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Author/s:

Beteramia, D;Azami, O;Garg, K;Grubor, D

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DR DANIEL BETERAMIA (Orcid ID : 0000-0002-1458-0398)

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Retrospective Multivariable Comparison for Complications of Third Molar Surgery Performed Under General Versus Local Anaesthesia

Daniel Beteramia, Omid Azami, Krati Garg, Dragan Grubor

University of Melbourne Dental School and

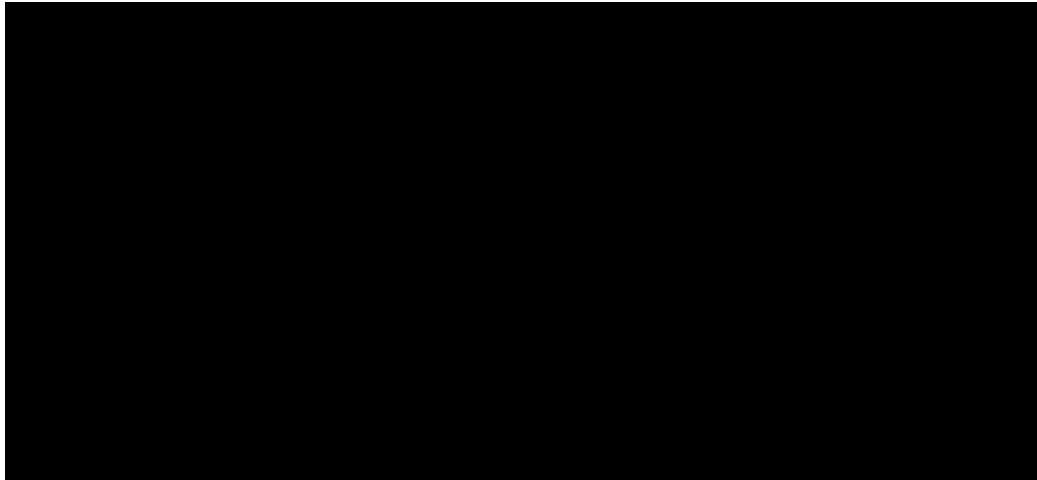
Dental Health Services Victoria

720 Swanston st. Carlton, VIC

3053

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Key Words:

General anaesthetic, inferior alveolar nerve, local anaesthetic, post-operative complications, third molars

Disclosure Statement

There is no conflict of interest to declare.

ABSTRACT

Aim: To compare the incidence of complication rates as a result of third molar surgery when performed under local versus general anaesthesia.

Materials and Methods: Data was collected using a combination of computer database and patient records. 277 patients were included in

the study (130 local anaesthesia, 147 general anaesthesia). Several variables were collected and assessed including age, gender, method of anaesthesia, radiographic grading and complications.

Results: 523 mandibular third molars were removed, 284 being removed under general anaesthesia and 239 under local anaesthesia. There was a total of 20 complications (3.8%), nine of those from procedures performed under local anaesthesia and 11 from procedures performed under general anaesthesia. There was a statistically significant increase of Alveolar Osteitis for procedures performed under LA. However, when assessing overall complication rate, there was no statistically significant difference in LA versus GA.

Conclusions: Teeth more severely impacted or angulated tend to be removed under general anaesthesia for reasons such as surgical access and patient experience. Our study suggests there is an increase in Alveolar Osteitis when third molars are removed under LA. However, there was no significant correlation found between method of anaesthesia and overall complication rate when combining all complications. The present study indicates that other variables, such as gender and age may be more important in determination of post-surgical complication rates after wisdom teeth removal. It is therefore reasonable for clinicians and patients to base their decision for

modality of anaesthesia on patient preference, surgical difficulty, medical background and economic factors.

CLINICAL RELEVANCE

Scientific rationale for study

There are few studies comparing the complication rates between local versus general anaesthesia in third molar surgery and have conflicting findings. Support for local or general anaesthesia may increase if it were found to have lower complication rates to the other.

