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REDUCING DNBI WITH PROPER WISDOM TOOTH DIAGNOSIS

A THESIS

SUBMITTED TO THE GRADUATE DENTAL EDUCATION

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE

MASTER OF ORAL BIOLOGY

BY

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Introduction

Wisdom teeth account for the second most common Dental-DNBI in a deployed setting. This problem has been observed by physicians and dentists alike. Medical staff at a Role II facility documented treatment needs in Iraq from 2003 to 2004. Over nine months they evaluated 4831 patients and found that 925 (19%) had dental needs.¹ The most common dental procedures performed were 47% restorations (“fillings”) followed by 21% extractions (oral surgery).¹ Murray concluded that predeployment dental screening must improve to minimize dental emergencies.¹

If a dental provider is not in the area of operations (AO), then Dental-DNBI often require medical evacuation for treatment which incurs time lost from work. During a deployment of French troops to Mali, dental emergencies (DE) accounted for 16% of all medical evacuations and 24% of total DNBI.² On average, Soldiers were absent from their unit for 10.5 days.² Gunepin also studied French DE in Afghanistan and estimated that 78% were predictable and attributed to pre-existing pathologies.³ Dunn found that wisdom teeth were the second most common cause for a DE in Air Force personnel, accounting for 19% of all emergency visits during an Operation Enduring Freedom (OEF) rotation.⁴ Wisdom teeth are a burden on unit effectiveness and account for 40% of all “acute dental events” while on deployment.⁵

Dental-DNBI may be prevented before Soldiers deploy if we improve diagnosis. This study proposes evidence-based clinical findings to diagnose third molars as Dental Readiness Classification (DRC) 3 and reduce provider subjectivity. Uniform diagnosis will benefit the individual patient and their unit by reducing time lost from work. This can also yield savings in the cost of care as measured by Dental Weighted Values (DWV). Improved diagnosis and predeployment treatment could minimize the burden Dental-DNBI pose in an austere AO.

Materials and Methods

This study was a retrospective chart review conducted to measure concurrence in third molar DRC diagnosis. Charts were selected at random to represent Active Duty (AD), Army Reserve (USAR) and Army National Guard (ARNG) populations. Soldiers received an updated exam or an evaluation to verify clinical and radiographic findings.

Dental providers conducted an initial patient examination during treatment as usual and assigned a DRC based on their clinical judgement. The dentists at each clinic were unaware of the project intent and were blinded to the investigators. If patients qualified for study inclusion, the investigators would conduct their chart review and evaluation after the initial examination. Investigators assigned a third molar DRC using guidelines developed for this study. Concurrence was measured between the pre-existing chart DRC and the proposed protocol DRC. The null hypothesis stated that there is concurrence amongst Army dental providers in assigning third molar DRC.

The investigators performed independent roles and were blinded to one another. Investigator A determined patient qualification for study inclusion. Inclusion criteria included current bitewings and a panoramic radiograph, a previously assigned DRC and the presence of third molars. Investigator B was blinded to the DRC assigned during initial examination.

Investigator A recorded descriptive information. This included: Age, Gender, Tobacco Use, HPI (History of Present Illness), Rank (E1-5, E6+, O1-3, O4+, WO1-5) and Component status (AD, USAR, ARNG). Investigator B interpreted the radiographs and performed a limited oral evaluation to record third molar information. This included: Winter's angulation, Pell and Gregory impaction, Pericoronitis, Caries, Pathology and Infection. Investigator B assigned a DRC 2 or 3 based on protocol guidelines. The protocol DRC was recorded solely for the study did not influence or alter patient care.

This protocol advocates early management of wisdom teeth to minimize the likelihood a DE when a Soldier is deployed. The following criteria were developed and used to diagnose wisdom teeth as DRC 3.

