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Coronectomy; Good or Bad?

Abstract: The removal of mandibular third molars can be complicated by injury to the inferior alveolar nerve (IAN). Coronectomy retains the tooth root; this method has been found to be preferable to extraction in the context of mandibular third molars. A failed coronectomy may cause mobilization of these roots, thereby requiring a subsequent extraction. Having undergone a previous coronectomy, extraction is then safer as the roots usually migrate away from the IAN. Computed tomography is more accurate than radiography when imaging mandibular third molars pre-operatively owing to its three-dimensional nature. Longer studies need to be conducted to evaluate the long term benefits of coronectomy.

CPD/Clinical Relevance: The removal of mandibular third molars can be complicated by the presence of the close lying inferior alveolar nerve. Coronectomy can be useful in this setting and therefore it is important to be aware of the pros and cons of this technique.

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The removal of mandibular third molars is a common procedure. According to the NICE guidelines, these are removed as a result of pathological changes or for prophylactic purposes for pathology-free impacted third molars.^{1,2} This is a relatively routine procedure, however, complications can occur due to the close proximity of the roots of these teeth to the inferior alveolar nerve (IAN), which can be damaged as a result of removal, with an incidence of up to 8%.¹

One method of management is coronectomy, which is the deliberate retention of the tooth root, therefore preventing potential damage to the IAN.³ Radiographic features can be used to assess the potential risk of injury, including:

- Darkening of the root;
- Diversion of the canal; and
- Interruption of the lamina dura.^{1,4}

This paper reviews clinical studies with regards to aspects such as the development of imaging techniques,

proximity to IAN, success rate and possible long-term complications, to evaluate the overall effectiveness of this procedure.

Methods

Metalib was used to access the articles and studies used in this paper. Searching through Swetswise and ScienceDirect produced highly relevant papers. Keywords used include: mandibular third molars, coronectomy and IAN injury. Information from sources such as the NICE guidelines is also included.

Reasons for mandibular third molar removal

Mandibular third molars, or wisdom teeth, are usually the last to erupt. Permanent molar teeth begin erupting from the age of six onwards.² If these teeth do not erupt into the correct alignment it can cause obstruction. Impaction may also occur, which can result in partial or no eruption of these teeth owing to the lack of space.² Impaction causes many problems, such as pericoronitis, an increased risk of caries, as well as possible abscesses.⁵ Other

potential problems include tumours, cysts and periodontal disease in adjacent teeth.^{2,5}

Coronectomy

Coronectomy was first described by Knutsson *et al* in 1989, as the action performed on the tooth and also the elimination of the prime cause of infection.⁶ It can be referred to as an intentional partial odontectomy; the removal of the crown but deliberate retention of the root.^{3,6} The roots of these molars are often in close proximity to the IAN and this method can prevent potential neuropathy.^{1,6} For this reason, it is considered a safe alternative for the removal of mandibular third molars.⁷

One disadvantage of this procedure is that, in a small number of cases (5%), it can cause mobilization of the mandibular third molars, which is classified as a failed coronectomy. This is especially found in conical roots, where it is possible to mobilize the root when transecting it. This means that the root is potentially vital and should be removed. In contradiction, an advantage is that the retained root will normally migrate away from the inferior alveolar canal, so facilitating safe secondary removal of any remaining roots without injury to the nerve.^{6,7,8} Coronectomy can also result in follicle remnants forming deep periodontal

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pockets leading to infection, incidence up to 5%, which is a weakness of the procedure.⁶

Removing the entire tooth, via an extraction, carries an increased risk of injuring the IAN and a coronectomy prevents potential neuropathy.^{3,9}

Clinical evidence

Studies often compare coronectomy to the traditional method of tooth extraction. The results of these studies can be used to evaluate the efficiency of each procedure and to determine long-term effectiveness.^{1,3,6,10,11}

Some of these studies are outlined below:

Coronectomy of the lower third molar is safe within the first 3 years¹²

This prospective cohort study reviewed patients who had previously undergone coronectomy as part of a randomized control trial conducted by the authors. These patients were reviewed post-operatively at regular intervals for 36 months for infection, pain, root eruption, re-operation for root removal, as well as any other pathology they have developed during this period.¹²

There were 155 successful coronectomies performed in 108 patients: 98 patients completed the follow-up (135 coronectomies). Six patients developed infection within the first week, which was treated with antibiotics and debridement. Post-operative pain was reported in week 1 in 58 patients (43%). The only subsequent pain was reported by four patients who had exposed roots and hence were sensitive to cold foods and water.¹²

Four patients presented with root eruption of lower third molars and underwent re-operation to remove the retained root. There was no IAN injury or other morbidity reported post re-operation. The mean age of these patients was found to be significantly older than the mean age of patients without root eruption (39.5 years [SD, 5.8 years] vs 27.2 years [SD, 7.7 years], $P = 0.002$).¹²

Root migration occurred within the first 12 months post-coronectomy. This stopped in 75.2% of the cases between 12 and 24 months. The non-erupting roots did not migrate after 24 months. No pathology developed in the retained roots during the entire follow-up period.¹²

The results show a significant decrease in IAN injury for high risk cases by carrying out coronectomy. This technique is found to be safe in the long-term for up to three years post-operatively, as demonstrated by the findings.¹²

Although the findings of this study are reassuring, highlighting the safe nature of coronectomy for the post-operative three years, a longer study is needed to evaluate the long-term benefits of this procedure.