Principal Findings

This study found that the method of anaesthesia does not play a significant role in complication rates of third molar surgery, whilst gender and age do.

Practical implications

Supports the stance that subjective assessment of patient anxiety and perceived difficulty of procedure are valid to determine the anaesthetic modality because of similar complication rates.

INTRODUCTION

The removal of impacted mandibular third molars is a common dentoalveolar procedure performed in oral and maxillofacial surgery, with differing levels of difficulty depending on several patient-specific and dental specific factors. Dental factors include the degree of impaction, angulation, anatomical form, relation to vital neurovascular structures and patient related factors include age, weight, medical

MAIN TEXT OF ORIGINAL ARTICLE

history and degree of mouth opening(1-6). While surgical outcomes are generally predictable, intra and post-operative complications rates of 1.1% and 4.3% have been documented(7). Intra-operative complications include injury to the inferior alveolar and lingual nerves, damage to the adjacent second molar, excessive bleeding, alveolar bone fracture and displacement of tooth fragments into fascial planes or spaces. Post-operative complications include alveolar osteitis, secondary infection, post-operative haemorrhage and persistent nerve damage(4, 8, 9).

Of these complications, damage of the two main neurovascular bundles in the region of the third molars, the Lingual nerve (LN) and Inferior Alveolar nerve (IAN), is highly significant due to the potential long-term consequences. In some cases, roots of lower third molars are in close proximity to the mandibular canal, leading to characteristic presentations on orthopantomograms as described by Rood and Shehab (5). In such cases there may be increased risk of nerve injury during tooth removal.

Third molar surgery can be performed using different modes of anaesthesia. It may be performed under local anaesthetic (LA) alone or in conjunction with oral sedation or general anaesthesia (GA). For many

patients, the operation is straightforward and treatment under local anaesthetic is the appropriate modality (10). In certain circumstances such as highly anxious patients, surgical difficulty and anticipated length of procedure however, LA alone may be inadequate and must be supported with alternate modes of anaesthesia. (10-12).

At the patient level, dentoalveolar complication rates associated with each method of anaesthesia is of particular importance. Majority of the literature has shown higher complication rates under GA (10, 13-17), with authors attributing this to the fact that more complicated cases are generally performed under GA. Other studies have shown up to five times the incidence of nerve damage under GA regardless of the level of surgical difficulty as assessed by severity and depth of impaction (15). Other variables that have been suggested to increase complication rates under GA include; the increased likelihood to perform lingual retraction, excessive depression of the tongue via the tongue retractor, patient supine positioning, extent of mucoperiosteal stripping and bone removal, and increased surgical force (17).

Alternatively, some studies have shown conflicting findings (9, 18, 19), reporting little difference in rates of adverse events per tooth extracted between the procedures performed under LA compared to GA.

Anaesthetic modality, experience level of the operator and patient age were not associated with higher complication rates. The only variable associated with higher complication rates was found to be the degree of third molar eruption and retraction of the lingual nerve.

The purpose of this study is therefore to compare and contrast the complication rates associated with third molar surgeries of similar perceived difficulty under local versus general anaesthetic. This assessment will utilise the data from the Royal Dental Hospital of Melbourne (RDHM; Melbourne, Australia) and results may influence the decision making protocol when deciding whether to perform the surgery under local or general anaesthesia.

MATERIALS AND METHODS

Data was collected retrospectively from a pool of patients at the Royal Dental Hospital of Melbourne (RDHM). The RDHM is the primary public dental hospital offering general as well as specialist treatment via referrals for the state of Victoria, Australia. Using the RDHM patient management software (Titanium), the names and dental record numbers of patients having one or both lower third molars removed was collected. To allow for adequate review and recall periods to track

any possible long-term complications, data collection started from cases done in December 2011. In total, 277 cases were included, comprising of 130 cases done under LA and 147 done under GA. This study was approved by Human Research Ethics Committee (HREC) at the University of Melbourne and Dental Health Services Victoria (ID 15456977).

