EVALUATION OF DRAIN USAGE IN ODONTOGENIC INFECTIONS, A 10 YEAR RETROSPECTIVE ANALYSIS

A Thesis
Presented in Partial Fulfillment of the Requirements for
The Degree Master of Science in the
Graduate School of The Ohio State University

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ABSTRACT

Purpose: The purpose of this study was to retrospectively evaluate patients with severe odontogenic infections and identify a potential correlation with type of drain used and length of hospital stay.

Patients and Methods: A medical chart review was completed retrospectively identifying patients with severe odontogenic infections admitted to The Ohio State University Medical Center under the Oral and Maxillofacial Surgery service from January 1, 2000 through December 31, 2009. Standardized data collection included length of hospital stay, type of drain, number of drains, site of infection, gender, age and pre-existing medical conditions associated with immunosuppression.

Results: The sample consisted of three hundred six subjects that underwent surgical incision and drainage, of which 59.5% were treated with non-irrigating drains. The remaining patients were treated with an irrigating drain alone, or in combination with non-irrigating drains. The mean patient age was 34.6 years; 34.8% were female, and 27 patients (8.8%) were immunocompromised. The mean length of stay was 5.70 days (SD=2.53). Variables that significantly increased length of stay include: site of infection and number of drains placed. The type of drain used did not significantly impact length of stay.
Conclusion: No significant differences existed in the length of stay related to type of drain selected. Length of hospital stay is best predicted on the basis of location and severity of infection.
ACKNOWLEDGMENTS

It is a pleasure to say thank you to those who made this thesis possible. Many people have been a part of my graduate education, as friends, teachers, and colleagues. Dr. Peter Larsen, first and foremost, has been all of these. The best advisor and teacher I could have wished for, he is actively involved in the work of all of his residents, and clearly always has their best interest in mind. Thank you for pushing me.

Thanks to my Master’s Examination Committee Dr.’s Larsen, Kreuter and Rashid for assistance in the development of this project.

A debt of gratitude to the authors of published works cited within. I now know first hand the difficulty involved in contributing quality information to the literature. They are truly advancing the specialty.

“In science the credit goes to the man who convinces the world, not the man to whom the idea first occurs”

-William Osler
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FIELDS OF STUDY

Major Field: Dentistry

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Chapter 1

Introduction

Maxillofacial infections are primarily related to dental disease and maxillofacial trauma.\textsuperscript{1} There have been great advances in the treatment of maxillofacial infections since 1836 when Wilhelm Frederick von Ludwig first described the disease process which now bears his name.\textsuperscript{2} Initial reports of Ludwig’s angina contend that the source was of dental origin in 51 percent of all cases.\textsuperscript{3} The incidence of mortality initially reported was greater than 50 percent in 1939 and greatly improved by 1943 to just 10 percent.\textsuperscript{2,3} It should not be overlooked that Alexander Flemming discovered penicillin in 1928 and the widespread use of it for the treatment of infections began in 1942.\textsuperscript{4} More recent literature suggests that the current mortality rate of deep neck infections has continued to decline to 1.6 percent in 2004.\textsuperscript{5}

Severe maxillofacial infections have been linked to violence and substance abuse and are more common in under-served patients who often obtain medical care through the emergency room of publicly funded hospitals.\textsuperscript{1,6} This subset of patients present with severe tooth related infections requiring surgical intervention and hospital admission for resolution of the infection. Infections can be related to anatomic
variation, limited access to care, neglect or complex medical illnesses that expose patients to increased risk.

The typical sequence of treatment involves extraction of the offending tooth or source and performing an incision in the neck and placing one or more drains into one or more anatomic spaces into which infection has spread. Next the patient is given appropriate antibiotics and observed for improvement, oftentimes necessitating intensive care. Antibiotic selection is based on the characterization of the infection by cause, location and flora. Hospital discharge criteria is based on resolution of symptoms including decreased swelling, declining white blood cell count, a period of abatement of fever and decreased malaise. The drain is removed once drainage ceases or becomes minimal and the patient is discharged with a home course of antibiotics.

Currently two types of drains are used, irrigating and non-irrigating. The choice of drain has been purely based on surgeon’s preference and frequently depends more on the surgeon’s training and less on scientific knowledge.

