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# Is juxta-apical radiolucency a reliable risk factor for injury to the inferior alveolar nerve during removal of lower third molars?

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**Abstract**

The aim of this study was to find out if juxta-apical radiolucency (JAR) is a reliable risk factor for injury to the inferior alveolar nerve (IAN) during removal of lower third molars. We designed a cohort study of patients whose dental panoramic tomograms (DPT) had shown JAR before complete removal of lower wisdom teeth. The outcome variable was postoperative permanent neurosensory disturbance of the IAN. A total of 39 patients (50 lower third molars) were identified and screened for permanent neurosensory disturbance. None reported any permanently altered sensation 18 months after the operation. Based on our group, the presence of JAR does not seem to be a reliable predictor of the risk of permanent injury to the IAN during removal of lower third molars.


*Keywords:* Lower third molar surgery; juxta-apical radiolucency; inferior alveolar nerve injury; high risk radiographic signs; wisdom teeth; risk factors

## Introduction

Injury to the inferior alveolar nerve (IAN) is a rare, undesirable complication of operations to remove lower third molars. It generally manifests as a neurosensory disturbance of the regions supplied by the third branch of the trigeminal nerve, and can have debilitating effects.[1] Several risk factors are associated with injury to the nerve during third molar surgery, the most important predictor of which may be the anatomical relation between the lower third molar and the inferior alveolar canal (IAC).[1,2]

Based on plain radiography only, overlapping of the canal by the molar roots produces distinctive images. Seven radiographic signs are indicative of this relation and an increased incidence of injury to the nerve when lower third molars are removed, and three of them (darkening of the roots, diversion of the canal, and interruption of the white line of the canal) were thought to be the most predictive signs of neurosensory deficit.[3–6] However, in 2005 a new one, "juxta-apical area" (JAA) or "juxta-apical radiolucency" (JAR), was introduced.[7] On plain radiography this is a well-defined area of radiolucency that is apical or lateral to the roots of the lower third molar, which often overlap the canal and interrupt its white line (Fig. 1).

The purpose of this study therefore was to find out whether or not JAR should be considered a risk factor for injury to the IAN when lower third molars are removed.

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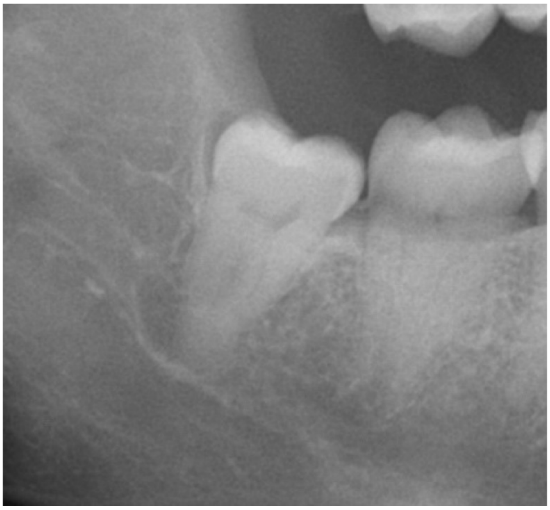

Fig. 1. Plain radiograph showing a juxta-apical radiolucency associated with a lower third molar.

## Material and methods

The study was approved by Queen Victoria Hospital audit and research department (identification number 1771).

### *Study design*

We searched the hospital's database to find all patients who had had lower third molars removed between February 2015 and February 2016. From this population, we selected all those with dental panoramic tomograms (DPT) that showed the presence of JAR.

### *Sample identification and selection*

Patients who were eligible had had full removal of at least one lower third molar, had agreed to be contacted by phone, and were 18 years of age or older at the time of operation. Patients were excluded if their lower third molars were associated with cysts or active carious lesions that extended into the dentine, pulp, or roots, as JAR should not be confused with apical disease that is related to inflamed, or necrotic, pulpal tissue. Those with lower third molars that showed other high-risk radiographic signs, or that overlapped the inferior canal, or were not fully formed with open apices, were also excluded, as were those who had had their teeth extracted during orthognathic surgery, during the repair of mandibular fractures, or whose teeth were involved within tumour sites.

