Research Protocol

A novel intraoral method of wound closure for third molar surgery: a comparison between conventional absorbable sutures and knotless sutures using a split-mouth design.

Postgraduate Student/ Principal investigator	Nigel Tan tanni823@student.otago.ac.nz
Primary supervisor	Professor Darryl C. Tong
Co-supervisors	Professor W. Murray Thomson
	Associate Professor Rohana K. De Silva
	Dr Harsha L. De Silva

For the partial fulfilment of the requirements for the degree of Doctor of Clinical Dentistry
in
Oral Surgery

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Introduction

Knotless sutures have been used in gynaecological, plastic, orthopaedic, abdominal and vascular surgery. These surgical specialities have benefitted from the associated reduction in surgical time and costs. The use of knotless sutures in the mouth has been reported but its use in third molar surgery has only just been explored. Given that surgical third molar (wisdom tooth) removal is one of the most common procedures undertaken in oral surgery, we intend to investigate the feasibility of using knotless sutures for this specific procedure. A randomised split-mouth study design, would allow us to compare the performance and efficacy of knotless sutures against conventional sutures in third molar surgical wound closure, as well as the impact on patients' oral health related quality of life (OHRQoL).

Thesis overview

Scientific question:	Are there any differences in procedural efficacy and post-operative outcomes between conventional 3-0 vicryl rapide suture wound closure and 3-0 V-loc knotless suture wound closure in third molar surgery?
Hypothesis:	Knotless wound closure would be more efficacious than conventional simple interrupted wound closure in third molar surgery. Knotless sutures would accumulate less debris and plaque, reducing erythema and eliminating irritation from the presence of knots, leading to an improvement in quality of life.
Statistical question:	What is the relative efficacy of knotless sutures in relation to third molar surgical wound closure and post-operative pain, swelling and irritation?

Background

Since their 1964 conception by Dr John Alcamo, barbed sutures have been used in plastic, urological, general, orthopaedic and gynaecological surgery (Lin et al., 2016). Kasi Ganesh et al. (2018) explored the use of knotless sutures to close intra-oral incisions used to access factures of the maxillofacial complex. Their case report utilised a split-mouth design for the closure of a Le Fort I fracture site and knotless wound closure for a mandibular angle fracture. A split-mouth design allowed comparison of conventional running absorbable sutures against their knotless counterpart in wound closure. The use of a knotless suture to close a surgical incision in the mandibular angle fracture highlights the utility of knotless sutures, even in a restrictive site such as the retromolar region.

Preliminary Literature Review

Advantages of knotless sutures in the oral cavity

Knotless sutures address some of the limitations of conventional sutures. These limitations are: (1) the time taken to tie-off multiple sutures; (2) uneven tension across the wound; and (3) bacterial adhesion, especially on the knot surface in multifilament sutures. Advantages of knotless sutures include: (1) shorter wound closure time; (2) improved wound stability; and (3) elimination of the knot.

Current bidirectional and unidirectional knotless suture designs facilitate continuous wound closure, enabling surgeons to re-approximate incisions rapidly (Mansour et al., 2013). The net result, when measuring the operating time saved, against the material cost, was an overall cost reduction (Gililland et al., 2014; Smith et al., 2014). Furthermore, knotless sutures did not alter complication rates nor affect the number manhours lost due to needlestick injury (Gililland et al., 2014). These findings were primarily drawn from orthopaedic literature, however, specific benefits relating to a reduction in third molar surgery time is as yet not well understood. In addition to bidirectional knotless sutures discussed earlier, unidirectional knotless sutures such as the V-loc wound closure device (Covidien, Mansfield, Massachusetts) exist where the suture is anchored on one end and then passed through the tissues to be closed (Matarasso & Ruff, 2013).

Wound stability is improved from the barbs on knotless sutures engaging the tissues across the wound edges, resulting in a more equal force distribution. Conventional continuous sutures are predisposed to slippage, which can cause uneven tension across the wound edge (Greenberg & Goldman, 2013). Maintaining optimal, even tension across the wound is likely to aid in healing.

