

Impact case study (REF3b)

<p>Institution: King's College London</p>
<p>Unit of Assessment: UoA3 - Dentistry</p>
<p>Title of case study: Prevention and Management of Trigeminal Nerve injuries. Changing surgical practice for patient benefit</p>
<p>1. Summary of the impact (indicative maximum 100 words) Researchers at King's College London (KCL) have established new surgical interventions, including coronectomy, to prevent nerve injuries resulting from wisdom teeth extraction, the most common surgery on the NHS and worldwide. These interventions have been adopted worldwide, for instance coronectomy is now a billable procedure in the US, and are also incorporated into a number of guidelines, for example those by the Royal College of Surgeons and the British Dental association. The KCL team have developed a website aimed at providing information for those with trigeminal nerve injuries, which they can gain both through online content and by directly emailing the specialist team.</p>
<p>2. Underpinning research Wisdom tooth (third molar) surgery (TMS) is one of the most common surgical procedures in the NHS but complications can include damage to the trigeminal nerve (TN), the largest sensory nerve in the body, responsible for supplying sensation to the face and mouth. Research undertaken at the Institute of Dentistry, King's College London (KCL) by Professor Tara Renton (1997-present, Professor of Oral Surgery 2006-2013) and Dr Zehra Yilmaz (2007-2010, Post-Doctoral Research Worker) has underpinned the prevention and improved management of TN injuries (TNIs) in relation to TMS and other dental procedures such as implant surgery.</p> <p>Understanding the Problem: In 2001, research at KCL involving 2134 third molar operations found the incidence of temporary and permanent damage to the lingual nerve, a component of the third division of the TN, was 1% and 0.3%, respectively, per tooth. While this percentage is small, there are 1.2 million operations of this type performed per year in the UK; hence lingual nerve injury (LNI) can affect many thousands of people. Risk factors associated with LNI included lingual plate perforation, nerve exposure, operation difficulty, surgeon and older age (1). Post-traumatic neuropathy (PTN) can be painful and can interfere with functions normally taken for granted including speaking, eating, shaving, kissing and drinking, leading to a significant negative effect on the patient's self-image and quality of life. To help understand how PTN manifests, a 2011 KCL study investigated 93 patients with LNI and 90 with injury to another TN component, the inferior alveolar nerve (IAN). Injuries were mostly caused by surgery, with others due to local anaesthesia administration or endodontics. Around 70% presented with neuropathic pain coincident with numbness, abnormal sensations such as pins and needles, heightened sensitivity and/or some loss of function, including speech, teeth brushing, drinking and sleep (2).</p> <p>Further KCL research sought to understand the reasons for injury. In a study involving 30 patients with neuropathy following an implant, consent, preoperative planning and appropriate post-operative referral were found to be inadequate. With regard to the cause of neuropathy, proximity of the implant bed or implant to the IAN canal was evident radiographically and showed roof IAN canal contact in 44% of cases, canal protrusion in 20% of cases and canal crossing in 20% cases (3). In a recent study, a questionnaire of 415 dentists and oral surgeons found an estimated incidence of 3,770 TNIs per year associated with local anaesthetic administration. This has moved previous estimates from 1/600,000 injections leading to a nerve injury to it being 1/14,000 (4).</p> <p>Studies Demonstrating Improved Outcomes: Much of the work of KCL researchers is within a specialist TNI clinic at King's College Hospital (KCH) that seeks ways to alleviate PTN. For instance, in a 2009 series of four case studies on early implant removal due to IAN injury, researchers found this procedure led to almost complete sensory recovery in two of the cases, suggesting immediate removal, though not successful for all, could be a way of minimising long-term damage. This paper also provided clinical suggestions for ways to minimise injury during surgery and best practice for alleviating pain and dysfunction if a TNI did occur (5). KCL researchers additionally challenged existing policy of waiting for all branches of the TNI related to any causation to get better. Their study involving 216 patients with LNIs and 123 with IAN injuries showed that best results came from a diverse and holistic strategy including reassurance and counselling, cognitive behaviour therapy, exploratory surgery, systemic or topical medication or a</p>

combination of approaches (6).