The purpose of the study is to determine if there is a statistically significant difference in length of stay in patients with odontogenic infections treated with irrigating drains versus non-irrigating drains.

A comprehensive review of the current literature revealed numerous studies regarding the length of hospital stay in patients with odontogenic infections. Flynn et al showed a mean hospital stay of 5.1 days with a standard deviation of 3.0, while Sato et al showed a mean hospital stay of 3.69 days with a standard deviation of 1.96. Meanwhile Storoe et al conducted a retrospective review covering two decades and showed a mean length of stay during the 1980’s of 6.66 with a SD of 6.20, and during the
1990’s a mean length of stay of 8.27 and a SD of 11.59. Clearly there are differences between institutions which is why our study is limited to one hospital and one admitting service with the specific etiology being of odontogenic origin.

Most studies analyzed multiple variables. The most common variable studied is antibiotic selection. Nearly all studies recorded general demographics such as age, race and gender. Additional data studied include: temperature on admission, white blood cell count, severity of infection as related to anatomic sites of involvement, attending surgeon, medical conditions, insurance class, specific tooth involvement, airway classification, and even the influence of weather has been investigated.\textsuperscript{13} One factor not accounted for is drain type. During our literature review there was only one instance where drain type was discussed\textsuperscript{10}. Surgical intervention is typically lumped into a broad category as a positive or negative finding. An article by Flynn et al\textsuperscript{10} discusses surgical intervention with placement of either a Penrose drain (non-irrigating drain) or a Jackson-Pratt drain (irrigating drain). No distinction is made between the two and no record of drain type is included in the statistical data presented.

Peters et al\textsuperscript{14} concluded that of all variables examined, length of stay is best predicted on the basis of underlying medical conditions and location of the infection. This belief is well founded and based on the concept that immunocompromised patients are more vulnerable to the development of serious infections.\textsuperscript{7,15}

For this reason we have chosen to study similar variables deemed important to overall outcomes and have added another variable not yet studied, which is irrigating drains versus non-irrigating drains.
The issue of irrigating drains versus non-irrigating drains is a significant factor as is evidenced in a statement by Flynn in Peterson’s Principles of Oral and Maxillofacial Surgery textbook “There is little evidence to indicate that frequent wound irrigation hastens the resolution of infection. However, it does make clinical sense to remove by irrigation bacteria, pus, clots, and necrotic tissue from infected wounds as they accumulate.” This text is widely considered the authoritative resource on oral and maxillofacial surgery. The problem is that there is no scientific evidence demonstrating that irrigation has any effect on infections either positive or negative; no studies have been performed to evaluate this.

For the purposes of this study we evaluated two commonly used drains at The Ohio State University Medical Center which include:

1) Penrose drains: A collapsible tube made of thin walled latex of 0.16cm thickness, described as x-ray opaque rubber. The drain is available in numerous sizes. For our study the most common size utilized was the 3/8 inch providing a 9.53 millimeter internal diameter, figures 1,2. This soft non-irrigating drain is named for Charles Bingham Penrose, a surgeon who introduced drainage in abdominal surgery in 1889.
2) Robinson (Red rubber) catheter: A thicker walled tube with a defined non-collapsible lumen. The most common size used in the study is an 18 French Robinson catheter measuring 6.0 millimeters in outer diameter. Latex and non-latex varieties are available and the rubber is manufactured to be x-ray opaque. The drain has a funnel at one end and a round hollow tip with opposing eyes or fenestrations at the other, figures 3,4,5. This feature allows for delivery of fluid from the funnel end to be expressed through the fenestrations at the other end and into the wound. The Robinson catheter is typically used as a urinary catheter to drain urine from the bladder. This differs from a Foley catheter in that the Robinson has no balloon at the tip.
Surgeons utilizing irrigation drains typically lavage the wounds with either a bacitracin and saline mix (50,000 units bacitracin per liter of normal saline) or saline alone. This was completed by gently irrigating with 90ml of the preferred solution every eight hours.

