

Managing Impacted Mandibular Third Molars: A Scoping Review of Surgical Extraction versus Orthodontic Traction and Nerve Injury Risk

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ABSTRACT

The management of impacted mandibular third molars can be a difficult clinical issue due to the proximity of the tooth to critical neurovascular structures. Surgical removal is routinely performed, but the technique carries a known risk of injury to the inferior alveolar and lingual nerves. The complication may induce temporary or permanent sensory impairment. Orthodontic traction can be an alternative to reposition the tooth in a more desirable location before surgical removal. The selection of the appropriate treatment is important to avoid a mechanical injury and to allow the adjacent bone and soft tissue to adapt, which may reduce the risk of nerve injury from compression or transection. This review discusses the anatomy of the inferior alveolar canal and the lingual nerve route, describes the known mechanisms and classifications of nerve injury, and outlines how orthodontic traction may diminish these risks. Technical aspects of traction, including the surgical exposure with coronectomy or not, force application, anchorage methods, and radiographic observation, are reviewed. Potential complications, including root resorption and unwanted tooth movement, were also explained. Criteria for patient selection are discussed, with emphasis on age, root morphology, eruption space, and imaging findings that indicate proximity to neurovascular structures. The purpose of this scoping review was to compare orthodontic traction and complete surgical extraction of mandibular impacted third molars with respect to injury of the inferior alveolar nerve (IAN) and lingual nerve (LN). The limited but growing evidence allows us to identify gaps in long-term outcome data and calls for further prospective studies. Orthodontic traction cannot replace extraction in every case, but for carefully chosen patients, it may offer a practical treatment option for preserving neurosensory function. The approach requires interdisciplinary collaboration, precise biomechanical planning, and a clear explanation of treatment goals to support informed decision-making.

KEYWORDS

impacted third molar; orthodontic traction; inferior alveolar nerve; lingual nerve; coronectomy; surgical extraction

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INTRODUCTION

Impacted mandibular third molars are concerned in both orthodontic and oral surgery practice with various frequency. These teeth often remain impacted because of space limitations and unfavourable angulation. According to the literature, these teeth may contribute to pericoronitis, caries of adjacent teeth, topical periodontitis, and cystic change, requiring conservative or surgical intervention (1, 2, 3).

Surgical extraction is effective but has potential complications. Injury to either inferior alveolar nerve or lingual nerve can result in altered sensation of the lower lip, chin, tongue, and floor of the mouth. The sensory alteration can vary from temporary to permanent (4, 5).

An alternative treatment option may be orthodontic traction. Orthodontic traction is the process of applying a controlled force to the impacted tooth to achieve guided eruption. Unlike extraction, orthodontic traction allows for the surrounding bone to remodel and for the tooth to erupt in a continuous, controlled manner that diminishes the possibility of nerve compression or trauma if the case assessed properly (6). Orthodontic traction with coronectomy or not is a technique of main interest in the instance of close contact between the tooth roots and the mandibular canal (7). The previous finding is usually observed during radiological assessment. Successful orthodontic traction relies upon a thorough understanding of the mandibular anatomy. Careful assessment of dental development and three-dimensional imaging are also essential in the treatment plan.

Patients with adequate space for the tooth to erupt, with little root development, are good candidates for orthodontic traction or guided eruption (8). On the contrary, ankylosis, curved root morphology, active infection, and related cystic lesions may preclude orthodontic treatment (9). Anatomical structures of specific importance are the inferior alveolar nerve (IAN) and lingual nerve (LN),

which are the principal neurovascular structures adjacent to the impacted mandibular third molars. Detailed anatomical knowledge regarding the IAN and LN is a starting point for any clinician, including orthodontist, to provide evidence-based and ethical care.

The IAN is the terminal sensory branch of the mandibular division of the trigeminal nerve. Entering through the mandibular foramen on the ramus' medial surface, it courses through the mandibular canal, giving dental and interdental branches before emerging at the mental foramen to distribute as the mental nerve (10). The path of the IAN is located in proximity to the roots of the third molar, and in some patients, the canal may be seen superimposed on panoramic tomography or encircle the tooth roots. The nerve provides sensation to the mandibular teeth, the lower lip, and the chin, and injury can result in sensory disturbance across these anatomical areas (11).