Coronectomy in patients with high risk of inferior alveolar nerve injury diagnosed by computed tomography¹³

This prospective case-control study evaluated 175 teeth of 120 patients via CT. Patients were evaluated by CT and the presence or absence of cortical bone between the root and inferior alveolar canal were used to allocate patients to the extraction ($n = 87$) and coronectomy ($n = 88$) groups, respectively.¹³

The overall success rates were 95.4% in the extraction group and 95.5% in the coronectomy group. Patients were followed up for approximately 17 months.¹³

During this period, two patients who underwent extraction had moderate IAN injuries that resolved within one month. There was one case of dry socket found in the extraction group and one patient in the coronectomy group had minor infection for one month post-operatively, which was treated with antibiotics and subgingival irrigations. There were two cases of failed coronectomies.¹³

This study illustrates coronectomy as a preferable alternative to extraction, with a low incidence of complications. This is recommended as a suggested technique for the removal of impacted mandibular molars when there is a high risk of IAN injury.¹³

The study concluded that more randomized controlled trials with longer follow-up are required to illustrate the long-term consequences of coronectomy, however, the findings to date are very positive towards this technique.¹³

A randomized controlled clinical trial to compare the incidence of injury to the inferior alveolar nerve as a result of coronectomy and removal of mandibular third molars¹

In this study, 128 patients, with radiological evidence showing proximity to

the IAN, were randomized to receive either an extraction or a coronectomy for the removal of mandibular third molars. Two sub-groups also formed as some coronectomy procedures failed, due to the roots becoming dislodged after the operation.¹

Patients were followed up with a median follow-up time of 25 months. IAN damage was found in 19 patients (19%), who received removal through an extraction, and in three patients (8%) who underwent a coronectomy procedure that was unsuccessful. This is most likely due to mobilization of the roots after the coronectomy. Although mobilization usually occurs away from the IAN, if the root is perforated directly by the nerve, this makes IAN neuropathy highly likely.¹

As expected, no IAN damage occurred after a successful coronectomy, as there was no interference with the root. Also, there was no lingual nerve damage and the incidence of dry socket was equal in all groups. However, one patient of the extraction group and three patients from the coronectomy group developed soft tissue infections. The higher incidence of these soft tissue infections with those undergoing a coronectomy is likely to be due to the retention of the remaining root.¹

The study found that IAN damage is likely when mandibular third molars are removed with a traditional extraction. Although the study reported similar incidence of 'dry socket' in all groups, this may not be truly representative, as a number of people taking part in this study had deep-impacted teeth with pericoronitis. It was found that, for failed coronectomies, unless the root is perforated by the IAN, this procedure facilitates safe secondary removal of the root, which is likely to erupt away from the IAN.¹

This study followed-up patients for 25 months, which is sufficient time to evaluate for IAN damage, early eruption and dry socket, but not for late eruption, therefore it is suggested that a longer study period is required to evaluate this.¹

Coronectomy: a technique to protect the inferior alveolar nerve³

This study investigated whether coronectomy reduces the chance of IAN damage during mandibular third molar removal.³ The study identified a number of rules to determine the method of removal

of mandibular third molars, such as teeth with active infection around them, especially involving the root, which should be excluded from this technique.³

There were no cases of IAN injury over the duration of this study. Out of the coronectomy procedures carried out, three patients (6%) required an extraction and 15 patients (30%) showed evidence of root migration over the study period. In all cases, roots migrated away from the IAN. The mean follow-up was 22 months and, as previously mentioned, it has been suggested that a longer follow-up time may have shown more roots requiring extraction. Further complications can be caused by root migration and, again, a longer study is required to rule out long-term adverse effects.³

Impacted wisdom teeth¹⁰

This review examined a number of sources, such as randomized control trials and observational studies, to answer the question 'What are the effects of different surgical methods of removing impacted wisdom teeth?'. However, it was concluded that further research is required, with a more extensive follow-up period, to evaluate all benefits. In conclusion, this study was unable to identify which removal method was most effective.¹⁰

Coronectomy (intentional partial odontectomy of lower third molars)⁶

This was a retrospective study of patients managed with a coronectomy over a ten-year period to evaluate the rate of infection post-operatively.⁶