For each patient, both the paper and their electronic records were reviewed. Additionally, the Oral and Maxillofacial surgery department at the RDHM maintains a database for post-operative and intraoperative complications utilising Victorian Health Management System (VHMS) – Clinical Incident Report (CIR) system. This database was also reviewed for these patients.

Several variables including patient age, gender, date of procedure, method of anaesthesia, perceived difficulty of lower third molar extraction based on radiographic presentation and complications associated with the operations were collected from each patient included in the study (Table 1). Operator skill level was not included in this study due to the fact that the RDHM is a teaching hospital where in many cases more than one operator participates in a procedure. However, all operations will have a senior consultant either performing or supervising the procedure at all times. For assessing the perceived

difficulty of each procedure the patient's pre-operative orthopantomogram (OPG) was assessed and categorised according to the Pell and Gregory (20, 21) (Figure 1) and Winter's (21, 22) (Figure 2) classification criteria. To calibrate for inter-examiner variation in OPG assessment and classification, the two researchers crosschecked each other's findings and in cases where the two researchers did not agree, a third researcher was consulted.

The complications included in this study were nerve damage, infection, haemorrhage, mandibular fractures, alveolar osteitis and displacement of third molars into fascial spaces. The inclusion criterion for nerve damage was patients who presented to their two week post-operative appointment with altered sensation along the distribution of either the inferior alveolar nerve (IAN) or lingual nerve (LN). The subsequent recall and review visits were followed up in the patient records and the nerve damage was classified as complete resolution, partial resolution or no improvement.

For infections, the inclusion criteria included unscheduled appointments with a physician or dentist where antibiotics were prescribed and recorded in the patient's file and/or on Titanium, or

patients presenting with post-operative infection at the OMFS department. Post-operative infection was diagnosed if there was subjective symptoms, such as fever, chills, malaise and fatigue in addition to signs of purulence, swelling, erythema and cervical lymphadenopathy. All other complications were tracked and recorded using intra-operative and post-operative appointment notes.

All procedures in this study were completed at the RDHM OMFS department under either local or general anaesthetic. All cases were referred from other departments within the RDHM, public community dental clinics and private dentists. The plan for the type of anaesthetic was determined during the initial consultation appointment based on several factors including assessed difficulty of procedure, comorbidities and patient preference. Antibiotic prophylaxis was not given, unless there was a medical condition predisposing patients to high risk of infective endocarditis. Furthermore, post-operative antibiotics were not given unless there was a therapeutic indication (i.e. existing infection). This is in accordance with the Oral and Dental Therapeutic Guidelines (23). The surgical procedures performed were standardized with a buccal mucoperiosteal flap, bone removal and tooth division where required. For procedures under LA, a W&H Dentalwerk electric

handpiece was used (40,000 rpm; W&H Dentalwerk, Bürmoos, Austria). For those under GA, a Hall 5058 Surgairtome pneumatic surgical handpiece was utilised (100,000 rpm, Conmed Linvetec, Sydney, Australia).

The data outlined was collected and entered into a computer database. Analysis was performed using Stata (V14) to produce two-way tabulations with tests of independence for clustered data. To account for repeated measures design, the Pearson chi squared statistic for two-way tables was turned into an F-statistic with non-integer degrees of freedom. A *P* value less than 0.05 was considered statistically significant.

RESULTS

This study included data collected from 277 patients (523 third molars), beginning in December 2011. Out of these, 130 patients (239 third molars) were treated under LA and 147 patients (284 third molars) under GA. Table 2 describes the distribution of third molars according to the Pell and Gregory (PG) classification system (A, B, C; 1, 2, 3 as

outlined in Table 1). Under local anaesthesia, the most frequently seen impaction was PG A1 (50.6%), followed by PG B1 (20.9%) and PG A2 (18.8%). Under general anaesthesia the most frequently seen impaction was PG A2 (37.3%), followed by PG B2 (27.1%) and PG B3 (15.5%).