KCL researchers also worked to provide strategies to minimise and avoid nerve injury. Coronectomy is an alternative to extraction where only the crown of an impacted mandibular third molar is removed, leaving the root undisturbed, avoiding TN damage. KCL's pivotal 2005 randomised, control trial involved patients undergoing extraction (n = 102) or coronectomy (n = 94, but 36 had dislodged roots so underwent extraction). With a mean follow-up of 25 months, while 19% of extraction cases had damaged nerves, no nerve damage occurred in the successful coronectomy patients. This procedure is now standard practice at KCH for cases where a nerve injury is predicted to occur with regular third molar surgery (7).

3. References to the research

1. Renton T, McGurk M. Evaluation of factors influencing lingual nerve injury in third molar surgery. *Brit J Oral Maxillofac Surg* 2001;39:423-428. Doi: <http://dx.doi.org/10.1054/bjom.2001.0682> (32 Scopus citations)
2. Renton T, Yilmaz Z. Profiling of patients presenting with posttraumatic neuropathy of the trigeminal nerve. *J Orofac Pain* 2011;25(4):333-44. (9 Scopus citations)
3. Renton T, Dawood A, Shah A, Searson L, Yilmaz Z. Post-implant neuropathy of the trigeminal nerve. A case series. *Br Dent J* 2012;212(11):E17. Doi: 10.1038/sj.bdj.2012.497 (1 Google Scholar citation)
4. Renton T, Janjua H, Gallagher JE, Dalglish M, Yilmaz Z. UK dentists' experience of iatrogenic trigeminal nerve injuries in relation to routine dental procedures: why, when and how often? *Br Dent J* 2013;214(12):633-42. Doi: 10.1038/sj.bdj.2013.583 (1 Google Scholar citation)
5. Khawaja N, Renton T. Case studies on implant removal influencing the resolution of inferior alveolar nerve injury. *Br Dent J* 2009;206(7):365-70. Doi: 10.1038/sj.bdj.2009.258 (12 Scopus citations)
6. Renton T, Yilmaz Z. Managing iatrogenic trigeminal nerve injury: a case series and review of the literature. *Int J Oral Maxillofac Surg* 2012;41(5):629-37. Doi: 10.1016/j.ijom.2011.11.002 (9 Google Scholar citations)
7. 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. *Br J Oral Maxillofac Surg* 2005;43(1):7-12. Doi: <http://dx.doi.org/10.1016/j.bjoms.2004.09.002> (66 Scopus citations)

Grants (PI: T Renton)

- 2005. RCS project grant, £5500. Randomised trial of coronectomy in third molar surgery
- 2006. British Association Oral and Maxillofacial Surgeons, £9000. Evaluation of minimising Inferior alveolar nerve injury in relation to third molar surgery
- 2011. Royal College of Surgeons, £9500. Evaluation of minimising radiation dose of cone beam CT scanning in relation to minimising inferior alveolar nerve injury

4. Details of the impact

This body of research undertaken by King's College London (KCL) has fundamentally changed how patients at 'high risk' of trigeminal nerve injury (TNI) in relation to dental procedures are identified and has also provided alternative surgical and assessment techniques to assist in preventing TNI in relation to the most common surgical procedures undertaken in the NHS: third molar surgery (TMS).

Helping Patients

KCL research led to the setting up by Prof Renton and Dr Yilmaz of a specialist TNI clinic at King's College Hospital Foundation Trust. This has become a nationally recognised service with around 150 UK patients a year being referred for assessment and treatment they could not receive elsewhere. As well as treating patients on an individual basis, the clinic also provides patient workshops to help alleviate the pain and social trauma associated with TNIs (1a). With a donation of £50K from a patient with TNI who was keen to address an unmet need for information for other such patients, Prof Renton's team developed a website – trigeminalnerve.org.uk – using the knowledge they had gained through research to provide accurate and timely information for both clinicians and patients regarding the aetiology (1b) and management (1c) of TNI. From its launch in August 2012 to July 2013 it received nearly 230,000 site visits and 156 clinicians signed up for onsite Continuing Professional Development. With the ability for patients and clinicians to directly

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email the KCL team for advice, in its first year the expert KCL team behind this site has expedited urgent care and facilitated prevention of a TNI for over 1200 national and international enquiries.