The aim of this study is to explore the possibility that drain selection affects length of hospital stay in patients with severe odontogenic infections. Potential confounding co-variables of the study include: inaccuracies in the medical chart, antibiotic resistance and a qualitative based discharge criteria.
A comprehensive list of patients was populated by the records department at Ohio State University Medical Center. The initial list consisted of all patients admitted to the Oral and Maxillofacial Surgery service between the dates of January 1, 2000 through December 31, 2009, during which time the procedures under investigation were being performed. This list included any admissions of longer than twenty three hours and totaled 1,016 patients. Each chart was then reviewed using strict inclusion criteria.

Inclusion into the study required that:

1) Patients were admitted for treatment of an odontogenic infection only. All other admissions for infections from other causes were excluded.

2) Patients must have undergone surgical management of the infection via transcutaneous approach with drain placement. Infections included were limited to serious life threatening infections, urgently requiring extensive surgical intervention. Minor infections requiring intraoral incision and drainage only were excluded.

3) Incision and drainage must have been completed by an Oral and Maxillofacial surgeon.

3) Only patients between the age of 14 and 89 were included.
4) Patients with incomplete medical charts were excluded. Patients that met the inclusion criteria totaled three hundred six. These charts were reviewed and data was collected including:

1) Length of Stay: Obtained from admission documents.

2) Type of drain: Obtained from the dictated operative report.

3) Number of Drains: Obtained in the dictated operative report.

4) Site of infection: The site of infection was divided into two categories referred to as primary and secondary. The data was obtained from dictated operative reports noting surgical access and anatomic location of infection as diagnosed both clinically or by computed tomography reports, as well as operative findings.\textsuperscript{18}
   a. Primary: Include maxillary and mandibular spaces with direct extension from the source of infection. These include the canine, buccal, submental, submandibular, and sublingual spaces.\textsuperscript{14,19-20}
   b. Secondary: spaces defined by fascial planes that are reached by extension from primary spaces.\textsuperscript{14,19-20} Secondary spaces include masseteric, pterygomandibular, superficial and deep temporal, lateral pharyngeal, retropharyngeal and prevertebral spaces. It is assumed that presence of infection in a secondary space also includes the associated primary space and therefore the presence of a single secondary space is adequate for classification into the secondary category.

5) Social history/medical history: Obtained from the history and physical completed in the emergency department at time of admission. Additionally, discharge summaries were reviewed for any new diagnosis found during the hospital stay.
that may be contributory to the length of stay. Existing or developing immunosuppressive medical conditions that may contribute to compromised healing and therefore prolong hospital stay were noted. Examples include, but are not limited to: Presence of human immunodeficiency virus, diabetes mellitus, alcohol abuse, systemic lupus erythematosus, and organ transplant recipients. Patients being treated with drug therapies that increase susceptibility to infection and may affect the healing process were also placed into the immunocompromised group. Examples include, but are not limited to: Cancer chemotherapeutics, chronic steroid use, immunosuppressive drugs. Patients determined to be immunocompromised were recorded as a positive or negative finding with a yes or no.

6) Age: Obtained from the admission record.

7) Gender: Obtained from electronic patient demographics.

Three categories were defined based on surgical drain placement.

1) Penrose drain alone, figure 6.

2) Robinson drain alone, figure 7.

3) Penrose and Robinson placed in combination, figure 8.

The data collected was examined in three categories as well as combining the three categories into two groups. The analysis presented was completed primarily evaluating drains in this way and will be presented as follows:

1) Non-irrigating- (penrose drain alone)

2) Irrigation present-includes all modalities that are irrigated. (Robinson drain alone, Penrose and Robinson combination)
Figure 6. Multiple Penrose Drains

Figure 7. Robinson Catheter Alone

Figure 8. Penrose and Robinson Combination
All data was analyzed using JMP version 8.0.2, (SAS Institute Inc., Cary NC).

Means and standard deviations were calculated for all continuous variables. Factors contributing to length of stay were analyzed and studied using an ANOVA test.

Distributions were calculated for all nominal variables.
Chapter 3
Results

Of the three hundred six subjects identified for the study, two were excluded as outliers. Both patients underwent multiple surgeries for multi-system involvement such as tracheostomy, percutaneous endoscopic gastrostomy tube placement, peripherally inserted central catheter, drainage of additional spaces such as retrobulbar abscess and pleural space abscess. The severity of these infections resulted in hospital stays in excess of twenty five days as well as combined inpatient rehabilitation with discharge to skilled nursing facilities. One infection was treated with non-irrigating drains and the other with combined irrigating and non-irrigating drains. One patient was previously healthy, the other was a known type II diabetic. There were no deaths while patients were admitted to the Oral Surgery service. All analysis was completed using the remaining 304 patients.