Table 3 describes the distribution of molars according to the Winter's classification system. Under local anaesthesia, the most frequent impaction seen was Vertical (51.9%), followed by Mesioangular (32.6%) and Distoangular (10.9%). Under General anaesthesia, the most frequent impaction was Mesioangular (47.5%), followed by Vertical (23.9%) and Distoangular (18.7%).

Overall, there were 20 total complications from the 523 third molars removed, giving an incidence of 3.8%. Of this, nine cases were performed under LA and 11 under GA. Table 4 describes the frequency of these complications and this is portrayed in Figure 3. Under local anaesthesia, of the nine total complications, the most common was alveolar osteitis (five patients; 55.5%), followed by temporary IAN paresthesia (two patients; 22.2%) and infection or haemorrhage (one patient each, 11.1%). There was no incidence of temporary lingual nerve paresthesia under LA. Of the 11 complications under GA, the most prevalent was infection (seven patients; 63.6%), followed by temporary IAN paresthesia (three patients; 27.3%) and temporary LN

paresthesia (one patient; 9.1%). The overall incidence of temporary paresthesia for both modes of anaesthesia combined was 1% (5/523) and 0.19% (1/523) for the IAN and LN respectively. No cases of permanent paresthesia were found in this study. The only variable with a statistically significant difference in complication rate was Alveolar Osteitis, which occurred more frequently under LA.

Table 5 presents complication rates of third molar surgery done under LA versus GA, controlling for several variables. No factor was found to have a significant effect on complication rates in the context of procedures performed under LA versus GA.

DISCUSSION:

The removal of impacted mandibular third molars is a common dentoalveolar procedure performed in oral and maxillofacial surgery. The literature has cited multiple factors that need to be thoughtfully planned, discussed and managed in order to reduce the risk of patient morbidity (4, 7-9).

Pre-operative radiographs as a basis of assessing the intimacy of mandibular third molar roots to the inferior alveolar canal and overall

perceived difficulty of third molar extractions has been widely cited in the literature (5, 24, 25). Several classification systems have been developed to aid clinicians in their decision making, including the Pell and Gregory classification(20) and Winter's classification(22). These classification systems are not without fault and their accuracy and effectiveness at predicting actual case difficulty have been questioned (26-28). Instead, patient factors are thought to have an increasingly important role (2, 4, 13). Although imperfect, these classification systems are consistent and reproducible, providing a broad overview and general appreciation to the difficulty of the procedure and risk of nerve damage (5), hence why they were used in this study to assess perceived difficulty of procedures. To minimize any limitations that each respective classification may have, radiographs in this study were assessed using both systems.

To the authors' knowledge, there is no current protocol in deciding whether third molar surgery should be carried out under local versus general anaesthetic. Most procedures are assessed subjectively based on perceived difficulty as per radiographic appearance, coupled with patient preference and/or medical conditions. This is supported by the findings of this study, where 85% of PG A1 teeth (i.e fully erupted, not

impacted) were removed under LA, whereas 95-100% of teeth classified as A3, B3 or C3 were removed under GA. Furthermore, results showed that as the impaction moved towards a mesial or distal angulation, there was an increased likelihood for the procedure to be performed under GA. Results also demonstrated that the lateral spatial relation of the third molar to the mandibular ramus (Pell and Gregory 1, 2 and 3 classifications) was more important in determining anaesthetic modality than depth of impaction (Pell and Gregory A, B and C classification). Overall, the data suggests that operators utilise two main variables when determining case difficulty and method of anaesthesia: spatial relationship of the third molar to the ramus and the angulation of the tooth.