Knots cause stress concentration, irritation and inflammation, and are a nidus of bacterial adhesion (Garg, 2012). Stress concentration weakens the area immediately adjacent to the knot, affecting real-world performance of the material (Chu, 2017; Greenberg, 2010). The volume of the knot is proportional to the amount of inflammation occurring at the sutured site (Van Rijssel et al., 1989). Eliminating the knot would also likely reduce the volume of material available for bacterial adherence and, eliminate inflammation associated with the volume of material in the knot.

Study designs for third molar surgery

Previous studies have used split-mouth designs to assess postoperative outcomes in patients undergoing third molar surgery. Examples of such studies include investigations of the effects of platelet-rich fibrin placement (Marenzi et al., 2015) and local infiltration of corticosteroids (Alcântara et al., 2014). A split-mouth design allows for direct intra-patient comparison, thus controlling for systemic variables.

Post-operative outcome assessment

The main outcomes commonly evaluated in oral surgery literature have been (1) pain, (2) swelling, (3) trismus and (4) bony healing. This is relevant to the evaluation of any potential outcome improvement from utilising knotless sutures. Our intended study will draw on this body of knowledge, however we will focus on assessment of swelling, pain and patient perceived irritation at the procedural site.

Visual analogue scales (VAS) have been used to measure patient-perceived post-operative pain (Berge, 1988, 1989). The use of the VAS as a pain measure is well documented and robust (Huskisson, 1974; Scott & Huskisson, 1976). A 100mm VAS was used by Lau et al (2020; in press) to assess third molar surgery outcomes, with 0 representing no pain and the 100mm mark representing the worst perceived pain possible. With respect to irritation at the procedural sites, Rodanant et al., (2016) used the VAS to assess irritation following closure using silk sutures.

Bello et al. (2011) used a manual tape measure method to compare pre- and post-operative swelling. They utilised fixed points of reference on a patient's face and recorded the sum of these measurements. A limitation of this method is soft tissue compression during measurement, which would lead to systematic error. Non-contact measurement methods such as stereophotography and 3-dimensional (3D) scanning have been used in the literature to circumvent these limitations in measurement of facial swelling (Lau, 2020; in press). However, this requires specialised imaging capabilities that may not necessarily be readily available across study sites.

Review intervals in studies, following third molar surgery, varies depending on the variable being evaluated. Some previous studies reviewed patients at days 1 and 7 following third molar surgery with no further recorded follow-up within the study (Brüllmann et al., 2014; Kumar et al., 2015; Matsuda et al., 2016; Pasqualini et al., 2005; Rana et al., 2011). Other studies, particularly interventional studies, evaluating the usage of platelet-rich fibrin (PRF), had longer follow-up periods of up to 3 months (Kumar et al., 2015; Marenzi et al., 2015). On the other hand, studies that looked at flap design or topical corticosteroids, generally reviewed partcipants for the last time 10 days or less following surgery (Alcântara et al., 2014; Dubois et al., 1982; Hu et al., 2017; Matsuda et al., 2016; Pasqualini et al., 2005).

Problem statement

Conventional wound closure in third molar surgery involves simple interrupted multifilament sutures. The knot takes time to tie, causes irritation, stress concentration, and is an area of focal weakness in the suture. Clinically, multifilament sutures pose an issue due to capillary action, which draws bacteria and saliva along the material, through the mucosa, and accumulates debris and plaque, which increases inflammation. Since monofilament knotless sutures do not have the same capillary action that multifilament sutures do, they eliminate issues associated with this. The use of knotless sutures in other areas of surgery is supported by a strong body of evidence, however, intraoral usage, particularly in third molar surgery has yet to be explored.

Aims of study

To evaluate the benefits of knotless sutures over conventional sutures for wound closure in third molar surgery.

Objectives

Primary objectives

- To determine if there is any difference in wound closure time between conventional and knotless sutures
- To determine if there is any improvement in post-operative outcomes from using knotless sutures in third molar surgery, measured as:
    - Pain (VAS)
    - Swelling (Facial measurements)
    - Tissue irritation (VAS)

Secondary objectives

- To determine if the savings obtained in operating time reduction justifies the increased material cost of knotless sutures.
    - Is there an impact on overall treatment cost provision?
- Patient's impression on healing of the surgical third molar extraction site and post-operative comfort between the two materials.
- To determine if patients perceive an improvement in QoL following third molar surgery.