Length of hospital stay was ascertained from the electronic medical record based on the date of admission and the date of discharge. While the majority of patients received surgical intervention immediately upon admission, there was a minority of patients that did not undergo surgical incision and drainage on the day of admission. The mean hospital stay was 5.70 days with a standard deviation of 2.53 days. The maximum stay was 20 days and the minimum was 1 day.
The remaining three hundred four patients all received surgical incision and drainage. The distribution of drain type was comprised as follows: 181 patients (59.5%) received non-irrigating (penrose) drains; 33 patients (10.8%) received irrigating drains alone; 90 patients (29.6%) had a combination of both irrigating and non-irrigating drains.

The mean length of stay was calculated according to specific drainage type selected.

1) Robinson only mean length of stay: 5.45 days

2) Penrose only mean length of stay: 5.24 days
3) Penrose and Robinson combination: 6.73 days

Mean length of stay was also calculated for drainage by group.
1) Non-irrigating (Penrose alone) : 5.24 days
2) Irrigation present (Robinson alone, Penrose/Robinson combination): 6.39 days

Drain Type

![Diagram of Drain Type Distribution]

Figure 10. Drain Type Distribution

Drain type was also evaluated along with the site of infection using an ANOVA test to understand if one method of drainage was more efficacious for each category of infection. There was nearly significant difference between the three drainage options in the treatment of primary and secondary infections.

The three groups were combined into two categories based on the presence of irrigation drains. This enabled analysis of the true function of what was occurring
clinically; flushing of wounds versus not disturbing the site. Again there was no significant difference noted between patients with irrigation versus non-irrigation drains (p=0.088).

Age distribution was collected and revealed a mean of 34.65 years with the oldest being 84 years and the youngest at 16 years. Age was not a significant factor in length of hospital stay (p=0.1029).

![Age Distribution](image)

**Figure 11. Age Distribution**

Health status was recorded for each patient by reviewing the admission history and physical, as well as the discharge summary and diagnosis for immunocompromising conditions. Existing or developing immunosuppressive medical conditions that may contribute to compromised healing and therefore prolong hospital stay were noted. The majority of the patients (277) were found to be healthy making up 91.1% of the sample.
Healthy patients had a mean length of stay of 5.66 days. The remaining 27 patients (8.8%) were considered to be immunocompromised and had a mean length of stay of 6.14 days. The effect of health status on length of hospital stay was not significant (p=0.316).

**Health Status**

![Figure 12. Immunocompromised](image1)

**LS Means Plot**

![Figure 13. Health and Length of Stay Plot](image2)
The site of infection was divided into two categories referred to as primary and secondary. The purpose of dividing the groups was to convey severity of the infection. Secondary infections are considered to be more severe due to further extension of the infectious process. The data was obtained from dictated operative reports noting surgical access and anatomic location of infection as diagnosed both clinically or by computed tomography reports, as well as operative findings. The distributions of the infections were fairly similar between the two groups; with 147 patients (48.3%) having infections consistent with a primary infection, while the remaining 157 patients (51.6%) had infections categorized as secondary infections. The mean length of stay for primary infections was 5.02 days. The mean length of stay for secondary space infections was 6.33 days. The site or severity was found to be significant (p=0.0172), showing the correlation that more severe infections have longer hospital stays.
Response LOS
Whole Model
Regression Plot

Total number of drains versus length of stay for primary and secondary space infections.

Figure 14. Linear Distribution by Site and Number of Drains

LS Means Plot

Figure 15. Site and Length of Stay Plot
Total number of drains was ascertained from the dictated operative report. This variable was found to be significant in all models (p<0.0001). [This correlation is consistent with previous findings that more severe infections require longer hospital stays, likewise, more drains placed equates to more severe infections and an increased length of stay.] The mean number of drains placed was 2.5 drains per patient with a standard deviation of 1.77 drains. Infections classified as secondary have more anatomic spaces involved and therefore required a greater number of drains. Naturally, patients with an increase in number of drains had a longer length of stay that mirrors the increased length of stay in patients with secondary infections.