The initial hypothesis was that the method of anaesthesia and impaction classification based on radiographic appearance of the case would play a significant role in determining the complication rates. Based on data collected, a clear correlation between perceived difficulty and chosen method of anaesthesia was found. There was a statistically significant increase in Alveolar Osteitis for cases performed under LA. However, when pooling all the complications together, there was no significant relationship between anaesthetic modality and

procedural complications for gender, age or any radiographic classification. These findings support those of Rehman et al 2002 (18) and Hill et al 2001 (19) who found no statistically significant association between anaesthetic modality and overall complication rate in third molar surgery. In contrast, these findings are in direct opposition to those in several other studies (10, 13-17). For most of these studies, the higher complication rate in GA can be explained by the fact that more difficult cases were generally performed under GA. However, Brann et al 1999 (15) found a statistically significant difference between complications under LA (3%) versus GA (18%) that could not be explained by surgical difficulty, pre-operative pathology, age or anatomical position.

The conflicting data highlights the need of further research in this area to determine whether anaesthetic modality can indeed influence third molar surgical complications. Until this data is available, it is reasonable to suggest that the decision on whether to perform third molar surgery under local versus general anaesthesia should not be based on complication rates, but rather on importing clinical factors such as patient preference, surgical difficulty, medical background and economic factors.

In light of these findings, other variables were assessed based on the data collected to determine if any significant correlations can be found. Within the overall categories of Age and Gender (including both LA and GA), the data collected demonstrates that patients under 25 had 35% of the total complications while patients over 25 had 65%. Considering the data set included 166 patients under 25 and 101 patients over 25, this shows that patients over 25 are three times as likely to have a complication compared to patients under 25. Similar findings have been shown in several studies (2, 4, 8, 9, 16, 17, 29, 30). Furthermore, only 20% of total complications occurred in males versus 80% in females. Considering that there were 342 female and 181 male patients in the study, the data suggest that females are twice as likely to experience post-operative complications compared to males. Unfortunately, operator experience and its influence on complication rate under LA and GA could not be reliably assessed in this study as was mentioned previously, however the literature supports the notion that increased operator experience will reduce the incidence of adverse events (9, 16, 30, 31). When assessing teeth with the same difficulty classification, there was a higher proportion of complications under LA for PG A1 and vertical impactions, whereas under GA the complication rate was higher for PG A2, A3, B2, B3, mesioangular, horizontal and

distoangular impactions. However, this finding is likely related to the fact there was a higher frequency of those impactions seen in the total sample size, hence by probability the chance of complication increases (Table 2, Table 3).

In interpreting this data set, there are certain limitations that must be considered. An obvious trend was the number of patients that did not attend postoperative review appointments. This low rate of postoperative appointment attendance can be due to many factors, including distance to travel for rural patients, costs and work commitments. As such many patients with minor post-operative complications may not necessarily return to the RDHM but rather seek treatment by a dentist or physician locally. This can lead to an underestimation of true postoperative complications. To account for this, the OMFS department at RDHM has improved their policy and have recently incorporated the option of a postoperative phone call to reduce the need for patients to come back into the clinic. Although not without limitations, this practice ensures that patients who cannot attend the hospital for postoperative reviews are still accounted for. Additionally, literature shows that there can be issues with under-reporting of certain complications by operators in fear of punitive

action or disrepute amongst colleagues and superiors (32, 33).

However, since patients either presented to the RDHM emergency department or to the OMFs department for their routine post-op visit for management of their complication they often saw a different clinician than the one who performed the procedure, which tends to reduce the likelihood of under-reporting.

The findings of this paper supplement the current literature and current practices of third molar surgery. Based on the results, the method of anaesthesia does not play a significant role in the overall postoperative complication rate. As such, it is reasonable for clinicians and patients to base their decision for the modality of anaesthesia on perceived surgical difficulty and length of procedure, patient anxiety and overall preference, the patient's medical background, as well as economic variables such as cost and public waitlist times.