Near the third molar, the lingual nerve lies about 2–3mm beneath the mucosa, a position that makes it highly vulnerable during reflection of a lingual flap or removal of lingual cortical bone (12). It supplies general sensation to the anterior two-thirds of the tongue and the floor of the mouth and carries taste fibres via the chorda tympani (13).

The surgical management of impacted mandibular third molars present significant clinical challenges, particularly when radiographic evidence indicates a close relation between the tooth roots and the mandibular canal. While removal is the definitive solution for symptomatic teeth, the risk of iatrogenic injury to the IAN and LN (ranging from temporary paraesthesia to permanent sensory loss) necessitates careful risk-benefit analysis.

Orthodontic traction, including surgical exposure with or without coronectomy, force application, anchorage methods, and radiographic observation, is reviewed and discussed.

The advantages and disadvantages of these techniques are described in Table 1.

Tab. 1 This table outlines the definitive advantages and potential complications of surgical extraction versus orthodontic traction, highlighting the differences in treatment duration and anatomical risks associated with each approach.

Technique	Advantages	Disadvantages
Surgical Extraction	Definitive removal of the impacted tooth.	Risk of inferior alveolar or lingual nerve injury leading to temporary or permanent sensory disturbance.
	Short treatment time once surgery is performed.	Potential for postoperative pain, swelling, and infection.
	Indicated for infection, cystic change, or unfavourable angulation.	Bone removal and nerve proximity increase complication rates, especially in high-risk anatomy.
Orthodontic Traction	Gradual, controlled tooth movement that may lower the risk of acute nerve injury.	Prolonged treatment over months with repeated visits and imaging.
	Allows bone to remodel during eruption.	Possible root resorption, periodontal injury, or migration toward the canal or lingual plate.
	Useful where imaging shows close contact between roots and the mandibular canal.	Requires surgical exposure and stable anchorage.
	Can be combined with coronectomy if roots remain close to the canal.	Attachment failure, infection, or poor oral hygiene can delay or compromise results.
		Limited evidence and lack of long-term comparative data.

MATERIALS AND METHODS

The purpose of this scoping review was to compare orthodontic traction (with coronectomy or not) and complete surgical extraction of mandibular impacted third molars with respect to injury of the inferior alveolar nerve (IAN) and lingual nerve (LN). Given the variability in reported outcomes and the lack of large, standardized studies, a gap in literature exists comparing the consistent estimates of nerve injury risk for each technique. To address this, relevant articles were identified through a structured search of PubMed, focusing on clinical studies, systematic reviews, and meta-analyses that reported rates of IAN and LN injury. Relevant articles were identified, covering a period that includes essential landmark studies as well as the most recent clinical developments. While foundational data were included for historical reasons, the majority of the analyzed evidence, particularly regarding 3D imaging and standardized traction protocols, was derived from a significant body of literature published after 2010. Data from these studies were extracted and analyzed to provide a comparative overview of the two techniques, highlighting both immediate and long-term nerve injury outcomes.

RESULTS

MECHANISMS OF INJURY

Both nerves can be damaged by direct trauma, compression, stretching, or ischaemia (14, 15). Surgical extraction may involve sharp burs, elevators, or retractors that may contact the canal or the lingual plate, leading to neurapraxia or more severe lesions. Orthodontic traction reduces the chance of direct mechanical insults but is not completely risk-free. Excessive orthodontic force or migration of the tooth roots into the canal could produce compressive neuropathy. Likewise, traction that displaces the tooth lingually may increase pressure on the LN, especially if the cortical bone is thin and fracture (16, 17).

In a prospective clinical study of 4338 lower third molar extractions, 0.35% had inferior alveolar nerve (IAN) injury and 0.69% had lingual nerve (LN) injury (18).

In another study of 3236 mandibular third molar extractions, 1.5% inferior alveolar nerve (IAN) sensory loss and 1.8% developed lingual nerve (LN) sensory loss presented at first month. At 18–24 months, permanent deficits were recorded in 0.6% for the IAN and 1.1% for the LN (19).