Patient gender was obtained from the electronic medical record. Males were far more likely than females to have severe odontogenic infections and made up 65.1% or 198 patients, while females accounted for just 106 patients (34.8%) in the study. The
gender of the patient was not significant (p=0.8758) and did not contribute to the length of stay.

Figure 17. Gender Distribution

<table>
<thead>
<tr>
<th>Variable</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunocompromised</td>
<td>27</td>
<td>8.9%</td>
</tr>
<tr>
<td>Healthy</td>
<td>277</td>
<td>91.1%</td>
</tr>
<tr>
<td>Drain Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>90</td>
<td>29.6%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>33</td>
<td>10.9%</td>
</tr>
<tr>
<td>Non-irrigating</td>
<td>181</td>
<td>59.5%</td>
</tr>
</tbody>
</table>

Table 1. Health and Drain Counts
Means and Standard Deviations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34.65</td>
<td>11.55</td>
</tr>
<tr>
<td>Length of Stay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>6.73</td>
<td>3.35</td>
</tr>
<tr>
<td>Irrigation</td>
<td>5.24</td>
<td>1.99</td>
</tr>
<tr>
<td>Non-irrigating</td>
<td>5.45</td>
<td>1.68</td>
</tr>
<tr>
<td>Immunocomp</td>
<td>6.14</td>
<td>3.44</td>
</tr>
<tr>
<td>Healthy</td>
<td>5.66</td>
<td>2.43</td>
</tr>
</tbody>
</table>

Table 2. Means and Standard Deviations

The data was analyzed using an ANOVA test as shown in table 3.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Ratio</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td>250.58193</td>
<td>250.5819</td>
<td>51.9871</td>
<td>&lt;.0001*</td>
</tr>
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<td>Immuno</td>
<td>1</td>
<td>4.84844</td>
<td>4.8484</td>
<td>1.0059</td>
<td>0.3167</td>
</tr>
<tr>
<td>Site</td>
<td>1</td>
<td>27.65730</td>
<td>27.6573</td>
<td>5.7379</td>
<td>0.0172*</td>
</tr>
<tr>
<td>Immuno*Site</td>
<td>1</td>
<td>1.11570</td>
<td>1.1157</td>
<td>0.2315</td>
<td>0.6308</td>
</tr>
<tr>
<td>Irr Present</td>
<td>1</td>
<td>14.11903</td>
<td>14.1190</td>
<td>2.9292</td>
<td>0.0880</td>
</tr>
<tr>
<td>Immuno*Irr Present</td>
<td>1</td>
<td>8.49322</td>
<td>8.4932</td>
<td>1.7621</td>
<td>0.1854</td>
</tr>
<tr>
<td>Site*Irr Present</td>
<td>1</td>
<td>2.54636</td>
<td>2.5464</td>
<td>0.5283</td>
<td>0.4679</td>
</tr>
<tr>
<td>Immuno<em>Site</em>Irr Present</td>
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<td>2.08826</td>
<td>2.0883</td>
<td>0.4332</td>
<td>0.5109</td>
</tr>
<tr>
<td>Error</td>
<td>295</td>
<td>1421.9227</td>
<td>4.8201</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>303</td>
<td>1945.3553</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. ANOVA of Full Model
The positive results of variables with a significant impact on length of stay include total number of drains and site of infection as shown in table 4.

<table>
<thead>
<tr>
<th>Source</th>
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<th>Mean Square</th>
<th>F Ratio</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td>374.58186</td>
<td>374.5819</td>
<td>78.2753</td>
<td>&lt;.0001*</td>
</tr>
<tr>
<td>Site</td>
<td>1</td>
<td>59.69350</td>
<td>59.6935</td>
<td>12.4740</td>
<td>0.0005*</td>
</tr>
<tr>
<td>Error</td>
<td>301</td>
<td>1440.4176</td>
<td>4.785</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>303</td>
<td>1945.3553</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Reduced ANOVA
Chapter 4
Discussion