Implications

Potential benefits

The current body of literature is built upon clinical studies carried out in other areas of surgery. There is no convincing evidence at present to support or refute the use of knotless sutures in third molar surgery, hence, further clinical investigation would help us evaluate the validity of this particular application.

Clinical benefits we anticipate involve reduced institutional cost and improved post-operative outcomes: 1) through an anticipated reduction in wound closure time, we expect a reduction in overall procedural time. The time related procedural cost is a

established component affecting the overall cost of service provision. 2) a reduction in post-operative swelling, pain and irritation, through the elimination of the knot as well as reducing the amount of capillary action present.

These findings may be extended to other intraoral procedures including full dental clearances, other dentoalveolar and periodontal soft tissue procedures. Anecdotally, patients have re-presented post-operatively because of irritation from the knot. By reducing these additional visits from the cost variables involved in service delivery, it might be possible to make each unit of funding to the institution stretch further, benefiting more individuals.

Proposed methodology

Study design

The proposed research will be conducted as a split-mouth study comparing of post-operative outcomes (pain, swelling, wound healing) and intraoperative wound closure time between knotless and conventional sutures. The sites, left and right mandibular molars, will be randomised with regards to the proposed intervention. Third molar surgery to both left and right sides will be carried out at the same time.

Study setting/Location

It will be a multi-centre study carried out at the 1) outpatient procedural suite, Clinical Services Building, Faculty of Dentistry, University of Otago (UoO) and 2) oral surgery clinic, Southland Hospital Dental Unit, Southern District Health Board (SDHB).

Study population

Subjects will be invited to participate from a population of patients who have been referred from their primary care provider (general medical practice or general dental practice) for the removal of their mandibular third molars.

Recruitment of participants

Patients will be screened for suitability as part of regular oral surgery service provision at the School of Dentistry, UoO and Southland Hospital Dental Unit, SDHB. They will be assessed for suitability based on clinical findings and radiographic

mandibular third molar impaction patterns. Approximately 20 participants will be recruited through the School of Dentistry and 50 through the Southland Hospital Dental Unit, to reflect the amount clinical time available to treat and review the patients at the different sites.

Eligibility criteria

Inclusion Criteria

1. Patients referred for third molar removal from a primary care provider
2. Patients who volunteer participation
3. Patients may be either male or female
4. The patient has been screened by the primary investigator or supervising specialist for suitability to participate in the study
5. Are aged between 18 and 44 years
6. Are able to understand verbal and written instructions.
7. Present with bilateral similarly impacted mandibular third molars as determined using Winter's (1926) classification system , requiring surgical removal
8. Are able to tolerate outpatient oral surgery under local anaesthetic and intravenous sedation
9. ASA l or ll
10. The patient has provided informed consent regarding:
    a. Participation in the study
        i. The use of knotless sutures in the closure of the surgical wound
    b. Surgical removal of third molars under local anaesthetic and intravenous sedation

Exclusion Criteria

1. American society of anaesthesiologists (ASA) physical classification[1] III or IV
2. Polypharmacy (≥5) medications[2]
3. ≤17 years, ≥45years
4. Patients contraindicated to undergo surgical third molar removal
5. Opioid and illict drug addiction
6. Patients who have allergies or contraindications to the procedural usage of:

[1] Abouleish, A. E., Leib, M. L., & Cohen, N. H. (2015). ASA Provides Examples to Each ASA Physical Status Class. ASA Newsletter, 79(6), 38–49.

[2] Masnoon, N., Shakib, S., Kalisch-Ellett, L., & Caughey, G. E. (2017). What is polypharmacy? A systematic review of definitions. BMC geriatrics, 17(1), 230. https://doi.org/10.1186/s12877-017-0621-2

    a. midazolam
    b. dexamethasone
    c. parecoxib
    d. paracetamol
    e. ibuprofen
    f. co-amoxiclav
    g. cefazolin
    h. clindamycin
    i. chlorhexidine
7. The presence of symptomatic pericoronitis.
8. The presence of other pathology in the oral cavity.
9. Patients with poor oral hygiene (plaque >1/3 of tooth surface).
10. Pregnant or lactating women.
11. Patients unwilling to remove facial hair for the purpose of facial measurements in order to assess swelling.
12. Patients who are unable to give informed consent.
13. Patients who decline participation.
14. Patients who are unable to attend the required follow-up appointments.
15. Patients who are unable to comprehend directions and instructions.

