Report

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Post-operative complications following dental extractions at the School of Dentistry, University of Otago

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ABSTRACT

Objectives: To determine the frequency and correlates associations of post-extraction complications at a dental school.

Design: Retrospective review of patient records.

Setting: Exodontia clinic at the School of Dentistry, University of Otago, Dunedin.

Main outcome measures: Provider characteristics, patient demographic characteristics, patient medical history, teeth extracted and occurrence of post-operative complications.

Results: Of the 598 extractions (540 routine and 58 surgical) which were undertaken in the audit period, 74 (12.4%) resulted in post-operative complications. Dry socket and post-operative pain were the major complications. A higher complication rate was found among patients treated by fourth-year undergraduate students than among those treated by more senior students or staff. Post-operative complications were not significantly associated with patients' ethnicity or medical history.

Conclusion: The rate of postoperative complications at the Univeristy of Otago's Faculty of Dentistry is consistent with reports in existing literature and inversely associated with operators' experience.

INTRODUCTION

Ranging from single tooth extraction to full arch clearances, exodontia constitutes an integral and routinely-undertaken part of general dental practice. It is a relatively straight-forward procedure, but it can be frequently followed by minor post-operative complications such as post-operative bleeding or pain. Most risk factors for complications (following both routine and surgical extractions including third molars) are patient-related, and include age, sex, medical status, medications, habits (such as smoking), history of past complications, and the nature of the extraction itself – whether traumatic or atraumatic (Alkhateeb et al, 1991; Oginni et al, 2003). Moreover, operator-related risk characteristics—such as level of experience and how long they take to do the procedure (Sisk et al, 1986; Oginni et al, 2002)—are considered relevant. Although the outright prevention of complications is desirable, it is not always achievable; however, it is helpful (among other precautions) to minimise extraction trauma and eliminate smoking, together with appropriate postoperative care.

However, most of the literature on post-operative complications is based on lower third molar surgery, which is a more difficult procedure than routine tooth extraction. Few published studies have focused on the post-operative complications associated with routine exodontia.

This study focuses on complications following non-specialist level routine and surgical exodontia performed by dental students and general dental practitioner staff at the Faculty of Dentistry in the University of Otago (exodontia treatment provided by specialist staff was not included). The aim was to report on the incidence and types of post-operative complications experienced by patients following routine exodontia under local anaesthesia.

METHODS

The study protocol was approved by the University of Otago Ethics Committee and involved a retrospective audit of the clinical notes of all patients who had been treated in the exodontia clinic at the Faculty of Dentistry at the University of Otago during the period 1 February to 30 June 2012.

Exodontia was provided by staff members and students in the context of a dental student learning environment.

DATA COLLECTION

All patients who had treatment in the exodontia clinic were included. Patients who had teeth removed in other clinics (such as in the minor oral surgery clinic) in the institution were excluded. Data were collected on patients' age, sex, ethnicity and medical history. The ethnicity section of the patient enrolment forms was used to identify the self-declared ethnicity of the patients (in order to categorise them as "Europeans", "Maori", and "Others"). Medical history data were categorised into immunocompromised, haematological disorders, smokers, cardiovascular diseases, diabetes, oral contraceptives and history of previous complications following exodontia. Patients with hepatitis, HIV/AIDS, liver cirrhosis or who were on long-term steroids were categorised as immunocompromised, whereas those with diagnosed anaemia, haemophilia or thrombocytopaenia were categorised as having haematological disorders. Patients with coronary heart disease, cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis or pulmonary embolism were categorised as having cardiovascular disease. Patients were coded as being affected or unaffected for each of these conditions. Information extracted from patient records included the number of teeth extracted, as well as the specific teeth that were removed, details of the mode of extraction (whether simple non-surgical extractions or surgical extractions), and the occurrence of complications following the initial surgery.