Iatrogenic nerve injury during the surgical management of impacted mandibular third molars can occur from direct and indirect trauma. Direct trauma happens when surgical instruments or excessive orthodontic force causes mechanical trauma to the inferior alveolar or lingual nerve (20, 21). These could be the result of extraction when there is contact with burs, elevators or retractors that can traumatize or transect the nerve tissue, or the use of excessive orthodontic force that may compress the canal or displace the tooth against the lingual plate (6–8). Indirect trauma can involve other secondary effects such as, compression, and ischaemia (11, 14). Within the confined mandibular canal, a swelling that can happen from within or the migration of the tooth roots during traction

can create sustaining compression that reduces blood supply, block conduction (22–24). Commonly, either pathway to the nerve injury can lead to various degrees of paraesthesia, hypoesthesia, or dysaesthesia of the lower lip, chin or tongue (4–12). In most cases, recovery will usually happen overtime, but some changes might persist. This highlights the importance of using imaging to aid assessment, recognizing applied forces or compensatory changes, maintaining appropriate monitored forces and evaluating neurosensory status, as continuous assessments will be important to the treatment (5–10).

CLINICAL MANIFESTATIONS

Injury to the IAN may present as paraesthesia, hypoesthesia, or dysaesthesia of the lower lip and chin. Lingual nerve trauma can lead to numbness of the tongue, altered taste, or burning sensations (4, 5, 11, 15, 18, 23, 24). Many of these sensory changes resolve within weeks, but a proportion persists beyond six months and may become permanent (1–5). Severity is often classified according to Seddon and Sunderland, ranging from transient conduction block, such as neurapraxia and axonotmesis, to complete neurotmesis, each with different prognostic implications (25–27).

Accurate imaging is essential to evaluate the risk of nerve injury. Cone-beam computed tomography provides three-dimensional views of the canal relative to the tooth roots and can indicate the lingual plate thickness (10, 11). Preoperative evaluation of these structures indicate both surgical planning and the design of orthodontic force vectors (4–6). In orthodontic traction, low-magnitude, continuous forces combined with frequent radiographic monitoring can help avoid tooth migration in the canal or displacement to the lingual plate (16).

Protection of the IAN and LN should be regarded as of primary importance when planning any intervention for impacted mandibular third molars (4, 14). The slow, controlled movement achieved through orthodontic traction may reduce the likelihood of acute nerve injury compared with immediate extraction, provided case selection and biomechanical control (6–8). However, the possibility of delayed or progressive nerve disturbance remains, underscoring the need for informed consent, and regular neurosensory evaluation.

ORTHODONTIC TRACTION TECHNIQUE

Orthodontic traction may be used (with coronectomy or not) to move an impacted mandibular third molar gradually into a position that permits functional eruption or simple extraction (7, 28). The orthodontic principles of light and continuous force application require adjustments according to the tooth's location, the density of mandibular bone, and the proximity of vital structures (20).

Clinical examination evaluates mouth opening, periodontal health, and adjacent tooth condition. Cone-beam computed tomography (CBCT) is used to evaluate the relationship of the third molar roots to the mandibular canal and to assess the thickness of the lingual plate (16). Panoramic radiographs alone may not always provide the

details needed for safe planning, especially if the roots of the third molar are superimposed on the IAN (22, 28). The ideal candidate for orthodontic traction is usually a younger patient with incomplete root formation, sufficient eruption space, and no signs of ankylosis or cystic changes (9). A clear written consent form is essential, because treatment often extends over several months and demands repeated follow-up visits.

The crown of the impacted tooth must be surgically uncovered to allow placement of orthodontic appliances. A conservative flap design is preferred to preserve gingival keratinized tissue and maintain good blood supply. Bone removal may be limited to what is required for visibility and bonding of the attachment (9, 20, 29, 30). This condition may be described as minor surgical orthodontics.

Once the crown of the tooth is exposed and isolated, an attachment such as a bonded button or bracket is bonded to the enamel. Traction forces can be delivered with chains, nickel-titanium coil springs, or ligature wires (16). The choice of the eruption technique depends on the eruption path. Force levels are kept light to permit physiologic bone remodeling and to reduce the risk of root resorption or nerve compression (20).

Anchorage is essential to direct the movement of the impacted tooth while preventing the displacement of adjacent teeth. Options include fixed orthodontic appliances on adjacent teeth, a rigid lingual arch, or temporary anchorage devices (TADs) inserted into cortical bone such as mini implants or fixation screws (29). Bone fixed anchorage often provides the most stable support in the posterior mandible, particularly when second molars are not suitable as anchorage units (30).