Randomisation

In this split-mouth study, the patients will receive the control, 3-0 vicryl rapide suture, on one side and the intervention ,3-0 V-loc suture, on the contralateral side.

The allocation of suture material to closure site, left or right third molar surgical site, will be drawn at random prior to the procedure. Allocation will be concealed through pre-sealed envelopes containing the side allocated the intervention. There will be an equal number of sealed allocations, of the intervention, to each site. The site receiving the intervention and the site receiving the control—left or right mandibular third molar—will be recorded in the patient's file. This will aid in ensuring a balanced number of interventions on each side.

Patients will be blinded as to which site receives the control (3-0 vicryl rapide) and which site receives the intervention (3-0 V-loc). However, as part of the consent process, patients will be made aware that both materials will be used.

Study procedure

Surgical procedure

The surgical removal of bilateral similarly impacted wisdom teeth will be performed by the primary investigator (Nigel Tan). All procedures will be supervised by a specialist oral and maxillofacial surgeon employed by the University of Otago, or, a senior dental officer at Southland Hospital. We aim to eliminate inter-operator variability and consequent performance bias by involving only a single operator. The surgical removal of the patient's third molars will be carried out at a separate appointment from the initial consultation. This allows the patient to have time to consider their participation in the study and whether they would like to defer of withdraw from the procedure.

Intravenous cannulation will commence following patient identification, confirmation of procedural consent and a 60 second pre-procedural 0.2% chlorhexidine gluconate mouthwash. The procedures will be carried out under intravenous (IV) sedation using midazolam which will be titrated to achieve the desired depth of sedation. Patients will have their height and weight (body mass) taken on the day. There will be a standardised pre-operative dose of 1.2g Amoxicillin/Clavulanic Acid, 8mg dexamethasone and 40mg parecoxib given to all participants. Patients that are allergic to penicillin antibiotics will be given a 1g dose of IV cefazolin; patients that are allergic to beta-lactam antibiotics will receive a 600mg IV infusion of clindamycin over 20 minutes.

Local anaesthetic (lignocaine 2% with adrenaline 1:100 000) will be administered via an inferior dental block and buccal infiltration to the procedural sites prior to incision.

A two-sided flap design will be used, where the:

1. papilla distal to the first molar will be incised but not relieved,
2. the papilla distal to the second molar will be incised and relieved,
3. with a distal relieving incision across the external oblique ridge
    a. In the event further exposure is required, an additional mesial relieving incision incorporating the distal papilla of the second molar will be made, making the flap 3-sided.

b. This will be determined pre-operatively, and where deviation from the planned flap design has occurred, this will be recorded.

The impacted third molar will be removed following any required sectioning of the tooth and bone removal.

The procedural site will be closed with simple interrupted 3-0 vicryl rapide sutures on the control side and the intervention side will be closed with a continuous running 3-0 v-loc suture. The difference in closure pattern is due to the differences in material handling and application.

A prescription for post-operative pain relief including 1g paracetamol, 400mg ibuprofen orally 4 times daily as needed, will be provided. Additional rescue analgesia will be prescribed, consisting of either 30mg codeine phosphate or 50mg of tramadol orally 4 times a day as needed. If required, the rescue analgesia will be recorded as part of the patient's post-operative pain diary. Patients who are unable to tolerate these medications will be excluded from this study.

Patients who require additional monitoring will be reviewed as per the institution's policy around post-operative complications.

Post-operative diary

The participants will be asked to rate the pain intensity as well as irritation from the sutures for the first 48 hours, every 6 hours while awake. A non-graduated visual analogue scale (VAS) will be provided to the patients for recording of this information as part of their pain diary.

