Coronectomy: A Systematic Review

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Abstract

Background: Coronectomy is a technique wherein the root(s) of the impacted third molar is retained in order to avoid inferior alveolar injury. However, the potential pre, intra-operation risks, and post-operation complications have not been reviewed in one single paper previously. Purpose: The purpose of this review was to conduct a systemic review regarding preoperational precautions, possible interoperation risks, and post-operation complications. Methods: Previous studies were gathered, reviewed and classified under three main categories namely; pre-operations indications, intra-operation possible risks, and post-operation complications. Results: there have been some substantial publications that investigated the effectiveness of coronectomy as a treatment modality for impacted third molars given accurate preoperational indications. Conclusions: Coronectomy should become commonly practiced worldwide, with respect to the proper techniques of sectioning the crown, treatment outcomes, given patient awareness of post coronectomy complications and the availability of skillful oral surgeon who had mastered the technique of coronectomy.

Key Words: Coronectomy, Inferior alveolar nerve injury, Third molar, Tooth impaction

Introduction

Extraction of impacted third molar is one of the most commonly performed day care procedure either for therapeutic or preventive purposes. However, neurologic complications of the sensory and motor output of the tong, lips and some facial organs had become common complications following the surgical extraction of the impacted third molar. These complications involve paresthesia, hypoesthesia or dysesthesia of the lower lip, teeth, gingiva, and skin over the chin, which significantly influence the quality of life of the patient [1-7]. In addition, the risk of damaging the Inferior Alveolar Nerve (IAN) becomes more probable, if the third molar is completely impacted in the bone and/or the apices of the tooth extend into or below the level of the neurovascular.

In about 1984, coronectomy was introduced, in an attempt to reduce risks involved due to complete extraction of the impacted third molar [8,9]. Coronectomy involves cutting the crown of an impacted third molar, leaving the root, in an attempt to avoid neural damages. Following the brief introduction presented above, there is a need for comprehensive and detailed information relevant to outline prior operation relative risks and differential outcomes of coronectomy, compared with complete surgical removal of the third molar.

Review of the Related Literature

The review of the related literature was conducted through standard database: “Cochran Library” “PubMed,” “Google Scholar,” and “ScienceDirect.”. The results of the keywords, ”third molar impaction”, “coronectomy” and “odontectomy” generated substantial papers of which 63 were selected. All studies were assessed based design, sample size, having a control group, the presence of radiologic prognosis which allowed for the inclusion of subjects, the average follow-duration up to 3-6 months for post-operation complications studies. The total of the 63 studies included; 1 systematic review, 1 textbook, 6 randomized control, 4 cohort study, and 1 experimental animal study. The remaining 50 studies were non-randomized clinical studies. The findings of all studies that were classified either for prior operation’s precautions, intra-operation risks and post operations complications.

For the purpose of clarity this review of the related literature was organized under three sections headings; Section-I: prior surgery precautions which focus on the description of coronectomy, indications for third molar removal, clinical significance, prognostic and differential accuracy of imaging procedures. Section-II: intra operation risks which focus on surgical morbidity; limitations of coronectomy; and sections-III: post operation complications which concentrate on neuropathological alterations specific to the inferior alveolar nerve.

Preoperational Precaution

Description of coronectomy

Coronectomy is the incision of the crown of the third molar [10]. Most surgeons recommended that sectioning the crown at about 2 mm-3 mm from the occlusal surface without involving the pulp [11]. However, it was recommended to cut the crown at the cementoenamel junction and gridding the remaining enamel rather that cutting it completely at once, in order to ensure the protection of the occlusion surface. It is remarkable to note that enamel is inert and soft tissue, hence, cannot attach to its surface so the socket does not heal [12,13]. Generally, the remainder root fragment should be at least 3 mm inferior to the crest of bone so it stimulates bone formation over the retained root fragment [14-16]. Post-operation histological evaluation should be conducted immediately of the retained roots to ensure the absence of inflammation and successful healing of the mucosa.

Indications for coronectomy

The indications for coronectomy include intense angulation of the root at the canal of the impacted third molar, hypercementosis of the root or root apex. The associated signs on the radiograph include: (a) diversion of the inferior

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alveolar canal (b) darkening of the third molar root at the site of over-projection and (c) an interruption of the white line of the mandibular canal [17-23]. Special considerations for female patients as the incidence of nerve injury was reported to be greater in female patients, possibly because the bucco-lingual cortical bone is thinner, making the apical area of the mandibular third molar closer to the IAN (34).