The direction of the orthodontic force should be applied to facilitate a path of eruption that allows the tooth to avoid compressing on the inferior alveolar canal and the lingual plate. Traction is usually planned in a way to move the crown occlusally and buccally, away from the canal (6, 7, 28). Orthodontic traction should be applied once its path of eruption has been planned using cross-sectional radiography to allow appropriate consideration of the location of the tooth in relation to the inferior alveolar nerve canal (10). In order to utilize orthodontic forces correctly, periodic assessments are necessary. As well as, clinical and radiographic assessment to monitor progress and check for potential complications (20). Cone Beam Computed Tomography (CBCT), periapical x-ray, or panoramic tomograph will determine whether the tooth is moving along the planned eruption path, while also ensuring mechanical pressure is not being applied to the canal or excessive root resorption is not occurring (7, 16, 22). Neurological assessment of the lower lip, chin, and tongue should be performed at each appointment to assess changes in sensory perception (4, 5, 11, 15, 18, 23). In situations where the tooth roots are close to the canal, surgical coronectomy can be planned and completed with orthodontic traction (7). Surgical removal of the crown while keeping the roots, will allow eruption of the segmental roots under controlled orthodontic forces, allowing the residual root structures to act as the anchorage unit (6, 9, 28).

In a recent article, coronectomy is suggested to reduce the risk of inferior alveolar nerve injury in comparison

to surgical extraction (31). In another relevant paper, the authors concluded that coronectomy could be a safe alternative for teeth in close contact with the nerve when careful case selection and follow-up are applied (32). In a systematic review of 2087 coronectomy procedures, successful coronectomies had nerve injury in 0.5% (inferior alveolar nerve) and 0.05% (lingual nerve). In failed coronectomies, IAN injury rose to 2.6%. Permanent paraesthesia was 0.05% after successful coronectomy and 1.3% after failed coronectomy (33). In a clinical and radiological study of 231 coronectomy cases (mean follow-up 5.7 years), 1.3% developed inferior alveolar nerve (IAN) injury (34). In a retrospective study of 124 coronectomy patients, 4.3% experienced inferior alveolar nerve (IAN) injury as a short-term complication, and 3.5% had IAN injury at long-term follow-up (>3 months) (35).

DISCUSSION

Currently, the extraction of impacted mandibular third molars presents a significant clinical situation, especially when the risk of iatrogenic inferior alveolar or lingual nerve trauma exists. Surgical extraction is the most common treatment approach and has a well documented risk for temporary or permanent sensory disturbance (4–7, 11, 18, 19). Orthodontic traction (with or without coronectomy) provides a gradual, controlled approach intended to minimize direct trauma (6, 7, 9, 22, 31–33). However, its role in clinical practice needs further consideration.

Orthodontic traction is a conservative treatment that is not a risk-free procedure (4, 6, 7, 20, 28, 29). Excessive or inappropriate force could produce root resorption, periodontal injury or movement of the tooth into potentially dangerous anatomical structures and spaces (13–15). Detachment of a bonded attachment or failure of anchorage may delay treatment and require a second surgical exposure (3, 16, 18–21). A recurrent infection or failure to maintain adequate orthodontic hygiene, could influence the surgical site and need prompt attention.

Choosing between extraction and orthodontic traction requires evaluation of anatomy, patient age, and root development. Favourable candidates are typically younger individuals with incomplete root formation, adequate eruption space, and a high predicted risk of nerve injury if surgical removal is performed (1, 8, 9, 17, 28). Unfavourable conditions include ankylosis, excessive root curvature, active infection, or very limited space (20).

Surgical extraction is usually necessary for teeth with infection, cystic change, or unfavourable angulation where movement is unlikely to succeed (1, 7, 9, 17). However, even with modern imaging and modern surgical techniques, the incidence of inferior alveolar nerve injury after high-risk extractions remains clinically significant. Lingual nerve disturbance can also affect quality of life. The advantage of orthodontic traction allows gradual bone remodeling and may reduce acute mechanical stress on the neural tissues. This controlled technique may lead to a lower rate of long-term neurosensory complications, particularly when cone beam computed tomography (CBCT) confirms intimate root and IAN canal contact (6, 9, 16).