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TABLES

Table 1. Classification of pre operative and post-operative variables collected	
Variable (Definition)	Classification
Gender	1. Male
	2. Female
Age	1. <25 yr old
	2. ≥25 yr old
Method of Anaesthesia	1. Local Anaesthetic (LA)

	2. General Anaesthetic (GA)
Pell and Gregory - Depth of Impaction	A. The occlusal plane of the impacted tooth is at the same level as the adjacent tooth.
	B. The occlusal plane of the impacted tooth is between the occlusal plane and the cervical line of the adjacent tooth.
	C. The occlusal plane of the impacted tooth is apical to the cervical line of the adjacent tooth.
Pell and Gregory - Lateral Spatial Relation	1. Situated anterior to the anterior border of the ramus.
	2. Crown ½ covered by the anterior border of the ramus.
	3. Crown fully covered by the anterior border of the ramus.
Winter's - Angulation (In relation to long axis of second molar)	1. Mesioangular 11-79°
	2. Horizontal 80-100°
	3. Distoangular -11 to -79°
	4. Vertical 10 to – 10 °
	5. Other (inverted, buccolingual)
Abbreviations: AST, Advanced surgical trainee; BST, Basic surgical trainee	

Table 2. Frequency of third molars in concordance with the Pell and Gregory classification system.			
Classification	Frequency (local anaesthetic)	Frequency (general anaesthetic)	Frequency (overall)
A1	121	21	142
A2	45	106	151
A3	1	22	23
B1	50	7	57
B2	9	77	86
B3	0	44	44
C1	11	0	11
C2	2	3	5
C3	0	4	4
TOTAL	239	284	523

Table 3. Frequency of third molars in concordance with Winters classification system			
Classification	Frequency (local anaesthetic)	Frequency (general anaesthetic)	Frequency (overall)
Vertical	124	68	192
Horizontal	11	26	37
Mesioangular	78	135	213
Distoangular	26	53	79
Other	0	2	2
TOTAL	239	284	523

Table 4. Frequency of complication by method of anaesthesia					
Complication	Frequency (LA)	Frequency (GA)	Total % (LA)	Total % (GA)	Significance
Alveolar Osteitis	5	0	100%	0	S (P= 0.017)
Temporary Paresthesia (IAN)	2	3	40%	60%	NS
Temporary Paresthesia (LN)	0	1	0	100%	NS
Infection	1	7	12.50%	87.5%	NS
Haemorrhage	1	0	100%	0	NS
Total	9	11	45%	55%	
Abbreviations: LA, local anaesthetic; GA, general anaesthetic; NS, not significant; S, significant					

Table 5. Factors affecting complication rates when comparing procedures performed under LA or GA				
Variable	Classification	LA Complications	GA Complications	Significance
Gender	Male	1	3	NS
	Female	8	8	
Age	<25 yr old	2	5	NS
	≥25 yr old	7	6	
Pell and Gregory	A1	7	0	NS
	A2	1	2	
	A3	0	1	
	B1	0	0	
	B2	0	4	
	B3	0	4	
	C1	0	0	
	C2	0	0	
	C3	0	0	
Winters	Mesioangular	1	5	NS
	Horizontal	1	3	
	Distoangular	1	2	

Vertical	5	1
Other	0	0
Abbreviations: LA, local anaesthetic; GA, general anaesthetic; NS, not significant		

Figure Legends:

