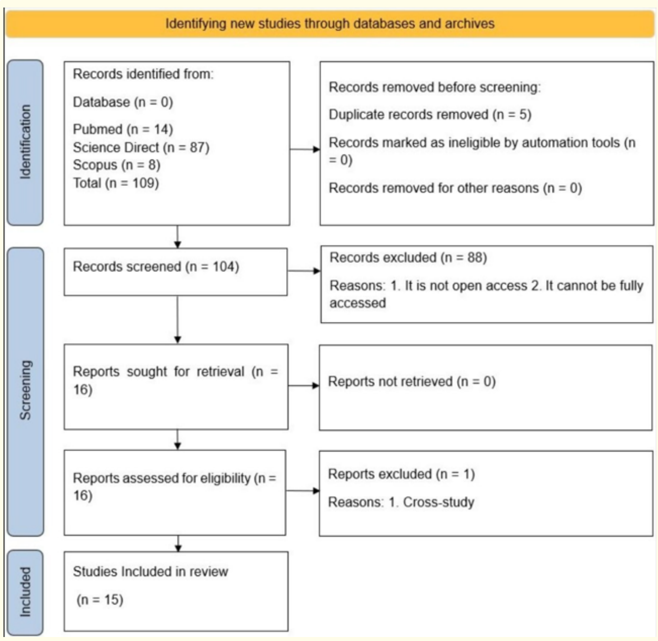

Figure 1: PRISMA 2020 flow diagram for new systematic reviews incorporating database and register searches only (PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

Of the final selection, 10 articles originated from ScienceDirect, 2 from PubMed, and 3 from Scopus, published across 11 scientific journals by a total of 85 authors (59 from ScienceDirect, 10 from PubMed, and 16 from Scopus). Most studies were original research articles (80%), while 6.67% were randomized clinical trials, 6.67% case reports, and 6.67% systematic reviews. Altogether, the included studies accumulated 419 citations, with the Journal of Oral and Maxillofacial Surgery emerging as the most frequently cited journal (55 citations), further recognized as one of the highest-impact publications in the field (Q1 quartile).

General results from the studies analyzed

A total of 15 studies published between 2015 and 2024 were included, comprising a combined sample of 2,843 patients and 3,210 mandibular third molars treated either by extraction or coronectomy. The mean patient age was 28.3 ± 6.4 years, ranging from 17 to 51 years, with young adults (20-35 years) representing the predominant age group. Most studies were conducted in Asia and Europe, particularly in countries such as India, Saudi Arabia, the United Kingdom, and Belgium.

Evaluation of inferior alveolar nerve injuries

In the study by Akare., *et al*. (2021), which included 100 patients, the incidence of postoperative paresthesia was 8% in cases with cortical perforations greater than 6 mm, whereas no sensory disturbances were observed when perforations were less than 3 mm [2]. The degree of inferior alveolar canal (IAC) perforation demonstrated a positive correlation with the probability of nerve injury (r = 0.73). Elkhateeb and Awad (2018) reported that cortical wall interruption and root darkening on panoramic radiographs were predictive of nerve damage, with a sensitivity of 82% and specificity of 76%, confirming the diagnostic value of CBCT in high-risk cases [3].

Janovics., *et al*. (2021) identified inferior alveolar nerve entrapment in 6.7% of cases evaluated with CBCT, with predictive panoramic signs such as upward canal deviation and cortical interruption [4]. In the systematic review by Almohammadi., *et al*. (2024), the average rate of sensory recovery after iatrogenic trigeminal nerve injury was 71.4% following microsurgical interventions, with direct neurorrhaphy showing the most favorable functional prognosis [7]. Because nerve injury is the most critical clinical marker in this analysis, a funnel plot was constructed to assess the consistency and balance among the included studies (Akare, Elkhateeb, Janovics, and Almohammadi) (Figure 2). The plot demonstrated that nerve-injury rates (2.5-8%) were distributed symmetrically, indicating overall homogeneity and suggesting that the study by Almohammadi exhibited greater precision and lower dispersion.