The groups of clinicians (fourth-year undergraduates, fifth-year undergraduates and graduate dentists) who carried out the extractions were identified by matching the dates and days of

Table 1. Patient characteristics by number of dental extractions

	Simple extractions only N (row %)	One or more surgical extractions N (row %)	Total teeth extracted N (mean per patient)	Total patients N (column %)
Sex				
Males	283 (91.0)	28 (9.0)	311 (1.4)	218 (48.0)
Females	257 (89.5)	30 (10.5)	287 (1.2)	236 (52.0)
Ethnicity				
NZ European	457 (81.6)	53 (18.4)	560 (1.5)	383 (84.4)
Maori	37 (97.4)	1 (2.6)	38 (1.3)	30 (6.6)
Other	46 (92.0)	4 (8.0)	50 (1.2)	41 (9.0)
Age				
≤20 years	29 (100.0)	0 (0.0)	50 (1.7)	29 (6.4)
21-30 years	92 (89.3)	11 (10.7)	139 (1.3)	103 (22.7)
31-40 years	59 (92.2)	5 (7.8)	84 (1.3)	64 (14.1)
41-50 years	65 (89.0)	8 (11.0)	94 (1.3)	73 (16.1)
51-60 years	78 (91.8)	7 (8.2)	105 (1.2)	85 (18.7)
61-70 years	38 (88.4)	5 (11.6)	54 (1.3)	43 (9.5)
≥71 years	51 (89.5)	6 (10.5)	72 (1.3)	57 (12.6)
Overall	**540 (90.3)**	**58 (9.7)**	**598 (1.3)**	**454 (100.0)**

the extractions with the oral surgery rosters of students/graduate clinicians who had been working on those particular days.

Data were electronically entered into Microsoft Excel and imported into SPSS version 20.0 for statistical analysis. Data were recategorised where necessary. The chi-square test was used to test the statistical significance of observed associations, with the P value set at 0.05.

RESULTS

The records of 470 patients were reviewed, and a total of 616 extractions were identified (some had had multiple extractions on the same day). Records for 16 patients (who had 18 extractions) were excluded due to incomplete data. Subsequent analyses were restricted to the remaining 454 patients (96.6% of reviewed cases), who received a total of 598 extractions (mean = 1.3 teeth; mode = 1 tooth). Of those patients (Table 1), 100 (22.0%) had more than one tooth extracted (maximum of 9 teeth; 6.6% of patients overall had three or more teeth extracted). About one-tenth of extractions were surgical. Males had a sllightly higher greater mean number of teeth extracted, but the difference was not statistically significant. Patients ranged in age from 11 to 91 years, with a mean age of 45 years (SD 19.3), with the greatest proportion aged 21-30 years. Most patients were NZ European.

No cases of postoperative bleeding or bruising were documented. No significant differences were identified in the post-operative complication rate according to age. Patients aged under 45 years had fewer underlying medical conditions than those aged over 45 years, but the rate of post-operative complications was only slightly greater among the latter (P>0.05). Of the 598 extractions provided, 73 (12.2%) resulted in post-operative complications. Data on post-operative complications among those having simple (nonsurgical) extractions are presented in Table 2. Of all 412 non-surgical tooth extractions, 57 (13.8%) resulted in post-operative complications. Dry socket was the most common complication (58.9% of complications, 7.7% of all single-tooth extractions) with twice the proportion of female patients presenting with this complaint than males.

The greatest incidence of post-operative complications was found among patients treated by fourth-year undergraduate students (18.5%), followed by patients treated by fifth-year students (11.0%) and graduate dentists/tutors (9.6%); this difference was statistically significant and examination of the adjusted residuals (respectively: 2.41, -0.40, and -1.95) revealed that the difference was between the fourth-year undergraduate students and the other two groups, with no significant difference between fifth-year students and graduate dentists/tutors. Operator experience is a factor that may influence post-operative complication rates, but most surgical extractions (which carry a greater risk of complication) were performed by more experienced operators. In order to enable comparison of postoperative complications following simple extraction by operator experience, further analyses were conducted excluding surgical extractions. Postoperative complications followed only 4.3% of routine extractions performed by graduate dentists/tutors.