### *Variables*

The primary outcome variable was permanent neurosensory disturbance that was reported at least 18 months after the operation. Table 1 shows the predictor variables. Surgeons were from different grades, which included dental core trainees, specialty doctors, associate specialists, clinical fellows, oral and maxillofacial surgery (OMFS) specialist registrars, and OMFS consultants. The operations were done as day cases under general anaesthesia in theatres where a surgical asepsis protocol was followed. In all cases, patients were reviewed before discharge, sutures were resorbable, and painkillers were prescribed routinely after operation.

Antibiotics were not prescribed postoperatively, and a second appointment was arranged only if requested by the patient. It is standard protocol that all patients are invited to contact the clinic in case of altered sensation in their chin, lip, gingiva, or tongue. A standard buccal approach was used in all cases, and the type of operation was classified as a simple extraction or mucoperiosteal flap only, mucoperiosteal flap and removal of buccal bone, or mucoperiosteal flap with removal of buccal bone and sectioning of the tooth.

Table 1
Details of the study group. Data are number unless otherwise stated.

| Variable | Study group |
|---|---|
| No. of patients | 39 |
| No. of mandibular third molars | 50 |
| Mean (range) age (years) | 30 (19-63) |
| Sex: | |
| Male | 5 |
| Female | 34 |
| Angulation of tooth (Winter's classification): | |
| Mesioangular | 9 |
| Distoangular | 6 |
| Horizontal | 5 |
| Vertical | 29 |
| Transverse/oblique | 1 |
| Conical roots | 20 |
| Type of operation: | |
| Simple extraction/mucoperiostal flap only | 20 |
| Buccal bone removed | 15 |
| Buccal bone removed and tooth sectioned | 15 |
| Temporary injury to IAN | 0 |
| Permanent injury to IAN | 0 |

IAN: inferior alveolar nerve.

### *Data analyses*

Three observers from different grades reviewed all the radiographs retrospectively, and cases were assigned to the study group only when there was a consensus. All patients were phoned at home at least 18 months after the operation and were asked two questions using non-technical language. The first was about altered sensation immediately after operation, and the second about permanent changes in sensation. Data were recorded in Microsoft Excel (2016).

## Results

A total of 734 patients were screened for eligibility. The final sample comprised 51, and of them, 12 were excluded, as they could not be contacted after the operation. The final sample therefore comprised 39 patients who had 50 lower third

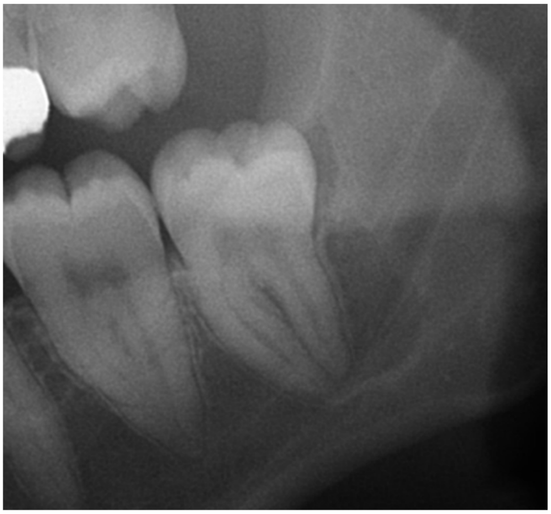

Fig. 2. The radiolucent area is located apically and distally.

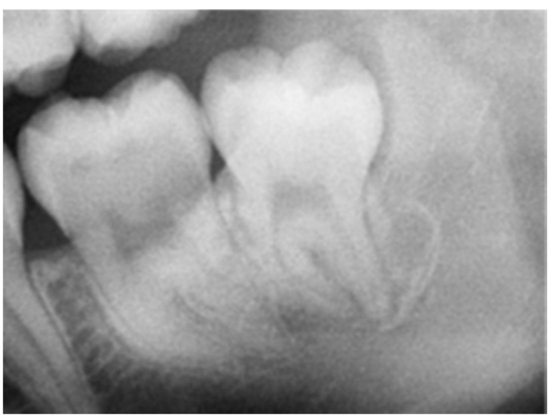

Fig. 3. Radiolucent area located distally.

