

Relationship between Route of Antibiotic Administration and Post-surgical Complications Following Removal of Lower Third Molars.

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ABSTRACT

This prospective clinical trial aims at evaluating the effects of antibiotic therapy following different administration routes on the postoperative complications of surgical removal of lower impacted third molars.

Two hundred and forty eight consecutive patients (100 males and 148 females) aged 18 to 38 years old (mean=24±5 years) were recruited into this study. The lower third molars of all recruited patients were surgically extracted. Participants received preoperative antibiotic cover either as intravenous Cephadrine injection (1 gram) or oral dose of 500 mg Cephalexin. Immediate and late complications following the surgery; including pain, swelling, trismus, paraesthesia, bleeding, dry socket, infection and fracture of mandible; were assessed 3 days and 7-14 days following the surgery.

The most frequent complications were slight pain, swelling, and trismus. Oral route of antibiotic administration was associated with more immediate and late complications ($p<0.001$). Oral route of antibiotic administration was associated with more pain, swelling, trismus, and dry socket ($p<0.05$).

Following surgical extraction of third molars, intravenous antibiotic administration was more effective in reducing the post surgical complications than oral antibiotic administration.

Keywords: Antibiotic Route, Third Molar, Post-Surgical Complications.

INTRODUCTION

The removal of lower third molars is the most common intervention in oral surgery¹. It is usually associated with significant post-operative complications that have biological and social impacts^{2,3}.

Complications incorporate pain, swelling, trismus, dysaesthesia, fracture of mandible, infection, dry socket, hemorrhage, damage to adjacent teeth, and displaced teeth^{4,5}.

The use of antibiotics in the presence of an ongoing infection is not in dispute⁶.

However, the effectiveness of antibiotics in the prevention of postoperative infection for cases in which

third molars are removed is still controversial. Some studies oppose the use of antibiotics and showed no benefit of prescribing them for third molar surgery⁷⁻¹².

On the other hand, some studies demonstrated significant effects of antibiotics in the reduction of post operative complications following third molar surgery¹³⁻¹⁵.

The use of antibiotics is still thought to affect the incidence of complications after third molar surgical removal^{4,5}. Different antibiotics were used following third molar extraction including metronidazole, penicillins, lincomycin, tetracyclins, neomycin, azithromycin, cephalosporins and others.

Systemic administration is still the most frequent form of antibiotic prophylaxis in third molar surgery, although antiseptic mouthwashes and locally administered antibiotics are used to prevent postoperative infection^{4,5,14,16}.

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In addition, intravenous route for antibiotic administration is used for third molar surgery^{14,16}.

Foy et al. (2004) found that intravenous administration of antibiotics before third molar surgery could improve clinical recovery in healthy adult patients with the presence of risk factors that might suggest delayed recovery such as having the third molars below the occlusal plane (16).

Antibiotic treatment might decrease swelling, pain, or trismus; and improve wound healing (6,13-15,17-18).

Some researchers reported that antibiotics reduce infections following third molar surgery but should not be prescribed in all cases and are not recommended for routine use (19).

With the modern advances in the contemporary standards of antibiotic prophylaxis in dentistry, it is important to monitor antibiotic use and prescription among dental practitioners as well as facilitate continuing education for practitioners regarding the public health risks related to the over-prescription of antibiotics (20).

Many studies were inadequate and of poor quality because they suffered flaws such as small sample sizes, no control groups and insufficient statistical power to avoid type II, or false-negative errors (20).

Consequently, clinicians would benefit from knowing whether it is clinically suitable to use effective antibiotic therapy for third molar surgery. Also, patients would not sustain the risk of pharmacological over-treatment or side effects. Therefore, further studies are still required in this regard (19,20).

The aim of this prospective study was to evaluate the effects and efficacy of antibiotic therapy using either oral or intravenous routes of antibiotic administration on the postoperative complications of surgical extraction of lower impacted third molars.

Patients and Methods:

Two hundred and forty eight consecutive patients (100 males and 148 females) were recruited into the study from patients who attended the Oral and Maxillofacial Surgery Department at Jordan University Hospital, Amman, Jordan for surgical extraction of lower third molars. Patients were 18 to 38 years old (mean=24±5

years).