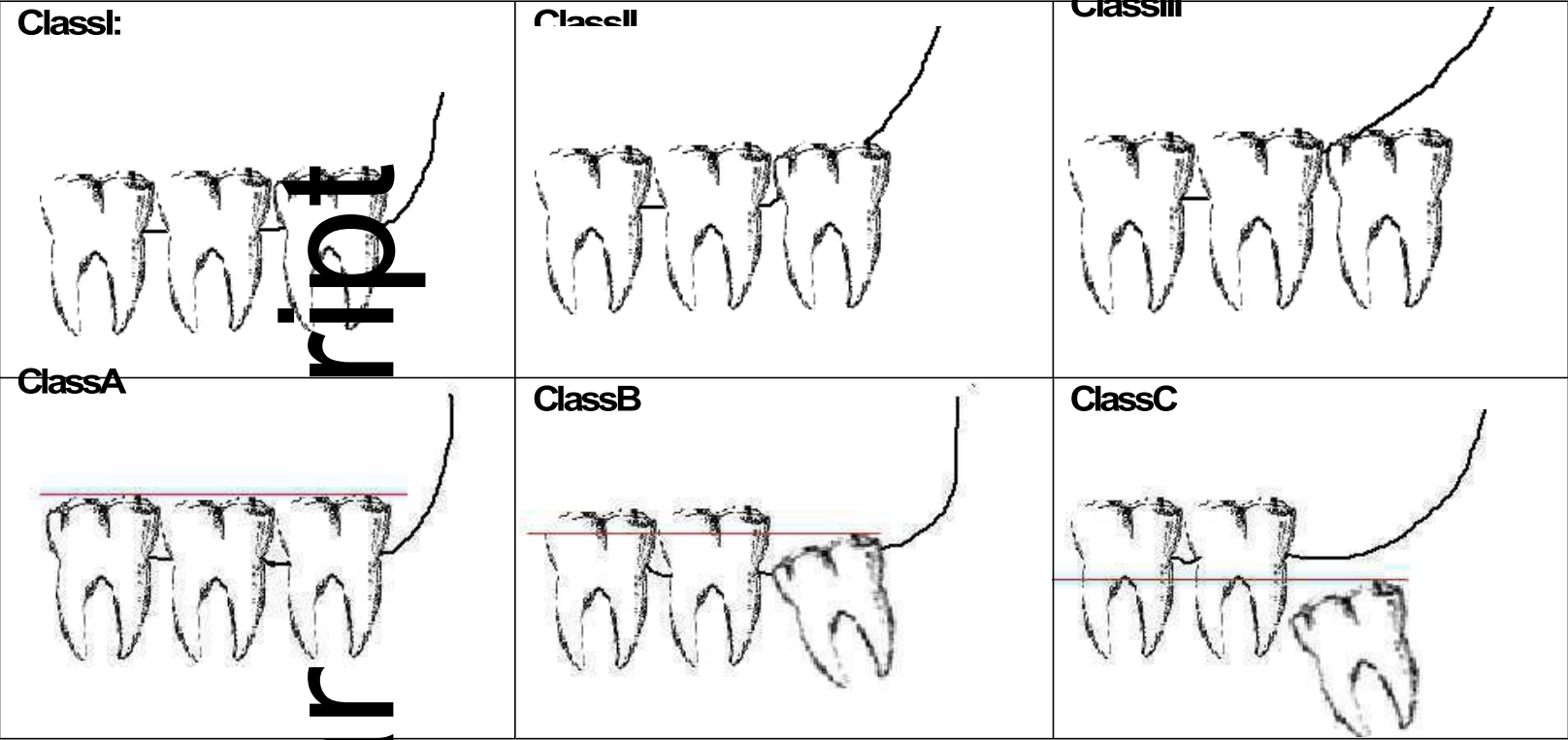
Figure 1. Pell and Gregory Classification Criteria

Figure 2. Winter's Classification Criteria

Figure 3. Bar graph portraying frequency of complication by method of anaesthesia.

Abbreviations: IAN, Inferior Alveolar Nerve; LN, Lingual Nerve

Figure 1. Pell and Gregory Classification Criteria



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Figure2. Winter’sClassificationCriteria