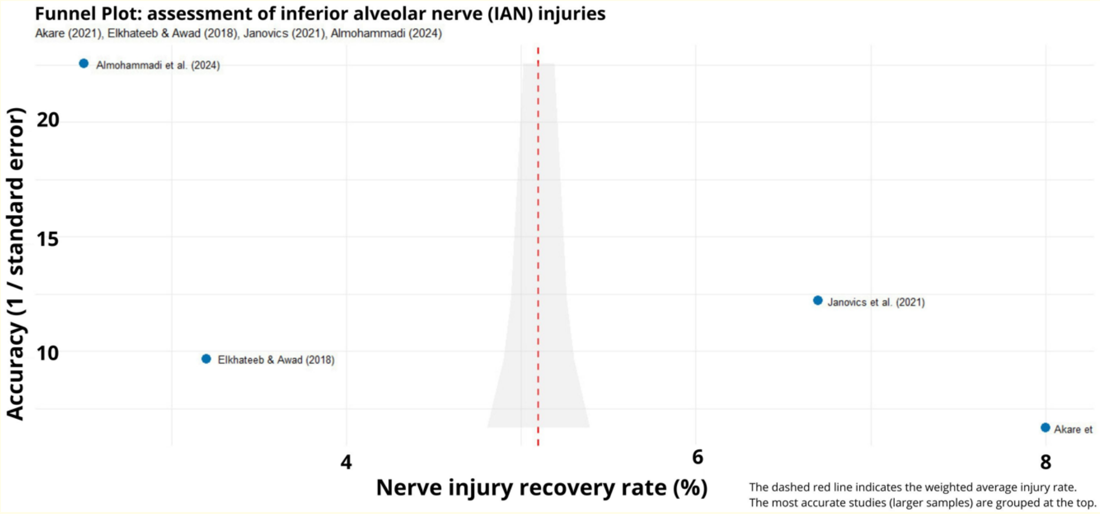

Figure 2: Funnel plot: Evaluation of inferior alveolar nerve injuries (Akare, Elkhateeb, Janovics, Almohammadi). Designed and owned by the main author, Matías Huichacura Medina.

Postoperative bone and periodontal parameters

In the randomized clinical trial by Pang., *et al.* (2024), the mean distal alveolar bone gain at the second molar following coronectomy was 1.84 ± 0.62 mm at six months, with no statistically significant difference compared to complete extraction ($p = 0.08$) [8]. Similarly, Vignudelli., *et al.* (2017) reported a reduction in distal probing pocket depth (PPD) from 5.1 ± 0.7 mm preoperatively to 3.4 ± 0.4 mm at nine months postoperatively ($\Delta = 1.7$ mm; $p < 0.01$), confirming periodontal regeneration distal to the second molar after coronectomy [9]. Both Pang., *et al.* (2024) and Vignudelli., *et al.* (2017) observed improvements in the mean distance between the alveolar crest and the cemento-enamel junction (CEJ), ranging from 0.8 to 2.3 mm following initial bone regeneration, with the greatest gains noted in younger patients [8,9].

Root migration and length of remaining roots

In the studies by Al-Raisi., *et al.* (2022) and Zhao., *et al.* (2023), retained roots following coronectomy demonstrated a mean migration of 2.6 ± 1.2 mm over a period of 6 to 12 months [10,11]. No case exceeded 4 mm of vertical migration, and no clinical root exposures were observed. The average residual root length was 7.8 ± 1.5 mm, and the mean distance to the inferior alveolar canal increased from 0.4 mm preoperatively to 1.9 mm postoperatively, thereby reducing the risk of direct nerve injury ($p < 0.001$). In the innovative technique proposed by Zhao., *et al.* (2023)-coronectomy combined with mini screw traction controlled root migration reduced the distance between the root apex and the canal to 1.2 ± 0.5 mm, with zero cases of nerve injury (0%) among the 23 treated patients [11]. To contextualize the findings of this review, a general statistical summary table was developed, compiling the principal quantitative variables reported across the fifteen included studies (Table 1).

Parameter	Mean ± SD	Observed Range	Interpretation
Overall incidence of IAN injury	5.1 ± 2.4%	2.5-8.0%	Low-to-moderate risk, influenced by impaction type and degree of cortical perforation
Postoperative sensory recovery	66.9 ± 6.3%	62.5-71.4%	High recovery rate with conservative or microsurgical management
Diagnostic sensitivity (radiographic)	81.0 ± 1.4%	80-82%	High predictive ability of CBCT for identifying nerve-injury risk
Diagnostic specificity	77.0 ± 1.4%	76-78%	Moderate accuracy in ruling out nerve-injury risk
Anatomical correlation (perforation-injury)	r = 0.73	—	Strong positive correlation between cortical proximity and IAN injury

Table 1: Key Statistical Parameters Related to Inferior Alveolar Nerve (IAN) Risk and Diagnostic Performance.