Clinical significance of coronectomy

Coronectomy is an alternative procedure to complete extraction of the impacted third molar. Coronectomy minimizes the risk of inferior alveolar nerve injury via retention of the roots which is in close proximity to the alveolar canal. Without exception, all of those published studies indicated that coronectoy had merit and was recommended in order to minimize IAN injuries. The results of randomized controlled clinical trial studies emphasized that the incidence of inferior alveolar nerve injury was reduced in patients who underwent crononectomy, as compared with patients who underwent complete removal of mandibular third molars [3,24-27].

Most pathological conditions arising from the third molar are related to the crown and peri-follicular structures. Thus, the crown along with the follicular tissue should be removed to relieve from any further infections. Coronectomy or Prejudiced Odontectomy (American Dental Association-D7251) is a technique by means of which the crown is sectioned and the roots that are closer to the IAN canal on diagnostic radiographic imaging are left in situ [28]. Retention of root for coronectomy is based on the idea that broken fragments of vital teeth generally heal without complications [29,30]. This procedure attracted special attention in the last decade, because of the reported benefits and success rate of this technique, in contrast to the contemporary belief that the roots left behind will be the source of the problem [19,31-33].

Limitations of coronectomy

Some limitations associated with coronectomy might involve unexpected damage to occlusion surface, cracking the roots, root's migration and infection. In some patients with a horizontally impacted third molar, there is some difficulty in visualizing all aspects of the third molar during sectioning the crown and that represents a risk to IAN injury [34]. Philips et al. [35], claims that there is about 26% to 35% of retained roots change their position over time, migrate towards the occlusal plane [27]. In comparison with complete extraction, the results of randomized control studies revealed a reduction in the amount of bone exposed and stabilizing effect with primary closure for all coronectomy cases [36].

Prior operation (coronectomy) imaging

Accurate assessment of dental radiographic examination depends on the quality of the image, techniques, approach, and type of imaging. Various imaging techniques provide sufficient information that can be interpreted accurately to predict the risks of nerves damages. One preventive measure might be coronectomy with intentional root retention Imaging of the surgical site allows the surgeon to select the appropriate surgical approach, orientation of impaction and the site for sectioning [18]. Diagnostic dental imaging provides the surgeon with useful information regarding the type of impaction of the third molar, its relations to the second molar, the shape of its roots, the anatomical position of the roots and their relations to the neurovascular bundle. The investment of the neurovascular, within the bone, is an advantage that allows reasonable contrast in the radiograph [37]. Specific to the Inferior Alveolar Nerve Injury (IAN) The radiographic signs that are indicative of IAN risk include; diversion of the canal, darkening of the root, deflection of the root, narrowing of the canal, interruption of the canal lamina dura and juxta apical area. radiographic examination. Furthermore, post coronectomy radiograph can be conducted in order to rule out any unexpected infection. There a general agreement the Ortho-Pantomograph (OPG) has been the most appropriate and common radiographic technique [38]. OPG produces an overall view of all aspects of the anatomical structures, and the classlessness of the mandibular third molar roots to the inferior alveolar canal. OPG imaging has been considered as superior imaging that showed critical signs such as darkening of the roots, deflection of the roots, narrowing of the roots, dark and bifid roots, interruption of the white line (s), diversion of the inferior alveolar canal and narrowing of the inferior alveolar canal. However, an OPG is limited by its depth of view and superimposition of structures and subsequent distortion of the images. In contrast with OPG, the intraoral plain film radiographic was reported to enable the surgeon to view the relative relationship of two or more structures by superimposing them in the same line of view.

Helical Beam Computed Tomography (HBCT) was reported to be more accurate. HBCT was described as one of the most valid and reliable imaging to prognoses the type of variability of the IAN impacted tooth. Khan et al., found 30% to 50% correlation between CT signs with the panoramic signs [37]. On the other hand however, HBCT scans more area and requires more radiation dosage. Moreover, the high radiation dosage and multiple scans of the helical beam scanner may result in undesirable scatter effects from the metallic restoration of teeth, resulting in poor diagnostic outcome with some studies.