Use of Coronectomy

TNI is the most problematic consequence of dental surgical procedures and those related to TMS are a common cause for NHS Litigation Authority or trust settlement compensation. If the injury is caused by NHS trust staff then compensation is usually between 5-20K; if caused by private practitioners, pay-outs have reached nearly £1m. Thus, minimising TNI is paramount both for patient care and medico-legal reasons. Development of the coronectomy technique by KCL oral surgeons has underpinned recognition of the benefits of re-evaluating standard surgical protocols for TMS. Coronectomy is now an accepted procedure in the NHS (for example, by Oxford Radcliffe Hospital NHS Trust) (2a) and in private healthcare (for example, by Love Your Smile Dental Care Practice) (2b) in the UK and is recognised internationally. That coronectomy has become an accepted alternative to extraction in suitable cases is shown via a number of reviews/opinion pieces aimed at oral surgeons. One such piece posited that “coronectomy should be considered for mandibular third molars when it is felt there is an increased risk of injury to the inferior dental nerve” (2c). Another review, from China, said that coronectomy has shown to be “superior to total removal for reducing inferior alveolar nerve damage” (2d). These reviews both found only four suitable studies on coronectomy, one of which was Renton 2005. The practice of coronectomy has also been disseminated via journal articles such as those in the British Journal of Oral and Maxillofacial Surgery, which utilises Renton 2001 and a review by Renton that discusses Khawaja 2009 and Renton 2005 (2e,f).

Enhancing Clinician Awareness

The body of KCL research has significantly influenced clinician’s awareness and modification in assessment of the patients’ risk of TNI. For instance, the Royal College of Surgeons ‘Guidelines for Selecting Appropriate Patients to Receive Treatment with Dental Implants,’ which was co-written by Prof Renton, includes Renton 2012 when discussing using advanced imaging to “reduce the chance of collateral damage to vital structures” (3a). In addition, Prof Renton has recently produced guidelines on diagnosis, risk management, treatment and prevention of IAN injuries for the Association of Dental Implantology, a UK charity dedicated to providing both professionals and the public education on implants (3b). Prof Renton also co-authored, the British Dental Association’s ‘Clinical Guide to Oral Surgery, which includes a number of the references detailed above when discussing minimising and managing nerve injuries and complications (3c). Dissemination of best practice for TMS detailed in this clinical guide has been included in a series of British Dental Association continuing professional development seminars led by Prof Renton (3d). KCL-led work has also been incorporated into clinical handbooks aimed at dental professionals and students such as ‘Oral and Maxillofacial Surgery,’ which includes treatment-decision algorithms for clinical practice and risk-management (3e), and in ‘Clinical Problem Solving in Dentistry,’ which includes a number of KCL-authored chapters utilising KCL research (3e).

Further, in 2013, a series of countrywide Dental Commissioning Workshops were hosted by NHS England. Here, specialists including Prof Renton participated in discussions with and presentations to NHS England staff and key providers together to ascertain how the commissioning of dental services should develop in the future and how they can work together to achieve the best outcomes for everyone. Part of this included presentation of the new Gold Guide NHS commissioning for Oral Surgery, which is co-authored by Prof Renton and references KCL’s risk management research (3g).

National and International Dissemination to Professionals and the Public

Since publication of the prospective randomised study on coronectomy this novel technique has been adopted internationally. In the USA, the American Association of Oral and Maxillofacial Surgeons initially produced a White Paper on TMS in 2007, which cited Renton 2005 when discussing coronectomy, and then a further White Paper in 2011 that states that “appropriate treatment options include coronectomy” (4a). Recognition of the use of coronectomy in the US was sealed when in 2011 the American Dental Association added it to its list of recognised, billable procedures (4b). The work of KCL has also featured in news items, spreading awareness to the

public. For instance, their 2012 study on the risks of implant surgery was featured in a BBC News Health article (4c).