Currently, the literature on orthodontic traction of mandibular third molars is limited to small cohort studies and case series. Usually, favourable outcomes are achieved, when treatment is carried out in young patients with incomplete root formation, but these findings cannot be generalized (1, 8, 17). Few studies include long-term neurosensory follow-up, and variations in force magnitude, anchorage systems, and monitoring protocols, which make comparison difficult. There is also a lack of randomized controlled trials that directly compare traction with immediate extraction in defined high-risk groups. Until such data become available, clinicians must base decisions on anatomical risk factors, patient preference, and professional expertise.

Successful third molar traction depends on close professional cooperation between oral surgeons and orthodontists. Oral surgeons provide the surgical exposure

and guide the risk assessment. Orthodontists manage the force and the placement of the orthodontic appliance. Treatment duration may be done over several months or longer, depending on the patient’s compliance and regular reviews (9, 28, 30). Inadequate follow-up or poor oral hygiene may affect the results or lead to infection.

Furthermore, the movement of the tooth is not always predictable. Ankylosis, unfavourable root morphology, or unexpected migration toward the inferior alveolar canal could change the treatment plan to surgical extraction (1, 7, 9, 17). Coronectomy combined with traction may address some of these challenges but requires careful monitoring for root migration or secondary pathology.

Because both extraction and orthodontic traction carry distinct risks, shared decision-making is central to responsible oral care. Patients should be informed about the risk for nerve injury with either approach, the duration

Tab. 2 A summary of key research findings regarding patient selection, the impact of age on root development, and the necessity of interdisciplinary planning.

Statement	Relevant Citations	Notes on Relevance
Choosing between extraction and orthodontic traction requires evaluation of anatomy, patient age, and root development. Favourable candidates are typically younger individuals with incomplete root formation, adequate eruption space, and a high predicted risk of nerve injury if surgical removal is performed	1, 8, 9, 17, 28	Discusses root development, growth pattern, anatomical considerations, orthodontic traction feasibility, and nerve injury risk.
Orthodontic traction is a conservative treatment that is not a risk-free procedure	9, 28, 20, 29, 30	Covers procedural risks, iatrogenic possibilities, anchorage devices, and technical challenges of traction.
Surgical extraction is the most common treatment approach and has a well documented risk for temporary or permanent sensory disturbance	4, 5, 6, 7, 11, 18, 19, 21, 31–35	Reports incidence, risk factors, preventive strategies, coronectomy comparisons, and clinical outcomes of IAN and LN injury.
Surgical extraction is usually necessary for teeth with infection, cystic change, or unfavourable angulation where movement is unlikely to succeed	1, 7, 9, 17, 28	Addresses anatomical constraints, cystic or pathological changes, and limitations of orthodontic movement.
The advantage of orthodontic traction allows gradual bone remodeling and may reduce acute mechanical stress on the neural tissues. This controlled technique may lead to a lower rate of long-term neurosensory complications, particularly when CBCT confirms intimate root and IAN canal contact	6, 9, 16, 28	Covers gradual orthodontic movement, reduced neural stress, and CBCT-guided planning for nerve safety.
Usually, favourable outcomes are achieved, when treatment is carried out in young patients with incomplete root formation, but these findings cannot be generalized	1, 8, 17	Discusses patient age, root formation, and variability of treatment outcomes.
Treatment duration may be done over several months or longer, depending on the patient’s compliance and regular reviews	9, 28–30	Highlights the gradual nature of orthodontic traction, dependence on patient compliance, and anchorage techniques.
Ankylosis, unfavourable root morphology, or unexpected migration toward the inferior alveolar canal could change the treatment plan to surgical extraction	1, 7, 9, 17, 28	Addresses anatomical/morphological constraints, nerve proximity, and limitations of orthodontic traction.
Comparison of nerve injury after surgical extraction and coronectomy shows IAN injury in 0.35%–1.5% and LN injury in 0.1%–1.8%	5, 18, 19, 31–35	Reports incidence of nerve injury in extraction and coronectomy; comparative studies included.
Permanent deficits were generally lower, with IAN involved in 0.33%–0.6% and LN in 0.1%–1.1%	5, 18, 31–35	Focuses on permanent nerve injury incidence after extraction and coronectomy.
Overall, coronectomy appears to reduce the immediate risk of nerve injury compared with complete surgical extraction, particularly for teeth in proximity to the IAN. Long-term monitoring is needed because retained roots can migrate or occasionally require secondary intervention	7, 31–35	Covers nerve benefits, retained root behaviour, migration, and need for follow-up.