The VAS will comprise of two 100mm horizontal lines with no markings along its length. The left end will be anchored with a vertical line and labelled 'no pain' and the right similarly anchored with a vertical line and labelled 'worst pain imaginable'. The score is determined by the distance between the end of the line on the left and the participant's mark.

This will be compared against baseline measures collected prior to the procedure, allowing for assessment and analysis.

Informed consent

Patients who are deemed suitable at the participation will be invited following the initial consultation process. Information will be delivered verbally and patients will be given a written copy of this, outlining:

- The nature and purpose of the study;
- Participant responsibility; and
- The right to withdraw.

Patients will be given ample opportunity to raise any questions or concerns prior to enrolment. Following enrolment, further clarifications can be sought at any time. Contact details will be provided to the patients for them to communicate any questions or concerns.

Patients will be able to withdraw consent at any time and will not be coerced to do otherwise. A signed form documenting their participation in the study will be separate from their consent to proceed with surgical third molar removal. Patients will be able to withdraw from the study, and continue to receive the required treatment without prejudice.

Participants will be required to present for their surgery on the scheduled date and time. Furthermore, participants will be required to complete their pain diary and attend the scheduled post-operative review appointments at 48h and 7 days. They will be required to record their perceived post-operative pain and irritation on each side of the mouth on the 100mm VAS in the post-operative diary provided every 6 hours while awake, for the first 48 hours post-operatively. The use of rescue analgesia, and any interim presentations to a healthcare provider regarding pain or discomfort, should be recorded. This diary should be returned to the principal investigator at the 48h post-operative appointment.

Participant incentive

The treatment fees will be in line with the institution's fee schedule and no monetary incentives will be provided to encourage patients to participate. Patients will be provided with the same standard of care regardless of participation status.

Data collection

1. Eligible patients will be invited to participate and will be provided with a copy of the participant information sheet if they express interest. The initial appointment will involve a consultation with the clinician/primary investigator. If the patient provides informed consent to participate, they will then complete the pre-operative questionnaire. This questionnaire contains the Oral Health Impact Profile, OHIP-14 (Slade, 1997), Locker's Global Oral Health Item (Thomson et al., 2012), and the Dental Anxiety Scale (Corah, 1969).

2. Patients will be assigned a study participant number which will be used during data collection. This will be recorded separately from their clinical records. According to the applicable institutional protocol, the intervention site, material and batch number will be recorded in the patient's clinical record.

3. The type of third molar impaction according to the Winter's classification (mesio-angular, disto-angular, vertical, horizontal, transverse bucco-lingual, inverted) will be recorded for each participant. Clinically and radiographically similar impaction patterns are crucial in a split-mouth design.

4. Prior to the procedure, the patient will:

    i. Complete a VAS score on pre-operative pain and irritation;
    ii. Have a triplicate of baseline measurements to later aid in assessing facial swelling will be recorded.
    iii. Have their height and weight taken.

    The removal of the bilateral similarly impacted third molars will then commence under IV sedation.

5. The time taken for removal of the mandibular third molar from each side will be recorded, starting from the time of the initial incision to the completion of tooth removal. Both sites will be irrigated and inspected to remove and fine debris in the surgical site, ensure no remnants remain and there is no inadvertent damage to adjacent structures. The time taken for wound closure will also be recorded, starting from the time of the first bite of the soft tissue, to

the time the sutures have been placed and the wound edges satisfactorily approximated.

   i. Prior to the procedure, the side receiving the intervention will be drawn.
   ii. This will be drawn at random, with the nurse and the clinician unaware of which side the intervention is assigned to until the envelope is opened.

6. Participants will be asked to rate the pain and irritation experience at each side every 6 hours while awake for the first 48 hours. A non-graduated 100mm VAS, in the patient's post-operative diary will be included, for every waking 6 hour interval.
   i. They will additionally record under the respective pages:
      i. The time between the end of the procedure (will be written down into the booklet at the conclusion of the procedure) and the first use of rescue medication
      ii. The amount of rescue analgesia consumed each day
      iii. Any adverse events experienced post-operatively (e.g. vomiting, nausea, headaches, uncontrolled pain and swelling from the site)

7. Participants will be asked to attend a post-operative review with the primary investigator at 48h following their procedure, and again at 7 days.
   i. A repeat triplicate of facial swelling measurements will be taken at each of these appointments.
   ii. A post-operative questionnaire will be completed at each appointment. This contains items relating to post-operative pain, irritation at the sites, whether they needed to be reviewed in a community-based practice or at the institution in the intervening period, whether intervention was required, compliance with the prescribed pain relief, requirement for rescue analgesia, OHIP-14, Locker's global oral health measure. Additionally, the patient's perception of which side they felt was healing better will be recorded.