Pericoronitis

Pericoronitis is an inflammation of the gingiva associated with an impacted or partially impacted third molar. Symptoms include pain, swelling and tenderness. If severe, symptoms may include fever, dysphagia, lymphadenopathy, limited opening <30mm, and a fetid odor. Purulence is common.

DRC 3 Criteria: Active pericoronitis or a history of pericoronitis. HPI will be defined as a previous entry of "pericoronitis" in the dental record or as reported by the patient.

Caries

Caries is a progressive demineralization that undermines tooth structure. Caries can occur on the fully erupted third molar and compromise the adjacent molar. This progression may be associated with pain or "pulpitis".

DRC 3 Criteria: Decay that involves ≥ 1 tooth surface, radiographically extends beyond the dentinoenamel junction (DEJ) or subgingival decay. "Pulpitis" will be defined as any hot, cold or percussive pain reported by the patient.

Infections

Untreated caries or pericoronitis can progress to an infection. A moderate infection can involve anatomic spaces that compromise the airway because of associated swelling or trismus. Examples include pterygomandibular, submental, sublingual and submandibular spaces. Infections with high severity directly compromise the airway and vital structures. Examples

include lateral pharyngeal and retropharyngeal spaces. In rare circumstances, this may progress to the mediastinum.

DRC 3 Criteria: Wisdom teeth with purulence, trismus, limited opening <30mm, fever >101°F, vestibular or fascial space. Extraoral findings include facial asymmetry and cervical lymphadenopathy. The inferior border of the mandible may appear distorted. Intraoral findings include swelling of the buccal vestibule and floor of the mouth, dysphagia, deviation of the uvula and displacement of the tongue.

Pathology

Impacted wisdom teeth may develop cysts and tumors that require oral and maxillofacial surgery. Common examples include the dentigerous cyst and odontogenic keratocyst. These are expansile and may undermine the jaws, which can risk a pathologic fracture. Insidious development of these lesions emphasizes the importance of current panoramic radiographs for early identification. Mesioangular and horizontally impacted third molars have also been associated with resorption of the adjacent molar.

DRC 3 Criteria: Wisdom teeth associated with radiographic lesions ≥ 4 mm in size, buccal or lingual cortical expansion, neurosensory changes or resorption of the adjacent molar.

Statistical Analysis

The hypothesis was tested by a Cohen's Kappa statistical analysis that measured concurrence between incoming chart DRC and protocol DRC.

Results

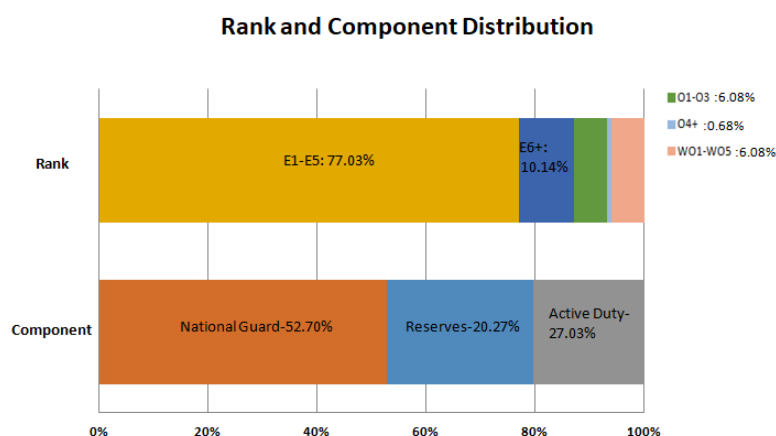


Figure 1: Service member distribution by rank and component.

The resulting kappa of 0.04 suggests that concurrence between dental providers and the protocol guidelines did not exist. Based on this, the null hypothesis was rejected.

148 patients qualified for study inclusion. This comprised 458 wisdom teeth; 222 were maxillary and 236 were mandibular.