Post-operatively patients were sent a questionnaire: out of 95 patients, 52 replied. Only three of these 52 patients had to have roots removed due to infection.⁶

This study had no controls owing to the explorative nature of the study and therefore is limited. However, the study reported a lower incidence of complications of infection post-coronectomy in patients where radiographic signs had indicated a high risk of IAN injury.⁶

Clinical evaluations of coronectomy (intentional partial odontectomy) for mandibular third molars using dental computed tomography: a case-control study⁷

This case-control study evaluates the role of coronectomy in patients with

signs of IAN injury on CT. Two groups were compared; traditional tooth extraction vs coronectomy.⁷

The incidence of IAN injury was 5% in the extraction group (n = 118), whereas no IAN injuries were reported in the coronectomy group (n = 102), despite four patients undergoing root removal due to infection post coronectomy.⁷

The study concluded coronectomy as potentially reducing the risk of IAN injury rather than the traditional extraction.⁷

Coronectomy practice. Paper 2: complications and long term management¹⁴

This paper considers the complications of coronectomy. Conclusions are drawn from a review of recently published data, coupled with clinical experience. The paper found that coronectomy does not increase complications, moreover, complications are similar to those found with traditional techniques and therefore should be dealt with using familiar techniques.¹⁴

This paper recommends considering coronectomy in patients with a high risk of IAN damage, as seen on imaging. This should be offered to these patients rather than traditional techniques.¹⁴

Discussion

Coronectomy is the deliberate retention of the tooth root, which has a close anatomical relation to the IAN; therefore the chances of injuring the IAN may be reduced with the technique of coronectomy. This proximity is commonly visualized by using radiographical imaging, which provides a two-dimensional view of the area. There are currently a set of indications to consider when interpreting radiographs, in order to decide the most suitable method of removal.¹⁵

A new situation now exists and there are three ways to manage the removal of wisdom teeth. The traditional method is the standard removal after an OPG examination. Now with 'at risk teeth' it is possible to augment the information with a CBCT before proceeding to removal. Additionally, one has the option in 'at risk teeth' (as judged on OPG) to proceed to coronectomy.

Coronectomy has many advantages over its predecessor, extraction. With regards to IAN damage, coronectomy may be considered a safer option, as reported by many of the studies discussed. It has a

lower reported incidence of infection post-operatively compared to traditional methods. Additionally, if coronectomy is unsuccessful, then an extraction is required to remove the remaining root, which is a disadvantage of the method. However, unless the IAN perforates the tooth root, a coronectomy actually facilitates a safe secondary removal of the remaining root.

The current criteria used to decide the fate of mandibular third molars is applicable when imaging via panoramic radiographs.¹⁵ These set criteria are used to evaluate whether a coronectomy or an extraction is more suitable for the patient, by examining features such as darkening of the root, interruption of the radio-opaque lines of the inferior dental nerve canal and diversion of the canal, thereby enabling surgeons to decide on the best method for removal.¹⁵ More recently, the use of computed tomography for imaging prior to removal has proven to be very beneficial.^{16,17,18} Radiographs offer a two-dimensional view but, as the IAN can lie in either a vestibular or lingual position in relation to the apices, using the markers highlighted may not be as valid as previously anticipated.¹⁸ Computed tomography offers a three-dimensional view, making this form of imaging more suitable, however, the matter of cost and radiation must be considered prior to usage of the technique.

The studies featured highlight the benefits as well as a few complications of coronectomy. Overall, the studies encourage coronectomies in patients where there is a high risk of damage to the IAN, especially as a useful alternative for the removal of mandibular third molars. One common conclusion found in all studies was that the long-term complications of this procedure are unknown due to the follow-up time being insufficient. Therefore, a longer period of study is required, with a follow-up of around 10 years, to be able to evaluate the long-term benefits of coronectomy thoroughly.

Conclusion

Damage to IAN is a prime concern when removing mandibular third molars and coronectomy is an efficient and possibly more beneficial substitute in many cases. As with any procedure, there are many advantages and disadvantages that need to be considered to evaluate the effectiveness

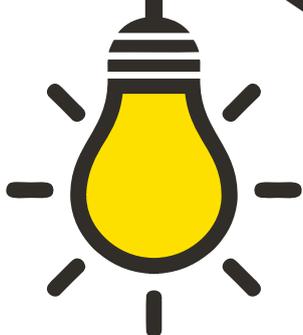
of the procedure. Specific radiographic signs have been identified to enable appropriate procedure allocation; however, CT is considered a more comprehensive imaging technique owing to its three-dimensional nature allowing better decisions to be made with regards to the removal technique. An important point to emphasize is that the longest time frame of patient follow-up in the studies featured was 42 months. This is sufficient to assess for IAN neuropathy, infection, early eruption and dry socket, however, late eruption can occur for up to ten years after coronectomy. Therefore, it is suggested that further studies need to be conducted to evaluate the long-term benefits of this procedure.

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