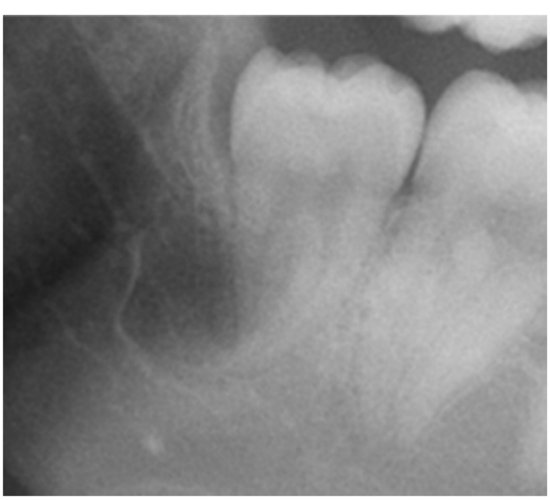

Fig. 4. Radiolucent area extending distally.

molars removed (Table 1). Eleven patients had bilateral JAR, and its prevalence overall was 6.9%. On DPT, JAR presented with several variations (Figs. 2–5). Four patients attended the trauma clinic for persistent pain within two weeks of operation, but none of them contacted our department with regards to residual altered sensation, and none reported permanent altered sensation 18 months after the operation.

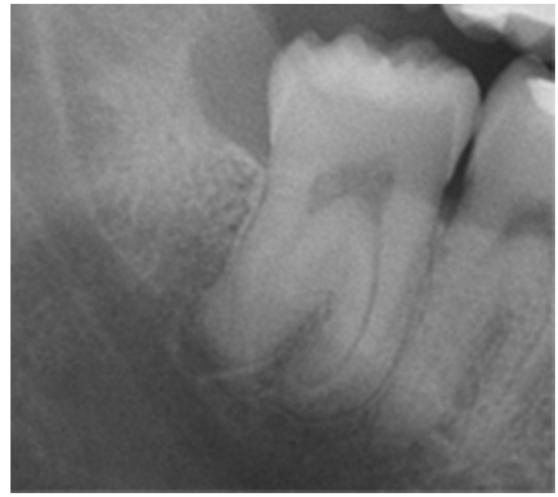

Fig. 5. Radiolucent area extending apically.

## Discussion

In a single randomised controlled trial,[7] Renton et al reported that JAR was significantly associated with injury to the IAN but, to our knowledge, the findings have not been validated or investigated since. None of our patients had permanent neurosensory disturbance.

We assessed patients only qualitatively and not quantitatively, as no sensory tests were done. However, the patient's subjective report is the best indicator of a sensory abnormality, as minor disturbances may not be detected on testing.[8] In our study recall bias might be an important factor in the recollection of temporary changes that occurred during the recovery period but not in relation to permanent changes. It remains debatable whether or not postoperative follow-up appointments are necessary, as telephone reviews in conjunction with clinical follow up where necessary, are more cost-effective.[9,10]

The results of our study suggest that JAR might not be a reliable risk factor for permanent injury to the IAN.

Rood and Shehab identified seven radiological signs that were indicative of a close relation between mandibular third molar roots and the IAC,[6] and only three were found to be significantly related to nerve injury. Other studies have since been published, and in their systematic review, Su et al stated that in the presence of one sign, patients have an 8% to 22% greater risk of temporary injury to the nerve.[5] Previous studies have confirmed that the simultaneous presence of two or more radiographic signs on DPT strongly suggest a true contact between the tooth and the mandibular canal with an increased risk of postoperative injury to the IAN.[3,4,11]

JAR was first reported in 2005 by Renton et al in their landmark randomised controlled trial (JAR and JAA have been used interchangeably to define the same entity)[7] that compared the incidence of injury to the IAN in patients who had complete removal of a mandibular third molar with those who had coronectomy. Two radiographic signs, JAA and deviation of the canal, were significantly associated with nerve injury ($p < 0.05$). This trial, although well conducted, had some limitations, as only a small number of patients were treated, the two groups were not treated equally, and there was no information concerning patients who had an injury to the IAN. Their results should therefore be treated with caution.