About one in every 11 extracted teeth were incisors or canines (Figure 1 and Table 3), and nearly one-third were first or second premolars (29.6% of all teeth extracted), while first, second, and third molar teeth comprised about 20% each (23.8%, 20.7%, and 17.3%, respectively). More maxillary teeth were extracted than mandibular teeth (56.7% and 43.3% respectively) overall. Dry sockets occurred more frequently following extraction of first and second molar teeth, particularly in the mandible.

DISCUSSION

This study audited routinely-collected data on extractions provided in an institutional exodontia clinic and found a relatively high rate of post-operative complications among patients treated

Table 2. Patient characteristics by post-extraction complications (for routine dental extractions)

	Dry socket N (%)	Pain/Trismus N (%)	Infection N (%)	No complications N (%)
Sex				
Females	22 (10.3)	14 (6.5)	1 (0.5)	177 (82.7)
Males	10 (5.1)[b]	9 (4.5)	1 (0.5)	178 (89.9)[b]
Medical problems				
Immune-compromisation	0 (0.0)	3 (25.0)[c]	0 (0.0)	9 (75.0)
Haematological disorders	0 (0.0)	2 (12.5)	0 (0.0)	14 (87.5)
Smokers	2 (5.7)	5 (14.3)[b]	0 (0.0)	28 (80.0)
Cardiovascular diseases[e]	4 (5.0)	5 (6.2)	1 (1.2)	70 (87.5)
Diabetic patients	3 (10.3)	1 (3.4)	0 (0.0)	25 (86.2)
History of exodontia complications	5 (17.9)[b]	4 (14.3)[b]	0 (0.0)	19 (67.9)[c]
Age of patient				
≤20 years	0 (0.0)	1 (3.4)	0 (0.0)	28 (96.6)
21-30 years	6 (6.5)	5 (5.4)	1 (1.1)	80 (87.0)
31-40 years	3 (5.1)	4 (6.8)	0 (0.0)	52 (88.1)
41-50 years	10 (15.4)	4 (6.2)	0 (0.0)	51 (78.5)
51-60 years	10 (12.8)	6 (7.7)	1 (1.3)	61 (78.2)
61-70 years	1 (2.6)	1 (2.6)	0 (0.0)	36 (94.7)
≥71 years	2 (3.9)[b]	2 (3.9)	0 (0.0)	47 (92.2)
Experience level of provider				
Fourth-year student	16 (12.4)	9 (7.0)	0 (0.0)	104 (80.6)
Fifth-year student	10 (7.0)	9 (6.3)	1 (0.7)	123 (86.0)
Graduate	6 (4.3)[b]	5 (3.6)	1 (0.7)	128 (91.4)[b]
Number of teeth being extracted				
Single extractions	26 (7.9)	20 (6.1)	2 (0.6)	278 (85.3)
Multiple extractions	6 (7.0)	3 (3.5)	0 (0.0)	77 (89.5)
Total cases	**32 (7.7)**	**23 (5.5)**	**2 (0.4)**	**355 (86.2)**

[a] Row totals may sum to greater than this as a small number of patients had more than one complication.
[b] P<0.05, χ^2 test.
[c] P<0.01, χ^2 test.
[d] Patients who had one or more surgical extractions are excluded from this table, including those who had both surgical and simple extractions, so total does not sum to 454.
[e] Includes coronary heart disease, cerebrovascular disease, rheumatic heart disease, congenital heart conditions and thromboembolic disorders.

Table 3. Tooth characteristics by post-operative complications (multiple extractions excluded)

	Dry socket N (%)	Pain/Trismus N (%)	Infection N (%)	No complications N (%)	Overalla N (%)
Type of tooth being extracteda					
Incisor or canine	1 (3.6)	1 (3.6)	0 (0.0)	26 (92.9)	28 (8.6)
Premolars	4 (4.2)	5 (5.2)	0 (0.0)	87 (90.6)	96 (29.6)
First molars	8 (10.4)	6 (7.8)	1 (1.3)	62 (80.5)	77 (23.8)
Second molars	11 (16.4)	6 (9.0)	0 (0.0)	50 (74.6)	67 (20.7)
Third molars	2 (3.6)[b]	2 (3.6)	1 (1.8)	51 (91.1)[b]	56 (17.3)
Archa					
Maxillary tooth	8 (4.4)	12 (6.6)	1 (0.5)	162 (88.5)	183 (56.7)
Mandibular tooth	18 (12.9)[c]	8 (5.7)	1 (0.7)	113 (80.7)	140 (43.3)
Overall (excluding surgical extractions)	**26 (8.0)**	**20 (6.2)**	**2 (0.6)**	**275 (85.1)**	**324**
Type of extraction					
Simple	26 (8.0)	20 (6.2)	2 (0.6)	276 (85.2)	324 (92.0)
Surgical	2 (7.1)	2 (7.1)	0 (0.0)	24 (85.7)	28 (8.0)
Overall	**28 (7.9)**	**22 (6.2)**	**2 (0.6)**	**300 (85.2)**	**354**