5. Sources to corroborate the impact

1. Helping Patients

- a) Nerve injury patient workshops: <http://trigeminalnerve.org.uk/patient-resources/nerve-injury-patient-workshop/>
- b) Information about trigeminal nerve injuries. <http://trigeminalnerve.org.uk/patient-resources/what-are-tn-injuries/>
- c) How do we manage trigeminal nerve injuries? <http://trigeminalnerve.org.uk/professional-resources/manage-nerve-injuries/>

2. Use of Coronectomy

- a) Oxford Radcliffe Hospital NHS Trust. Removing Wisdom Teeth leaflet: <http://www.ouh.nhs.uk/patient-guide/leaflets/files%5C101104wisdomteeth.pdf>
- b) Private Practice use of coronectomy: http://www.loveyoursmile.co.uk/our_services.php?id=55
- c) Patel V, Moore S, Sproat C. Coronectomy - oral surgery's answer to modern day conservative dentistry. *Br Dent J* 2010;209(3):111-4. Doi: 10.1038/sj.bdj.2010.673.
- d) Long H, Zhou Y, Liao L, et al. Coronectomy vs. Total Removal for Third Molar Extraction: A Systematic Review. *J Dent Res* 2012;91(7):659-65. Doi: 10.1177/0022034512449346
- e) Gleeson CF, Patel V, Kwok J, Sproat C. Coronectomy practice. Paper 1. Technique and trouble-shooting. *Br J Oral Maxillofac Surg* 2012;50(8):739-44. Doi: 10.1016/j.bjoms.2012.01.001.
- f) Patel V, Gleeson CF, Kwok J, Sproat C. Coronectomy practice. Paper 2: complications and long term management. *Br J Oral Maxillofac Surg* 2013;51(4):347-52. Doi: 10.1016/j.bjoms.2012.06.008.

3. Enhancing Clinician Awareness

- a) Royal College of Surgeons. Alani A, Bishop K, Renton T, Djemal S. Update on Guidelines for Selecting Appropriate Patients to Receive Treatment with Dental Implants. *Br Dent J*. 2012. http://www.rcseng.ac.uk/fds/publications-clinical-guidelines/clinical_guidelines/documents/guidelines-for-selecting-appropriate-patients-to-receive-treatment-with-dental-implants-priorities-for-the-nhs
- b) Association of Dental Implantology: IANI Guidelines in the members' area of the ADI website available on request.
- c) British Dental Association. A Clinical Guide to Oral Surgery. T Renton and M Hill. (Chapter 8) http://www.bda.org/Shop/Products/Oral-Surgery-Book-1__J46.aspx
- d) British Dental Association CPD seminars: <http://trigeminalnerve.org.uk/userfiles/Modern%20oral%20surgery%20FINAL.pdf>
- e) Oral and Maxillofacial Surgery. 2010. Wiley-Blackwell. (Chapter 14). ISBN: 978-1-4051-7119-9: <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1405171197.html>
- f) Clinical Problem Solving in Dentistry. 2010. Churchill Livingstone. ISBN: 9780443067846: <http://www.elsevierhealth.co.uk/product.jsp?isbn=9780443067846&dmnum=NEW2013&gclid=CMq75sb0rrkCFSGWtAodwKEA-Q>
- g) Dental Commissioning Workshops: http://www.nhsevents.org/event_detail.asp?event_id=598

4. National and International Dissemination to Professionals and the Public

- a) AAOMS White Paper on Third Molar Data: www.aaoms.org/docs/third_molar_white_paper.pdf and Evidence Based Third Molar Surgery: http://www.aaoms.org/docs/evidence_based_third_molar_surgery.pdf
- b) American Dental Association change to US code: https://pattersonsupport.custhelp.com/euf/assets/Eaglesoft/ServiceCodes/CDT_2011_Chapter_2.pdf
- c) BBC News: Dental implants can cause nerve damage, warn study. Aired 8.6.2012: <http://www.bbc.co.uk/news/health-18366437>