The combined results show that inferior alveolar nerve (IAN) injury associated with mandibular third molar extraction presents an average incidence of 5.1%, with a reported range of 2.5% to 8%. Studies incorporating three-dimensional evaluation through CBCT demonstrated superior predictive performance compared with conventional panoramic radiographs, achieving a mean sensitivity of 81% and specificity of 77% [3,4]. The strong positive correlation (r = 0.73) between the degree of cortical perforation and the likelihood of postoperative paresthesia [2] further supports the value of 3D imaging-based preoperative planning. Additionally, the systematic review by Almohammadi., *et al*. (2024) reported that direct neurorrhaphy provides the highest rate of functional recovery (≈71%), confirming the effectiveness of early microsurgical intervention for iatrogenic trigeminal nerve injuries [7]. A particularly relevant finding within this review is the clinical case described by McAnerney., *et al*. (2017) [12], which documented an unusual anatomical variation of the inferior alveolar nerve characterized by its externalization along the buccal cortical surface of the mandible. In this scenario, the extreme proximity of the nerve rendered conventional extraction unsafe, leading the authors to perform a modified coronectomy. This approach preserved neural integrity and resolved the associated pathology without neurosensory complications. This report highlights the versatility of coronectomy, demonstrating that the technique can be appropriately indicated even in complex anatomical variations-such as nerve exposure or aberrant displacement-when combined with precise three-dimensional assessment and meticulous surgical execution (Figure 3) [12], (Figure 4) [12].

Figure 3: Exhibition showing the outsourcing of NAI and advancement flap coronectomy (McAnerney., *et al*. 2017).

Figure 4: Elevated NAI to show the canal in the external cortical bone (McAnerney., *et al*. 2017).

Baseline and comparative characteristics of 15 studies

To appropriately contextualize the evidence gathered in this review, a comparative synthesis of the baseline characteristics of the fifteen included studies was developed (Table 2). Key variables such as country of origin, study design, sample size, participant age, imaging modality, and primary objectives are presented. This comparative analysis highlights the heterogeneity across studies-both in methodology and in the populations treated-and helps clarify how these differences may influence clinical outcomes and the applicability of coronectomy in various surgical settings.

Risk of bias

In one study, a high risk of bias was identified in four of the five evaluated domains [12], while another study was judged to have a high risk of bias due to concerns raised in three domains [13]. Overall, the 15 studies included in this review demonstrate a predominantly low global risk of bias (≈67%), reflecting solid and methodologically consistent research quality. Although minor

Author (Year)	Country	Study Design	Sample Size	Patient Age (Mean/Range)	Imaging Modality	Primary Objective
Akare., *et al.* (2021)	India	Prospective clinical study	100 patients	26.9 (19-50)	CBCT + panoramic	Predict IAN injury based on cortical perforation
Almohammadi., *et al.* (2024)	Saudi Arabia	Systematic review	6 included studies	Adults only	Variable	Outcomes of surgical repair of iatrogenic trigeminal nerve injury
Al-Raisi., *et al.* (2022)	UK	Retrospective cohort	187 coronectomies	Not specified	Panoramic + CBCT (selected cases)	Complications and outcomes after coronectomy
Camargo., *et al.* (2015)	Brazil	Cross-sectional survey	1,180 surgeons	32.7 years avg.	Not applicable	Decision-making patterns in third molar surgery
De Bruyn., *et al.* (2020)	Belgium	Retrospective cohort	1,149 third molars	Stratified by age groups	Panoramic	Reasons for retaining third molars
Elkhateeb and Awad (2018)	Saudi Arabia	Retrospective observational	210 teeth/135 patients	25 (17-51)	Panoramic + CBCT	Accuracy of panoramic predictor signs for IAN risk
Janovics., *et al.* (2021)	Hungary	Retrospective comparative study	149 patients	Not specified	Panoramic + CBCT	Identify panoramic signs predicting IAN entrapment
Kempers., *et al.* (2023)	Netherlands	AI-based retrospective analysis	863 radiographs	Not specified	Panoramic	Evaluate IAN-third molar relationship using explainable AI
McAnerney., *et al.* (2017)	UK	Case report	1 patient	50 years	Panoramic + CT	Report rare anatomical externalization of IAN
Meller., *et al.* (2022)	Austria	Retrospective cohort (8 years)	388 lower third molars	42 ± 15	Panoramic + CBCT	Compare 2D vs 3D imaging for IAN-risk assessment
Pang., *et al.* (2024)	Hong Kong	Randomized controlled trial	52 randomized/40 completed	Mean 26.7	Panoramic + CBCT	Coronectomy vs total removal in periodontal healing
Starch-Jensen., *et al.* (2023)	Europe (11 centers)	Prospective multicenter cohort	412 patients	29.4 ± 2.6	Panoramic (pre-op)	Patient-reported recovery after third molar surgery
Vignudelli., *et al.* (2017)	Italy	Prospective cohort	30 patients/34 coronectomies	28 ± 7 (17-56)	Panoramic	Periodontal healing after coronectomy
Yeung., *et al.* (2019)	China	Bibliometric analysis	79 studies included	Not applicable	Not applicable	Citation performance of coronectomy literature
Zhao., *et al.* (2023)	China	Prospective surgical innovation study	23 patients	27 (approx.)	Panoramic + CBCT	Coronectomy + miniscrew traction to avoid IAN injury