[a] Simple extractions only
[b] P<0.05, χ^2 test
[c] P<0.01, χ^2 test

by less experienced operators. Dry socket and post-operative pain were the two major post-operative complications. These findings are consistent with those of other studies (Oginni et al, 2003; Kolokythas et al, 2010).

Before considering the implications of these findings, it is important to consider the limitations and strengths of this research. A weakness is the nature of the data collection. As with analysis of routinely-collected data, the quality of the data is limited by what has been entered into the records (and its completeness). It may have been affected by either active or passive omission of relevant information, especially with medical histories, medication usage, or complications considered to be trivial. Given the relatively small number of participants from Maori and other non-European ethnic groups, the representativeness of the sample might be called into question; however, the sample is based on a clinical sample, and fewer Maori visit the dentist than those of European descent (Ministry of Health, 2010). One of the strengths of this study is that we assessed post-operative complications following routine exodontia (as opposed to focusing on third molar surgery), and all reported post-operative complications were included for analysis. Thus, the data presented in this study are unique and of relevance to general dental practitioners and undergraduate teaching institutions. Through using a broad sample of patients treated in a teaching institution, rather than focusing on patient-related factors alone, we have also been able to examine clinician 'experience level' as a possible risk factor for post-operative complications.

Comparisons with previous work are difficult because most other studies have focused on post-operative complications following lower third molar surgery. However, our study found some similarities in relation to the operator and patient factors that were associated with the development of post-operative complications. Our study showed that more than one in every ten extractions was followed by post-operative complications. Of these, dry socket was the predominant complication (almost 60% of all such) and occurred more frequently than reported in other studies (Oginni et al, 2003; Kolokythas et al, 2010). Dry socket may be defined as severe pain developing 2 to 3 days postoperatively, with an extraction socket that may be partially or totally devoid of blood clot (Kolokythas et al, 2010; Daly et al, 2012), but its definition varies among both clinicians and researchers. In a Cochrane summary review on the topic of dry socket, Daly et al (2012) found that it was difficult to make comparisons among studies because of the variability in the working definition of what constitutes a dry socket. Post-operative pain (as distinct from dry socket) was also a common complaint in our study (affecting more than one-third of patients).

No cases of post-operative bleeding or infection were observed. Bui et al. (2003) reported that bleeding was very common post-operatively, but that study considered complications after third molar surgery, and so a direct comparison cannot be made.