An invitation to participate in the study was extended to the patients. Each participant was provided with a full explanation of the study and an informed consent was obtained from each participant before being recruited into the study.

One investigator conducted all clinical and radiographic examinations and thoroughly assessed each patient before and after third molar surgical extraction. The assessment included patients' dental and medical histories, complaints, and personal information including name, age, gender, education, occupation, address and marital status. Patients with any medical problem were excluded from the study. Only patients with fully impacted third molars that are partially or fully covered with bone were recruited into this study.

Intra examiner reliability was performed on 25 duplicate examinations using Kappa statistics. Kappa was 0.97 indicating substantial agreement as examination criteria were very clear and simple.

The lower third molars of all recruited patients in this study were surgically extracted by the same surgeon who was an experienced consultant in Oral and Maxillofacial surgery. Non-traumatic surgical approach was adopted during the removal of all third molars. The extracted teeth were removed by simple elevation following the removal of bone from around and height of contour of tooth and tooth division. This technique ensured reducing trauma levels to the minimum.

The study population was distributed into 2 groups according to gender. The males group was then divided to 2 subgroups (M1 and M2) that were equal in the number of participants (M1=50 participants and M2=50 participants) and matched by age. The females group was also divided to 2 subgroups (F1 and F2) that were equal in the number of participants (F1=74 participants and F2=74 participants) and matched by age. The study sample was finally comprised of 2 groups; each contains 50 males and 74 females. One group received preoperative oral antibiotic (Cephalexin 500mg) and the other group received intravenous antibiotic (Cephadrine 1g).

After surgery, the immediate and late complications

of the surgery were assessed.

The assessed complications included pain, swelling, trismus, paraesthesia, bleeding, dry socket, infection and fracture of mandible. The immediate complications were assessed during the first 3 days following the surgery and late complications were assessed 7-14 days later according to Siddiqi et al. (2010) ¹².

Statistical Analysis:

The data were analyzed using the SPSS computer software (Statistical Package for the Social Sciences, version 11.0, SPSS Inc., Chicago, IL, USA). The association between the variables was analyzed using the Chi-Square test, while the linear regression analysis was used to predict complications using the timing of antibiotic administration. For all statistical analysis, the significance level was set at $P \leq 0.05$.

Results:

Oral antibiotic cover was given to 124 patients (50 males and 74 females) while intravenous antibiotic cover was given to 124 patients (50 males and 74 females).

The most frequent immediate complications were slight pain, swelling, and trismus. Patients' immediate complications are summarized in Table (1).

The most frequent late complications were also slight pain, swelling, and trismus. However, 143 patients recorded no late complications at all. Late complications are summarized in Table (2).

Table 1: Immediate complications associated with surgical removal of lower third molar (n=248).

Complication	Frequency	Percent
slight pain	20	8.1
slight pain and swelling	20	8.1
slight pain, swelling and trismus	121	48.8
slight pain and trismus	5	2
moderate pain, swelling and trismus	65	26.2
severe pain, swelling and trismus	17	6.9
Total	248	100.0

Table 2: Late complications associated with surgical removal of lower third molar (n=248).

Complication	Frequency	Percent
slight pain	1	0.4
slight pain and swelling	3	1.2
slight pain, swelling and trismus	10	4
slight pain and trismus	28	11.3
slight swelling and trismus	1	0.4
slight trismus	13	5.2
slight pain, trismus and dry socket	4	1.6
slight trismus and dry socket	27	10.9
dry socket	2	0.8
dry socket "smoker"	5	2
infected socket	2	0.8
no complications	152	61.3
Total	248	100.0

Correlations:

Immediate complications were significantly related to the route of antibiotic administration (Chi square test degree of freedom (df)= 5, $p = 0.000$). More frequent immediate complications were associated with oral antibiotic administration.

Late complications were significantly related to the route of antibiotic administration (Chi square test degree of freedom (df)= 11, $p = 0.000$). Most frequent late complications were associated with oral antibiotic administration and least complications were associated with intravenous antibiotic administration.

When each immediate complication was considered individually the following significant relations were identified using Pearson correlation: Oral antibiotic administration was associated with more immediate swelling ($r = -0.147$, $p = 0.02$) and immediate trismus ($r = -0.132$, $p = 0.038$). On the other hand, when each late complication was considered individually the following

significant relations were identified using Pearson correlation: Oral antibiotic administration was associated with more late pain ($r = -0.436$, $p = 0.000$), late swelling ($r = -0.245$, $p = 0.000$), and dry socket ($r = -0.358$, $p = 0.000$).