Length of hospital stay has become an important factor in efforts to reduce the cost of healthcare. The natural feeling is that reducing length of hospital stay will yield large cost savings. It becomes of even greater interest in patients with odontogenic infections, as the etiology is potentially a preventable problem. Additionally a large number of patients with this affliction seek medical care through the emergency room of publicly funded hospitals.\textsuperscript{1,6} Unfortunately reducing length of stay may not have the desired impact that healthcare administrators are looking for. A recent study reviewed hospital stays in a major academic center of 12,365 patients with admissions greater than 4 days and reported that 40\% of all costs are incurred during the first 3 days of admission.\textsuperscript{21} The same study reported that by reducing the length of stay by just 1 day reduced the total cost of care on average by just 3\% or less.\textsuperscript{21} One could reason that the patients in our study fit this profile; as the majority of all procedures, consultations, blood draws and imaging studies are completed within the first 24 hours of admission. Following completion of surgical intervention and stabilization of the patient, the remaining hospital stay typically involves parenteral antimicrobial therapy and daily re-evaluations, awaiting resolution of the infection. The rational for completion of this study is not to provide a cost basis for length of stay but rather to ascertain if there are
methodologies that may improve or speed recovery in patients with severe infections. If
decisions made at the time of surgery affect the final outcome at the end of a patient’s
hospital stay, and possibly return them to a state of health sooner, then these decisions
should be explored.

The majority of our findings were similar to other studies of comparable design
for the same variables studied. Age and gender had no significant impact on length of
hospital stay in our study and were not significant variables in any studies reviewed.\textsuperscript{11,12}
The positive finding that severity of infection increases length of hospital stay was not
surprising. The location of an infection is an important clinical factor in the management
of infections.\textsuperscript{23} This was also a consistent finding in our literature review.\textsuperscript{9,14,23,24}

There was no significant difference in length of stay for patients considered to be
immunocompromised. Nearly all studies that reviewed health status showed that the
general health of a patient significantly impacted outcomes.\textsuperscript{5,6,9,14,22} We found only 27
patients, or 8.8\% of the sampled population, that were considered immunocompromised.
Our study found no significant difference between healthy and immunocompromised
patients with regard to length of hospital stay. One reason for this anomaly is that the
quantity of patients in this population may be misrepresented. Reasons for a falsely
underrepresented group is that the search of the hospital records was primarily for
patients admitted to and discharged from the Oral and Maxillofacial Surgery service.
This would leave out severely ill patients admitted to medicine services for management
of their multiple co-morbidities. A search was completed using diagnosis and procedure
codes for odontogenic infections and yielded no new patients. An additional source of
error is that data compiled in a retrospective study is heavily weighted on the accuracy of
the medical record. It may be postulated that underrepresentation may be secondary to
underreporting in the medical record. Lastly, it could be explained that no difference was
observed between the two groups because there may be no difference between the two
groups. Further studies would be prudent before definitively concluding that patient
health has no impact on length of hospital stay.

The other interesting finding concerns the chief purpose of the study, drain type.
Empirical thinking would lead one to believe that flushing bacteria regularly from an
infected wound would hasten recovery. This effect was not realized. We found no
significant statistical difference between patients who received irrigating or non-irrigating
drains. There was an increase in length of stay in patients with irrigating drains, but this
difference was not statistically significant. Possible reasons for this increase may be
related to:

1) Irrigating drains may have been used for more severe infections that would by
definition have longer length of hospital stay.

2) Multiple surgeons participated in the surgeries. Surgeons that placed
irrigating drains may use different discharge criteria that produce longer
hospital stays.

3) Irrigating drains may make infections worse by forcing bacteria into deeper
anatomical spaces by aggressive injection of irrigating fluid.

Using the data presented, no difference was seen between the two modalities.
Time, effort, cost and patient comfort may be factors to consider when deciding on drain
type.
Chapter 5

Conclusion

The results of our evaluation of drain usage in 304 patients with severe odontogenic infections support the following conclusions:

1) No relationship between health status and length of hospital stay was found in our study.

2) More severe or advanced infections correlate with increased length of hospital stay.

3) Number of drains placed is related to length of hospital stay.

4) Age and Gender do not impact length of hospital stay in patients with severe odontogenic infections.

5) Findings of this research reveal no statistical rationale for choice of drain type for use in odontogenic infections.
Bibliography