Hatano et al[12] designed a case-control study that assigned patients with high-risk radiographic signs to coronectomy or extraction groups. One patient whose imaging showed darkening of the root and JAR, had postoperative dysaesthesia that resolved in three weeks.

In 2014, Kapila et al[13,14] published two research papers on the relation between JAR, the canal, and third molars roots, on DPT and cone-beam computed tomography (CT). In the first, they assessed 42 cases of JAR. After cone-beam CT only 12 were confirmed to have JAR that was in contact with the IAC. In the second, published in the same year, they were able to locate JAR on cone-beam CT in 27 cases in which there was no superimposition between JAR and the IAC. JAR was commonly located buccally or superiorly to the canal, and the authors noticed that it was accompanied by a thinning of the cortical plates. They postulated that thinning could be responsible for postoperative paraesthesia after the extraction of third molars, and introduced the concept of disease associated with JAR.

Nascimento et al[15] studied 252 patients with 47 cases of JAR (a prevalence of 15.9%). Most (25/47) were distal to the roots of the third molar and were in contact with the IAC, thereby preserving its cortical integrity. In 19 patients this was not the case. These differences were not significant. The only significant result was the association of JAR with a lingually placed canal ($p < 0.05$).

In two more papers Nascimento et al[16,17] showed that cases of JAR were more often detected on cone-beam CT than on DPT. When the JAR was larger than 6 mm or associated with loss of cortication on the buccal side of the mandible, its prevalence ranged from 11% to 24% on DPT.

Radiological studies on JAR are inconsistent. It is clearly an area of increased separation of trabeculae in cancellous bone, and not an extension of the lamella of the IAN with the dental lamina dura, as previously postulated.[18] Umar et al[18] examined the main high-risk radiographic signs with cone-beam CT and showed that JAR is a large cancellous bony space which, on plain radiography, is superimposed on the IAC, but not always in contact with it. These findings explain why JAR should not per se be thought to increase the risk of injury to the nerve.

It is not clear if the presence of JAR is an independent risk factor or is related to the presence of lingual positioning of the canal or loss of cortical bone between the roots of the mandibular third molar and IAC, or both. Authors have shown that both the lingual position of the canal and lack of cortical preservation greatly increase the risk of nerve injury.[19] Whether or not JAR is a fragile area around the IAC, which exposes the IAN to damage when the tooth is removed, is unknown. Case-control studies that correlate cone-beam CT with surgical and postoperative data are needed to confirm this.[16] Recently it has been hypothesised that JAR is an initial area of focal bony dysplasia.[17] Our study supports the idea that JAR is not an independent risk factor for permanent injury to the IAN. We think that further investigations are needed to elucidate its origins and its role during the removal of third molars.

There are several recognised risk factors for nerve injury. Patients over 25 years of age have a higher risk possibly because of increased bone density, reduced elasticity and vascularisation, an increased rate of hypercementosis, and perhaps a reduction in neuronal plasticity. Other risk factors are sex (it is more common in women than in men), the experience of the operator, multirooted third molars, horizontally and distally impacted teeth, depth of impaction, radiographic proximity of the roots to the IAC, and whether the operation was done under general anaesthesia.[20–26] In our group, the main risk factors were the presence of JAR on DPT and the operators' experience.

Because of the low prevalence of JAR (6.9%) in our population and the low incidence of both temporary and permanent injury to the nerve (8.4% and 0.26%),[4] a large number of patients and controls would be needed to power the results. For this reason, we did not include a control group that should have been made up of patients with no radiographic signs.

To the best of our knowledge this is the first study of injury to the IAN in patients with JAR on preoperative DPT.

## Ethics statement/confirmation of patients' permission

Work approved by our audit and research department. Patients' permission was obtained.

## Conflict of interest

We have no conflicts of interest.

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