Linear regression analysis showed that the route of antibiotic administration could predict immediate complications following third molar surgical extraction ($R = 0.649$, $p = 0.000$), as well as predicting late

complications ($R = 0.528$, $p = 0.000$).

Using ANOVA test to compare the complications according to the route of antibiotic administration; significant differences were identified between the two groups in regard to immediate complications, late complications, immediate swelling, immediate trismus, late pain, late swelling, late trismus, and dry socket ($p < 0.05$). Oral route of antibiotic administration was associated with more significant complications (Table 3).

Table 3: ANOVA test to compare the complications according to the route of antibiotic administration.

Complication	Group Comparison	df	Mean Square	F	Significance
Immediate complications	Between Groups	1	45.306	27.272	.000
	Within Groups	246	1.661		
	Total	247			
Late complications	Between Groups	1	1333.165	81.839	.000
	Within Groups	246	16.290		
	Total	247			
Immediate Swelling	Between Groups	1	.488	5.458	.02
	Within Groups	246	.089		
	Total	247			
Immediate Trismus	Between Groups	1	.581	4.333	.038
	Within Groups	246	.134		
	Total	247			
Late Pain	Between Groups	1	7.113	57.644	.000
	Within Groups	246	.123		
	Total	247			
Late Swelling	Between Groups	1	.790	15.655	.000
	Within Groups	246	.050		
	Total	247			
Late Trismus	Between Groups	1	14.036	83.838	.000
	Within Groups	246	.167		
	Total	247			
Dry Socket	Between Groups	1	4.129	36.214	.000
	Within Groups	246	.114		
	Total	247			

Discussion:

Prophylactic antibiotics have been prescribed to reduce the possibility of postoperative local complications following third molar extraction.

This study reported a significant difference between the different groups where intravenous antibiotics were associated with less immediate and late complications than oral antibiotics.

After the surgical removal of lower third molars, the oral prophylactic antibiotic treatment was less effective in reducing immediate and late complications than

intravenous antibiotic administration and, therefore, is less recommended for routine use. This could be due to the ability of intravenous route to allow for higher levels of the antibiotic in blood and surgery site just before the surgery as compared with oral antibiotics. This concurs the results of previous studies²¹. Intravenous antibiotics are not exposed to the GIT factors that might hinder absorption and affect the biochemistry of the antibiotic.

The findings of this study are consistent with the established principles of systemic antibiotic prophylaxis, which state that the systemic antibiotic should be present

in the tissue before starting the procedure²² and that the use of post surgical antibiotics has no advantage²³.

Furthermore, the axiom of antibiotic prophylaxis is to provide an adequate drug level in the tissues before, during, and for the shortest time possible after the surgical procedure to prevent or reduce the incidence of postoperative infection^{24,25}.

Once surgery has been completed, antibiotics are no longer justified since they do not lessen any of the postoperative clinical symptoms²⁶.

Rout and Frame (1992) found that a single intravenous bolus injection of cefuroxime provided satisfactory alveolar bone concentrations for routine antibiotic prophylaxis at the time of wisdom tooth removal²¹. Adequate concentration of cephradine in serum and mandibular bone was reported in patients undergoing third molar surgery following a single 1 g intravenous injection²⁷.

Most articles involved either small numbers of patients in prospective studies or larger numbers in retrospective studies, none of which stated whether the

patients were all seen postoperatively⁶.

Unfortunately, a comparison of the published studies represents a tremendous challenge because of the variability in parameters and methods used for each study²⁸.

It is worth noting that the frequency of complications following surgical removal of third molars might be associated with other variables such as surgical techniques and the state of eruption of third molars. Every attempt was made during this study to standardize such factors by following atraumatic surgical technique and the removal of fully impacted third molars that were fully or partially covered by bone. Further studies are required to study the effects of other factors on post operative complications following the surgical extraction of lower third molars.

Conclusion:

Following surgical extraction of lower third molars, intravenous antibiotic administration is more effective in reducing the post surgical complications than oral antibiotic administration.

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