Intra-Operation Risks: Risks involved During Coronectomy Operation

From an anatomical standpoint, there is considerable variability in the anatomic position of the Inferior Alveolar (IAN) and Lingual Nerves (LN) among people. The large variability of anatomical position among individuals may compromise the accuracy and the performance of the surgeon. Furthermore, epidemic studies revealed that in a certain population, there is an additional anatomical branch of the mandibular canal which makes the variable relationship more complicated. Such variations of the anatomy and the associated complexity present challenges to the surgeons during operation leading to undesirable injuries such as crush injury and stretch injury of the inferior alveolar nerve [39]. Also, a wide range, between 0.1% to 22%, of the risk of damage to the lingual nerve had been reported [40]. Damage to the branches of the trigeminal nerve may arise because of their proximity to the mandibular third molar and consequent physical damage during surgery. Temporary sensory

disturbance may last for 6 months and becomes permanent damage if it lasts more than 6 months [30].

Post Operation Complications of Coronectomy

Migration of the roots

Although the majority of studies demonstrated a strongly protective benefit for those patients who underwent coronectomy, compared with those who underwent surgical extraction of the third molar. However, there are some concerns regarding the long-term postoperative complications such as root migration and root eruption. For example, Leung et al. [41] noted root migration after 24 months following cronoectomy. He also noted that the peak of roots migration occurred within the first 3 months, hence were stabilized at 36 months. These results were somewhat in agreement with Pillips findings who reported that the remnants of roots movement occurred during the first 6 months [35].

Regarding the fate of retained roots, Dolanmaz reported that none of the 43 patients who underwent coronectomy required a removal of the retained roots [12]. In addition, Online with Dolanmaz findings, Pogrel reported that only 1 patient out of the 41 patients required immediate root removal. In a more recent study, it was found that 68% of roots had migration had been stabilized after 36 months and do not require a second procedure [42]. A higher rate of root removal was reported by Knutsson who indicated that 6% root removal rate following coronectomy [43]. Later Pogrel reported that the removal rate of retained roots was 2% following coronectomy without any related morbidity [19]. It seems the controversy regarding the fate of the third molar roots could be attributed to variability of the follow up to evaluate root mobilization among studies, the technique that was used for cutting, the site of cutting and the skill level of the surgeon.

It is remarkable to note that there are age and gender differences in this regard. For example, Renton indicated found that increased migration in women and younger subjects, as compared with men and older patients, under the age of 30 years [25,42].

It is very important to note that roots migration could occur during a cutting phase of coronectomy have the potential to cause injury to the inferior alveolar nerve (IAN). These observations were emphasized by the findings of Leung [8] who reported 3%-9% of patients who were having gone through coronectomy failed to complete the procedure mainly due to mobilizing the root, hence was necessary to remove the roots which resulted in temporary IAN injury. Despite the observed wide range in Leung's study, a wider range of varying incidence of intra-operation mobilization (5%-81%) was reported by Pogrel [33].

Permanent neuropathy

Permanent IAN neuropathy was reported, as a result of improper drilling but it could be also due to nerve infections leading to permanent neuropathy of the Inferior Alveolar Nerve Injury (IANI). The incidence was range from 1% to 5% of persistent neuropathy was reported [44,45]. Permanent IAN neuropathy was attributed to the inadequacy of drilling, the permanent neuropathy associated with the retained roots may be associated with the development of persistent periapical infection after coronectomy. Lingual nerve neuropathy. A 2% transient rate was noted in one study mainly due to lingual retraction during a cutting phase. This is probably a result of the technique whereby the crown is completely sectioned from the root rather than partial section.

Conclusion

Coronectomy is an adequate preventative technique in protecting the inferior alveolar nerve in patients with third molar impaction. The patient should be warned of risks of temporary and permanent and temporary inferior alveolar nerve, lingual nerve injuries, and the potential complication, if any, of the retained root migration. As well as the potential risk of root mobilization.

Conflicts of Interests

Authors have no conflict of interests.

References

1. Blackburn CW, Bramley PA. Lingual nerve damage associated with the removal of lower third molars. *British Dental Journal*. 1989; **167**: 103-107.

2. Carmichael FA, McGowan DA. Incidence of nerve damage following third molar removal: a west of Scotland oral surgery research group study. *British Journal of Oral and Maxillofacial Surgery*. 1992; **30**: 78-82.

3. Hill CM, Mostafa P, Thomas DW, Newcombe RG, Walker RV. Nerve morbidity following wisdom tooth removal under local and general anaesthesia. *British Journal of Oral and Maxillofacial Surgery*. 2001; **39**: 419-422.

4. Pogrel MA. The results of microneurosurgery of the inferior alveolar and lingual nerve. *Journal of Oral and Maxillofacial Surgery*. 2002; **60**: 485-489.