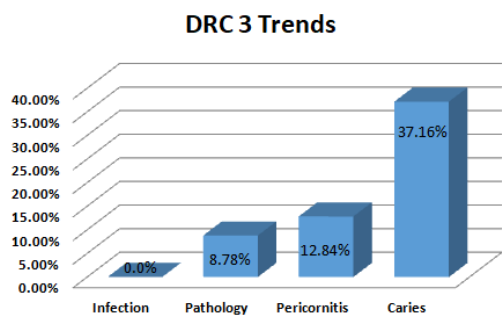


Figure 2: Presence of indicated DNBI within sample population

The population ranged from 19 to 53 years old, with the average patient being 29 years old. 119 were male and 29 were female. The component distribution was 20.2% Army Reserves, 27.0% Active Duty, and 52.7% Army National Guard. The 18-25-year-old age group accounted for 41% of the population.

Caries was observed in 55 individuals which accounted for 37.1% of the DRC 3 population. 48.3% of all decay was recorded in fully erupted wisdom teeth. 44 of these 55 individuals with caries were in the “E1-E5” rank. 23, or 41.8%, of these individuals were 18-25 years old.

Pericoronitis was observed in 19 individuals which accounted for 12.8% of the DRC 3 population. Pathology was observed in 13 individuals, accounting for 8.7% of the total DRC 3 population.

Tobacco use was categorized as “no use”, “inhalational”, “chewing tobacco” or “both”. 26.3% of all patients used tobacco. Tobacco use

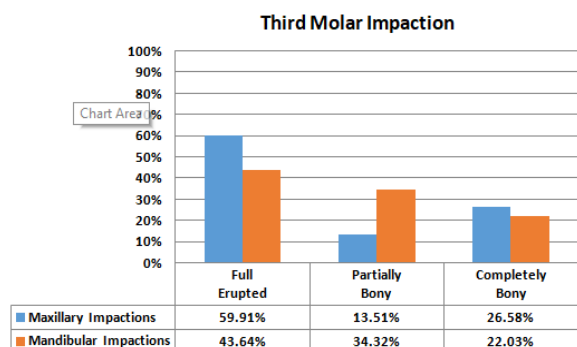


Figure 3: Distribution of maxillary and mandibular third molar impactions

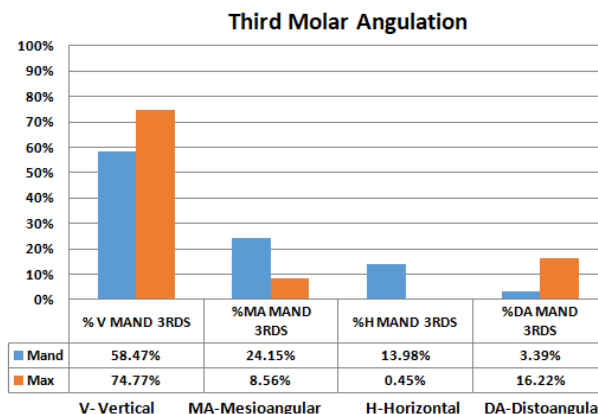


Figure 4: Distribution of maxillary and mandibular third molar

was reported by 23.6% of E1-E5 and 46.6% of E6-E9. Caries was more commonly observed in tobacco users. Caries was observed in 41% of tobacco users versus 35.7% of non-tobacco users.

There were 222 maxillary wisdom teeth and 238 mandibular wisdom teeth. 59.9% of maxillary wisdom teeth were fully erupted. The most common angulation was vertical at 74.7%, followed by distoangular at 16.2%. 43.6% of mandibular wisdom teeth were fully erupted. 34.3% of mandibular teeth were recorded as partial bony impactions. The most common mandibular angulation was vertical at 58.4% followed by mesioangular at 24.1%.