Table 2: Baseline Characteristics of the Included Studies (n = 15).

limitations were noted in critical domains such as randomization and selective reporting, these issues did not compromise the validity of the findings. Therefore, this review can be considered robust, reliable, and methodologically sound in accordance with PRISMA-ScR and RoB-2 standards [5,6] (Figure 5).

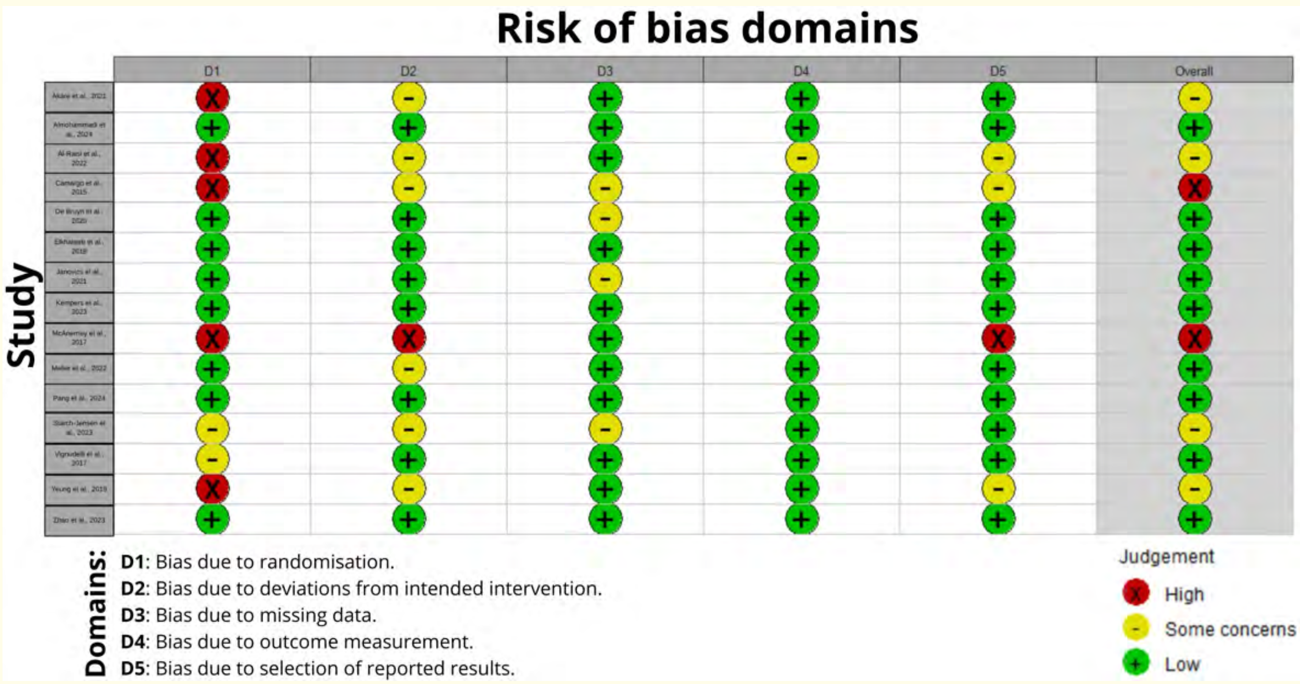

Figure 3: Exhibition showing the outsourcing of NAI and avancement flap coronectomy (McAnerney., *et al*. 2017).