Measurement of facial swelling

Facial swelling will be determined by tape measurements between the tragus and soft tissue pogonion (A), tragus and lateral corner of the mouth (B), lateral corner of the eye and the angle of the mandible (C). Facial measurements will be calculated as: (A

+ B + C)/3, and facial swelling (%) will be calculated as: [(postoperative measurement − preoperative measurement)/preoperative measurement] × 100% (Baqain et al., 2012).

1. These measurements will be taken prior to commencement on the day of the procedure;
2. 48h post-operatively;
3. 7 days post-operatively.

Data entry

Data will be entered into a Microsoft Excel spreadsheet, recording the triplicate of facial measurements, the nature of impaction involved, the time taken to close the surgical site, the intervention side/site and scores from the operative questionnaires. The data will be checked for errors prior to de-identification and data analysis.

Statistical considerations and data analysis

Sample size. Power analysis yielded a sample size of 63 participants based on a paired sample t-test analysis with alpha of 0.01, power of 0.9, and a moderate effect size (Cohen's d = 0.5). Previous research supports that moderate to large effect sizes can be expected for our key outcome, closure time (Durand, 2017; Zhu et al., 2017). Furthermore, a simulation study on the sample considerations of split mouth designs also indicated that a sample size of approximately 60 participants would be appropriate. 70 participants will be recruited to account for possible drop-out and data loss from participant protocol deviation.

Statistical approach. Statistical analyses will be conducted using the statistical programming language R. Our outcome variables, closure time, inflammation, and pain, will be modelled using separate mixed models Analyses of Variance (ANOVA) with suture type as a within-subjects variable and age, sex, ethnicity, smoking status, previous pericoronitis and dental anxiety score as between-subjects variables. In the case of inflammation, irritation and pain, we will use a repeated measures design to account for multiple follow-ups. A post-hoc polynomial comparison of follow-up outcomes by suture type will also be used to determine whether the trajectory of healing differed significantly between suture types. In all cases, we will use an alpha

of 0.01, more stringent than the traditional 0.05. Using a lower alpha allows us to be more certain of our findings and also implicitly controls for the multiple comparisons we are making across different outcome variables.

Bias and confounding

Bias

The patient is blinded to which side receives the intervention to minimise reporting bias. Handedness will be controlled for by allocating an equal number of interventions to each of the left and right sides through the randomly selected system of sealed envelopes drawn prior to the procedure. Uneven loss to follow-up or withdrawal may cause one intervention-control-side combination to be over-represented.

Modifiers

Age

Increasing age has been associated with increased procedural difficulty. We have excluded individuals 45 years or older to minimise the effect of age.

Peri-operative medications

Dexamethasone is part of the current peri-operative protocol for IV sedation to maintain patient comfort. Omitting this medication may increase intraoperative pain levels and post-operative swelling during the immediate period. However, it is likely to exert some effect on the immediate post-operative pain measures during the immediate post-operative window.

Post-operative pain relief

The benefits of paracetamol in conjunction with ibuprofen in relation to post-operative pain management following third molar surgery has been previously established in the literature (Best et al., 2017). The effectiveness of post-operative pain relief will likely have a global influence on the reported pain scores, likely modifying the study results. However, due to the multifactorial nature of pain, certain patients may perceive an improvement in pain control from weak-opioids such as codeine, in spite of the literature suggesting otherwise.