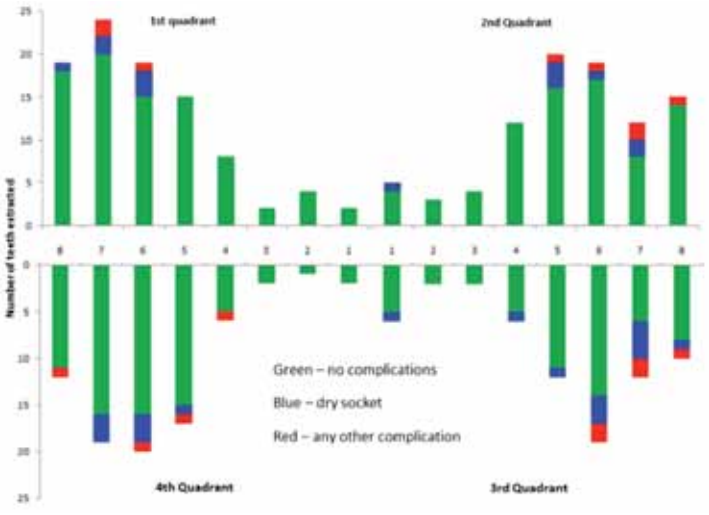
Female sex is often mentioned as a risk marker for post-operative complications. Several studies have reported a greater rate of post-operative complications among female patients than males (Muhonen et al, 1997; Oginni et al, 2002; Malkawi et al, 2011), in line with the findings of this study. Some researchers have suggested that this difference exists because of oral contraceptive use (another commonly reported risk factor); consequently, some studies have made a distinction between female patients on oral contraceptives and those who are not (Cohen and Simecek 1995; Muhonen et al, 1997). None of the females in our sample indicated the use of oral contraceptives in their medication histories, and so the difference between males and females in our study cannot be attributed to oral contraceptive use alone. However, it is likely that patients did not volunteer information on oral contraceptive use because they may not see it as a medication for treating an ailment; this is a limitation of the current study.

Ethnicity is not a characteristic commonly associated with post-operative complications, although some have suggested that lower third molar extractions are more difficult among certain ethnic groups (Renton et al, 2001). In our study, a greater proportion of NZ Europeans than Maori patients required surgical extractions of teeth, suggesting less difficulty in removal of teeth of Maori patients (although no conclusions can be drawn from these findings, because selection bias may be an issue), but this did not relate to any observed difference in the rate of postoperative complications.

It is fairly well accepted that a higher rate of post-operative complications is seen with increasing age (Muhonen et al, 1997; Bui et al, 2003; Malkawi 2011), and some third molar studies have suggested that, after the age of 25 years, a higher post-operative complication rate can be expected (Chuang et al, 2007; Pogrel 2012). The mean age of patients was in this study was 45 years, so comparisons were made using cut-points of 25 years and 45 years of age, and no significant differences were found.

A clinician's experience may also affect complication rates in oral surgery (Oginni et al, 2003; Kolokythas et al. 2010). Several studies have reported lower rates of post-operative complications following lower third molar surgery by more experienced operators (Sisk et al, 1986; Muhonen et al, 1997; Renton et al, 2001; Malkawi et al, 2011), and this was attributed to shorter surgical duration and less traumatic techniques. Similarly, Oginni et al. (2002) found that dry socket occurred more frequently following routine exodontia performed by undergraduate students and house-officer-level dentists than that done by more experienced Faculty staff. This association between experience and complication rate was also seen in the current study, where patients treated by the most junior operators

Figure 1. Number of teeth extracted by site, nonsurgical single tooth extractions only.



(fourth-year students) had a significantly greater rate of post-operative complications than those treated by graduate dentists. The difference was even greater between fourth-year students and graduate dentists when surgical extractions (normally performed by the staff) were removed from the analysis. This supports an inverse association between operator experience and post-operative complications. However, there are still characteristics that should be taken into account which may affect these differences, especially among the graduate dentist group, who may range in experience from house surgeon level to highly experienced general dentists.

Medical comorbidities and medications have been associated with the development of post-operative complications following lower third molar surgery; they include tobacco smoking, the use of oral contraceptives, and bleeding disorders (Mulhonen et al, 1997; Bui et al, 2003). However, our findings suggest that their influence is weaker than that of other risk factors such as age, difficulty of extraction and operator experience

This study has identified characteristics that are related to the development of post-operative complications. From a strategic outlook, this type of information can also be used to help guide future directions in curriculum development. The current system of triaging/allocating exodontia patients to students may not be ideal. Insufficient time is available for students to obtain greater exposure to oral surgery procedures, given the number of students and limited chair space. An increase in the time spent in minor oral surgery might be achieved through increasing the number of patient treatment chairs and students working in exodontia, but it would require a proportionate (and expensive) increase in staffing levels. Revision of the exodontia triaging system to ensure all gradings were done by a trained and calibrated clinician would improve the allocation of patients to operators with different levels of experience. It remains important that difficult exodontia cases should be used as teaching cases, in order that experience may be passed from Faculty staff to students.

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