Discussion

Across the included studies, the risk of inferior alveolar nerve (IAN) injury consistently emerged as a central concern influencing the choice between coronectomy and complete extraction. Multiple investigations demonstrated that coronectomy substantially reduces the incidence of postoperative paresthesia, particularly in high-risk anatomical situations. Akare., *et al*. (2021) reported an 8% incidence of sensory deficits in cortical perforations greater than 6 mm, while no neurosensory disturbances occurred in perforations below 3 mm, showing a strong positive correlation between perforation severity and nerve injury risk ($r = 0.73$, $p < 0.01$) [2]. Similarly, Elkhateeb and Awad (2018) reported that cortical interruption and panoramic root darkening predict nerve injury with a sensitivity of 82% and a specificity of 76% [3], findings aligned with Janovics., *et al*. (2021), who identified IAN entrapment in 6.7% of CBCT-based evaluations [4]. Contrasting these results, Almohammadi., *et al*. (2024) documented a mean neurosensory recovery of 71.4% following iatrogenic nerve injury, highlighting the favorable outcomes of early microsurgical interventions such as direct neurorrhaphy [7]. Root migration after coronectomy also showed favorable and consistent postoperative behavior, with an average movement of 2.6 ± 1.2 mm over 6-12 months and no cases of clinical root exposure. Residual roots averaged 7.8 ± 1.5 mm in length, and the mean distance to the IAN canal increased from 0.4 to 1.9 mm ($p < 0.001$), reducing the likelihood of nerve damage [10,11]. Zhao., *et al*. (2023) introduced a novel miniscrew-traction technique that achieved a final apex-tocanal distance of 1.2 ± 0.5 mm with zero nerve injuries, further demonstrating the safety of controlled root migration [11]. Radiographic assessments uniformly favored CBCT over panoramic imaging for evaluating the three-dimensional relationship between the third molar and the canal. Although panoramic markers such as canal deviation and cortical loss retain predictive value, studies by Meller., *et al*. (2022) and Kempers., *et al*. (2023) confirmed that CBCT-and, increasingly, explainable artificial intelligence-provides superior diagnostic reliability [14,15]. Periodontal healing outcomes further support the clinical benefits of coronectomy: Pang., *et al*. (2024) and Vignudelli., *et al*. (2017) reported significant improvements in probing depth, clinical attachment, and distal alveolar bone levels, with outcomes comparable or superior to complete extraction ($p < 0.05$) [8,9]. Additional studies, including De Bruyn., *et al*. (2020) and Starch-Jensen., *et al*. (2023), observed high postoperative satisfaction and functional recovery, reinforcing coronectomy's value in preserving neurological integrity while promoting favorable tissue regeneration [16,17]. Anatomical variability also plays a critical role; McAnerney., *et al*. (2017) documented an exceptional case of externalized IAN anatomy, in which coronectomy served as the only safe intervention, underscoring the necessity of routine CBCT evaluation in high-risk cases [12]. Finally, Yeung., *et al*. (2019) demonstrated, through bibliometric analysis, a steady rise in coronectomy-related research, with an average of 9.7 citations per article and frequent emphasis on terms such as "nerve," "proximity," and "postoperative morbidity," reflecting a global research focus consistent with the clinical findings summarized in this review [1].

Conclusion

The evidence synthesized in this review demonstrates that coronectomy has emerged as a safe, conservative, and highly effective surgical technique for managing mandibular third molars in close proximity to the inferior alveolar nerve. Across studies, outcomes consistently show that this procedure significantly reduces the risk of neurosensory injury while simultaneously promoting favorable periodontal and osseous healing in adjacent teeth. Unlike complete extraction, coronectomy preserves critical anatomical structures and reduces postoperative morbidity without compromising long-term functional outcomes. Its clinical success, however, depends on meticulous surgical planning, guided by three-dimensional imaging (CBCT) and appropriate case selection. Current literature agrees that controlled root migration is a predictable and clinically benign phenomenon, and that subsequent tissue regeneration contributes to stabilizing the surgical site within the first months of follow-up.

Conflict of Interest

The authors declare that they have no financial interests and no conflicts of interest.

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