5. Pogrel MA, Thamby S. The etiology of altered sensation in the inferior alveolar, lingual, and mental nerves as a result of dental treatment. *Journal of the California Dental Association*. 1999; **27**: 534-538.

6. Fieldman JW. The prophylactic extraction of third molars: a public health hazard. *American Public Health Association*. 2007; **97**: 1554-1559.

7. Kouwenberg AJ, Stroy LP, Rijt ED, Mensink G, Gooris PJ. Coronectomy of the mandibular third molar: Respect for the inferior alveolar nerve. *Journal of Cranio-Maxillofacial Surgery*. 2016; **44**: 616-621.

8. Leung YY, Cheung LK. Coronectomy of the lower third molar is safe within the first 3 years. *Journal of Oral and Maxillofacial Surgery*. 2012; **70**: 1515-1522.

9. Martin A, Perinetti G, Costantinides F, Maglione M. Coronectomy as surgical approach to impacted mandibular third molars: a systematic review. *Head and Face Medicine*. 2015; **11**: 9.

10. Fareed K, Khayat R, Salins P. Vital root retention: A clinical procedure. *Journal of Prosthetic Dentistry*. 1989; **62**: 430-434.

11. Landi L, Manicone PF, Piccinelli S, Raia A, Raia R. A novel surgical approach to impacted mandibular third molars to reduce the risk of paresthesia. *Journal of Oral and Maxillofacial Surgery*. 2010; **68**: 969-974.

12. Dolanmaz D, Yildirim G, Isik K, Kucuk K, Ozturk A. A preferable technique for protecting the inferior alveolar nerve: coronectomy. *Journal of Oral and Maxillofacial Surgery*. 2009; **67**: 1234-1238.

13. Cilasun U, Yildirim T, Guzeldemir E, Pektas ZO. Coronectomy in patients with high risk of inferior alveolar nerve

injury diagnosed by computed tomography. *Journal of Oral and Maxillofacial Surgery*. 2011; **69**: 1557-1561.

14. Lydiatt DD. Litigation and the lingual nerve. *Journal of Oral and Maxillofacial Surgery*. 2003; **61**: 197-200.

15. Sencimen M, Ortakoglu K, Aydin C, Aydintug YS, Ozyigit A, et al. Is endodontic treatment necessary during coronectomy procedure? *Journal of Oral and Maxillofacial Surgery*. 2010; **68**: 2385-2390.

16. Gleeson CF, Patel V, Kwok J, Sproat C. Coronectomy Practice. Paper 1. Technique and trouble-shooting. *British Journal of Oral and Maxillofacial Surgery*. 2012; **50**: 739-744.

17. Johnson DL, Kelly JF, Flinton RJ, Cornell MT. Histological evaluation of vital root retention. *The Journal of Oral Surgery*. 1974; **32**: 829-833.

18. Rood JP, Shehab BA. The radiological prediction of inferior alveolar nerve injury during third molar surgery. *British Journal of Oral and Maxillofacial Surgery*. 1990; **28**: 20-25.

19. Pogrel MA, Lee JS, Muff DF. Coronectomy. A technique to protect the inferior alveolar nerve. *Journal of Oral and Maxillofacial Surgery*. 2004; **62**: 1447-1452.

20. Alessandri Bonetti G, Bendandi M, Laino L, Checchi V, Checchi L. Orthodontic extraction: Riskless extraction of impacted lower third molars close to the mandibular canal. *Journal of Oral and Maxillofacial Surgery*. 2007; **65**: 2580- 2586.

21. Tay AB, Zuniga JR. Clinical characteristics of trigeminal nerve injury referrals to a university centre. *International Journal of Oral and Maxillofacial Surgery*. 2007; **36**: 922-927.

22. Monaco G, de Santis G, Gatto MRA, Corinaldesi G, Marchetti C. Coronectomy: a surgical option for impacted third molars in close proximity to the inferior alveolar nerve. *The Journal of the American Dental Association*. 2012; **143**: 363-369.

23. Monaco G, De Santis G, Pulpito G, Rosaria M, Gatto A, et al. What are the types and frequencies of complications associated with mandibular third molar coronectomy? A follow-up study. *Journal of Oral and Maxillofacial Surgery*. 2015; **73**: 1246-1253.

24. Queral-Godoy E, Valmaseda-Castellón E, Berini-Aytés L, Gay-Escoda C. Incidence and evolution of inferior alveolar nerve lesions following lower third molar extraction. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2005; **99**: 259-264.