Tab. 3 Statistical overview of temporary and permanent sensory deficits associated with the inferior alveolar nerve (IAN) and lingual nerve (LN) across different surgical techniques.

Procedure	IAN Injury (Temporary)	LN Injury (Temporary)	IAN Injury (Permanent)	LN Injury (Permanent)	Notes
Surgical Extraction	0.35%–1.5%	0.1%–1.8%	0.33%–0.6%	0.1%–1.1%	Most common treatment. Risk influenced by root proximity, angulation, and patient anatomy (5, 18, 19).
Coronectomy	~0.1%–0.6%	~0.1%–1.2%	0.1%–0.6%	0.1%–1.1%	Reduces immediate IAN injury risk. Retained roots may migrate and require long-term monitoring (7, 31–35).

of orthodontic treatment, and the possibility of surgical removal even after months of traction. A clear explanation of these factors supports informed consent and sets realistic expectations.

According to the reviewed studies, a comparison of nerve injury after surgical extraction and coronectomy of mandibular third molars can be concluded that inferior alveolar nerve (IAN) injury occurred in 0.35% to 1.5% of cases, while lingual nerve (LN) injury ranged from 0.1% to 1.8%. Permanent deficits were generally lower, with IAN involved in 0.33%–0.6% and LN in 0.1%–1.1%. Additionally, in systematic reviews and clinical studies, IAN injury after successful coronectomy was lower, around 0.5%–1.3%, and LN injury was very rare, approximately 0.05%. Failed coronectomies had higher IAN injury (up to 2.6%), but permanent paraesthesia remained uncommon (0.05%–1.3%) (5, 18, 19, 31–35).

Overall, coronectomy appears to reduce the immediate risk of nerve injury compared with complete surgical extraction, particularly for teeth in proximity to the inferior alveolar nerve (7, 33). Long-term monitoring is needed because retained roots can migrate or occasionally require secondary intervention (32, 34). Table 2 summarizes the key studies supporting important statements, detailing relevant research on orthodontic traction, surgical extraction, coronectomy, and associated nerve injury by highlighting patient age, root development, anatomical considerations, treatment duration, and complication rates. The comparative data indicate that surgical extraction of mandibular third molars carries a higher immediate risk of inferior alveolar and lingual nerve injury, whereas coronectomy appears to reduce this risk, particularly for teeth in close proximity to the nerve, although long-term monitoring is required due to potential root migration and delayed complications (Table 3).

Advances in imaging, such as high-resolution CBCT and three-dimensional modelling, may define selection criteria and improve the prediction of root movement relative to the mandibular canal. Development of standardized force protocols and anchorage systems would allow for a more meaningful comparison of outcomes. Prospective multi-centre trials with long-term evaluation are needed to specify the true benefit of orthodontic traction in preventing neurosensory injury.

Several gaps in the current research on nerve injuries on coronectomy versus surgical extraction can be identified. Also, comparative studies directly evaluating

cost-effectiveness and procedure time between coronectomy and full extraction are limited.

Future research could focus on large, multicentre, prospective trials with standardised definitions of nerve injury and uniform follow-up intervals. Longitudinal studies examining root migration and the need for secondary interventions would clarify long-term safety. Inclusion of patient-reported outcomes and economic analyses could provide a more comprehensive assessment of the clinical and social impact. Finally, studies exploring predictive imaging markers or risk stratification tools may help identify patients who would benefit most from coronectomy versus surgical extraction.

CONCLUSION

Orthodontic traction with coronectomy or without provides a conservative option for carefully chosen patients in whom surgical extraction carries an identified risk of nerve injury. While preliminary evidence suggests a lower incidence of temporary and permanent nerve injury, the method requires sustained collaboration, precise biomechanical control, and a willingness to accept longer treatment times. Until stronger data are available, the decision between orthodontic traction and surgical extraction should remain individualized, guided by detailed imaging, patient factors, and the clinician's experience.

Long-term follow-up in coronectomized teeth regarding retained root migration, late complications, and secondary interventions is limited. Additionally, patient-reported outcomes, such as sensory recovery, functional impact, and quality of life, are not consistently evaluated, making it difficult to fully assess the clinical implications of each technique.

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