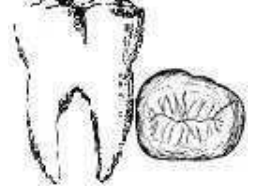
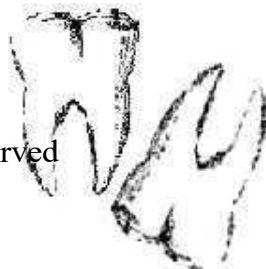
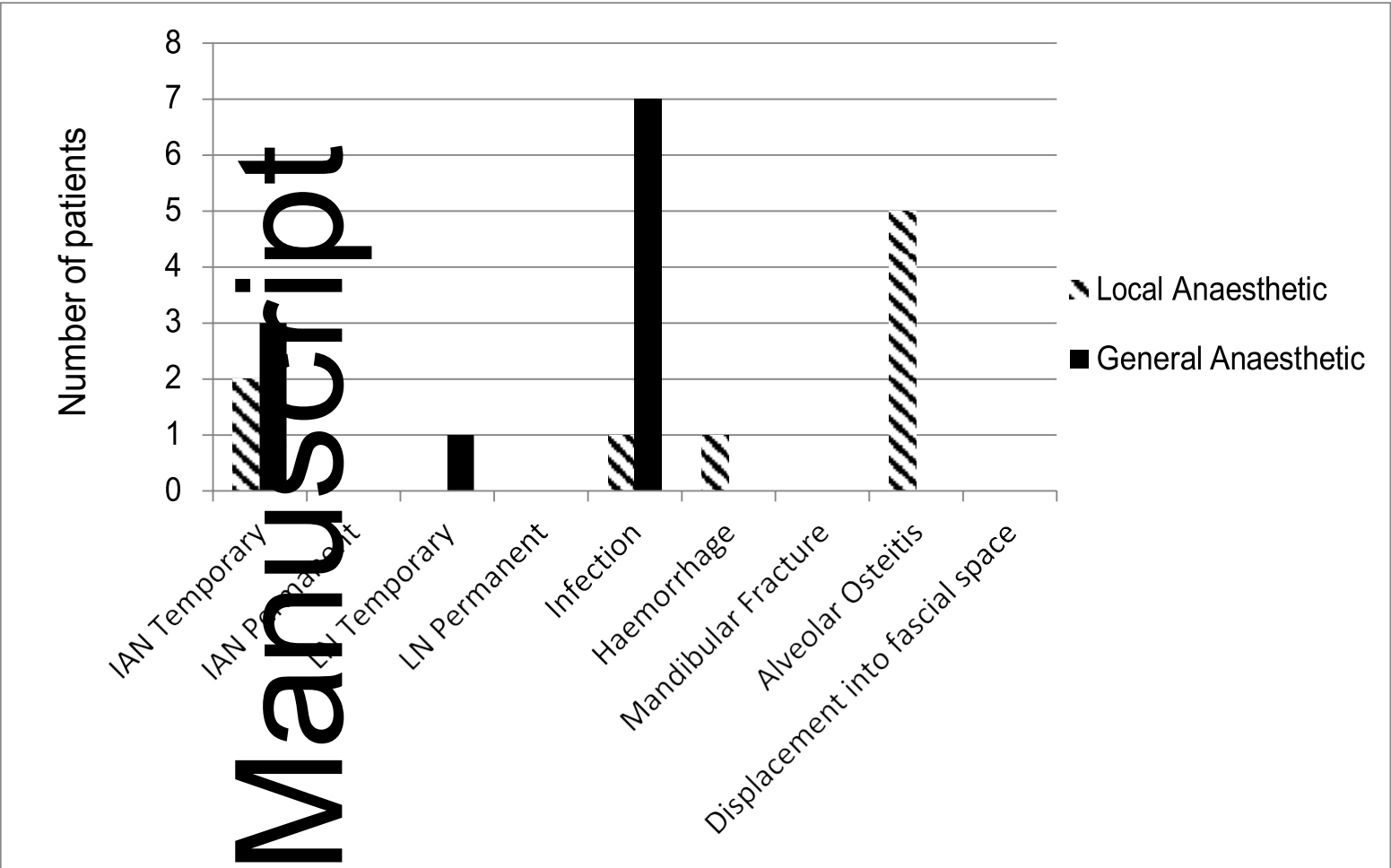
TypeofAngulation	
Vertical	
Horizontal	
Mesioangular	
Distoangular	
Buccolingual	
Other	

Figure 3. Bar graph portraying frequency of complication by method of anaesthesia.



Abbreviations: IAN, Inferior Alveolar Nerve; LN, Lingual Nerve

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Beteramia, D;Azami, O;Garg, K;Grubor, D

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