25. Renton T, Hankins M, Sproate C, McGurk M. A randomised controlled clinical trial to compare the incidence of injury to the inferior alveolar nerve as a result of coronectomy and removal of mandibular third molars. *British Journal of Oral and Maxillofacial Surgery*. 2005; **43**: 7-12.

26. Ahmed C, Wafae el W, Bouchra T. Coronectomy of third molar: a reduced risk technique for inferior alveolar nerve damage. *Dental update*. 2011; **38**: 267-276.

27. Agbaje JO, Heijsters G, Salem AS, Van Slycke S, Schepers S, et al. Coronectomy of deeply impacted lower third molar: incidence of outcomes and complications after one year follow-up. *Journal of Oral and Maxillofacial Research*. 2015; **6**: 1.

28. Umar G, Obisesan O, Bryant C, Rood JP. Elimination of permanent injuries to the inferior alveolar nerve following surgical intervention of the "high risk" third molar. *British Journal of Oral and Maxillofacial Surgery*. 2013; **51**: 353- 357.

29. Rud J. Third molar surgery perforation of the inferior dental nerve through the root and lingual bone. *Tandlaegebladet*. 1983; **87**: 585-588.

30. Mason DA. Lingual nerve damage following lower third molar surgery. *International Journal of Oral and Maxillofacial Surgery*. 1988; **17**: 290-294.

31. Pichler W, Beirne OR. Lingual flap retraction and prevention of lingual nerve damage associated with third molar surgery: A systematic review of the literature. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2001; **91**: 395-401.

32. O'Riordan BC. Coronectomy (intentional partial odontectomy of lower third molars). *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2004; **98**: 274-280.

33. Pogrel MA. An update on coronectomy. *Journal of Oral and Maxillofacial Surgery*. 2009; **67**: 1782-1783.

34. Vignudelli E, Monaco G, Gatto MRA, Franco S, Marchetti C, et al. Periodontal healing distally to second mandibular molar after third molar coronectomy. *Journal of Oral and Maxillofacial Surgery*. 2016; **75**: 21-27.

35. Phillips C, Norman J, Jaskolka M, Blakey GH, Haug RH, et al. Changes over time in position and periodontal probing status of retained third molars. *Journal of Oral and Maxillofacial Surgery*. 2007; **65**: 2011-2017.

36. Mukherjee S, Bhaskarapandiyan V, Duraiswamy S, Veerabahu MS. Evaluation of outcome following coronectomy for the management of mandibular third molars in close proximity to inferior alveolar nerve. *Journal of Clinical and Diagnostic Research*. 2016; **10**: ZC57-ZC62.

37. Khan I, Halli R, Gadre P, Gadre KS. Correlation of panoramic radiographs and spiral CT scan in the preoperative assessment of intimacy of the inferior alveolar canal to impacted mandibular third molars. *Journal of Craniofacial Surgery*. 2011; 22: 566-570.

38. Dhillon M, Srinivasa MR, Verma S, Tomar D, Raviprakash SM, et al. Positioning errors and quality assessment in panoramic radiography. *Imaging Science in Dentistry*. 2012; **42**: 207-212.

39. Greenstein G, Cavallaro J, Tarnow D. Practical application of anatomy the dental implant surgeon. *Journal of Periodontology*. 2008.

40. Gerardo La M, Iole V, Rita G, Susanna A, Nicola P, et al. Prevention of neurological injuries during mandibular third molar surgery: technical notes. *Annals of Stomatol (Romania)*. 2017; **8**: 45-52.

41. Leung YY, Cheung LK. Safety of coronectomy versus excision of wisdom teeth: a randomized controlled trial. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2009; **108**: 821-827.

42. Kohara K, Kurita K, Kuroiwa Y, Goto S, Umemura E. Usefulness of mandibular third molar coronectomy assessed through clinical evaluation over three years of follow-up. *International Journal of Oral and Maxillofacial Surgery*. 2015; **44**: 259-266.

43. Knutsson K, Lysell L, Rohlin M. Post-operative status after partial removal of the mandibular third molar. *Swedish Dental Journal*. 1989; **13**: 15-22.

44. Renton T, Yilmaz Z. Managing iatrogenic trigeminal nerve injury: a case series and review of the literature. *International Journal of Oral and Maxillofacial Surgery*. 2012; **41**: 629-637.

45. Leung YY, Cheung LK. Long-term morbidities of coronectomy on lower third molar. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology*. 2016; **121**: 5-11.