Alveolar osteitis and post-operative infection

Dry socket or alveolar osteitis is a common post-operative complication associated with tooth extraction, particularly third molar surgery. The hypothesis is that premature fibrinolysis occurs due to the nature of the patient's intraoral flora, particularly smokers, that may predispose them to this. Patients that have had previous or recent bouts of pericoronitis will also likely have unfavourable bacterial microenvironments within the surgical site. 0.2% chlorhexidine mouthwash will be used pre-operatively as well as an IV dose of 1.2g co-amoxiclav. Symptoms are generally reported between day 3-5 following extraction, hence our main data collection points avoid this window.

Confounders

Confounding variables will be addressed through statistical means and modelling techniques at the time of data analysis.

Ethical approval and Māori approval

Ethical approval

Approval pending, application in process. Universal Trial Number (UTN) U1111-1259-5457

Māori consultation

Completed with approval

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Payment for treatment

Patients will bear the cost of treatment according to the fee schedules outlined at the respective institutions.

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Appendices

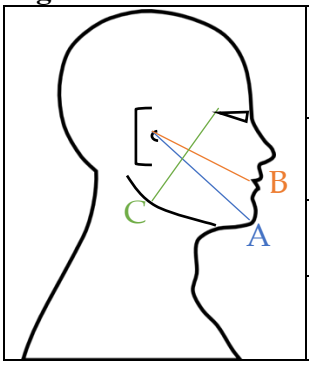
Appendix 1

UNIVERSITY of OTAGO
SAPERE AUDE
Te Whare Wānanga o Otāgo
NEW ZEALAND

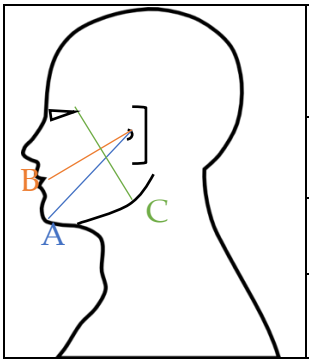
Facial measurements *before* wisdom tooth removal

Date: _____ *Time:* _____

Right facial measurements

	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible

Left facial measurements

	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible

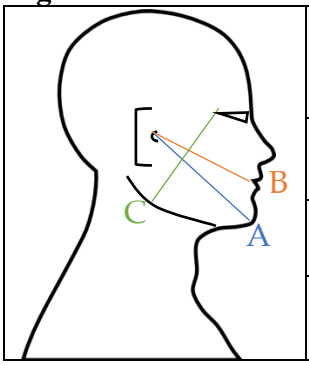
Appendix 2

UNIVERSITY of OTAGO
SAPERE AUDE
Te Whare Wānanga o Otāgo
NEW ZEALAND

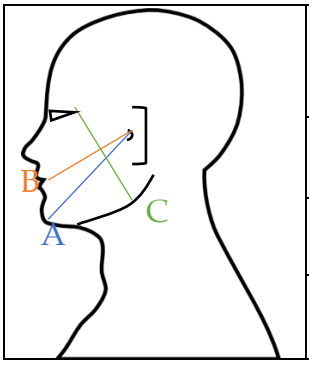
Facial measurements *2-days following* wisdom tooth removal

Date: _____ *Time:* _____

Right facial measurements

	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible

Left facial measurements

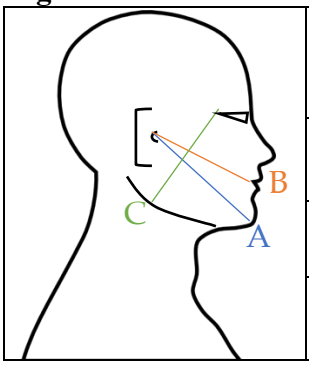
	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible

Appendix 3

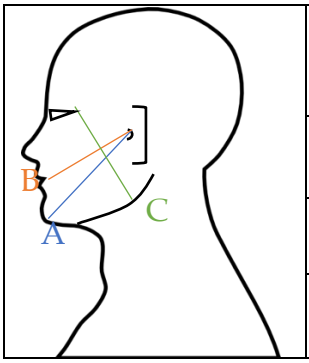
Facial measurements *14-days following* wisdom tooth removal

Date: _____ *Time:* _____

Right facial measurements

	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible

Left facial measurements

	**(A)** tragus and soft tissue pogonion	**(B)** tragus and lateral corner of the mouth	**(C)** lateral corner of the eye and the angle of the mandible