Discussion

Age

41% of the Soldiers were 18 to 25 years old. A previous study recognized that 80% of patients who seek wisdom teeth removal were younger than 25 years old.⁶ 37% of these patients cited current or previous pain and swelling as motivators for oral surgery.⁶ If patients retain wisdom teeth then they are also more likely to develop caries. Patients who were 25 years or older had more caries in third molars.⁷ It can be estimated that 33% of young adults with fully erupted third molars could be affected by caries.⁷

Most dental providers advocate wisdom tooth removal before 25 years of age to minimize morbidity and postoperative complications. The AAOMS White Paper on Third Molar Data cautions that the incidence of postoperative morbidity is higher in patients over 25 years of age.⁸ These risks include oroantral perforations and periodontal defects which may require additional procedures to manage. The likelihood of developing decay, pain; and the severity of postoperative morbidity increase with age. This protocol advocates wisdom tooth removal at an early age and phase of military service to improve patient outcomes.

Pericoronitis

Pericoronitis accounted for 12.8% of the DRC 3 population. Dunn and Mahoney observed rates of pericoronitis at 19% and 17% respectively.^{4,9} Other authors have also observed “tooth impaction pain” and pericoronitis at rates of 19%.¹⁰ It has been noted that as much as 95% of pericoronitis cases involved a mandibular wisdom tooth.¹¹ In a review of DNBI among British troops in Iraq and Afghanistan, 81% of pericoronitis cases involved a mandibular wisdom tooth.¹² The 20- to 29-year-old age group has been observed to account for 81% of pericoronitis cases.¹¹

Pericoronitis is characterized by a sudden, unpredictable onset. Combes observed that 53% of pericoronitis cases had no previous history of symptoms.¹² A previous study found that 61% of patients had no history of symptoms.¹³ These authors also observed that mandibular third molars accounted for 86% of pericoronitis cases.¹³ A history of pericoronitis should be considered when a dental provider assigns a DRC.

Caries

Caries accounted for 37% of the DRC 3 population and nearly half of all decay was observed in fully erupted wisdom teeth. Previous authors had similar findings. In a study of occlusal caries, it was found that 28% of patients with an erupted wisdom tooth were affected by caries and that mandibular wisdom teeth were most affected.¹⁴ A 4.6-year longitudinal study showed that 33% of patients developed decay on 1 or more retained wisdom teeth.¹⁵ The authors estimated that smoking was associated with a two-fold increase in caries.¹⁵ The current study also found that tobacco users experienced more caries in comparison to non-tobacco users.

A 2008 review found that caries accounted for 35% of all dental emergencies or Dental-DNBI.¹⁶ In Bosnia, caries comprised 37% of all dental emergencies.¹⁷ Previous authors compared dental emergencies at two clinics supporting operations in the CENTCOM AO. They found that caries was the most common reason for a dental emergency followed by pericoronitis.¹⁸ It can be anticipated that nearly one-third of patients with retained wisdom teeth will develop caries and require treatment. Soldiers who smoke should also be considered at a higher risk for decay.

Angulation and Impaction

Combined, vertical and mesioangular wisdom teeth comprised 82% of all mandibular third molars. 58% were vertical and 24% were mesioangular. These findings are in agreement with previous authors who observed that vertical and mesioangular teeth accounted for 79% of cases; 67 and 12% respectively.¹¹ These two angulations of mandibular wisdom teeth are most likely to develop pericoronitis. A previous study found that pericoronitis cases involved 81% of vertical and 11% mesioangular wisdom teeth.¹⁹ Other authors recorded vertical angulation at 51% and mesioangular at 25% of all pericoronitis cases.²⁰ Wisdom teeth with vertical or mesioangular orientations should be considered “at risk” for developing pericoronitis.

The angulation of a wisdom tooth may compromise the adjacent molar or “second molar”. 16% of second molars developed decay when adjacent to a mesioangular wisdom tooth.²¹ When the mesioangular wisdom tooth remained for more than 5 years, this prevalence increased to 30%.²¹ Allen documented second molar decay in 19% of their population and stated that second molars were 9 times more likely to develop decay when adjacent to a mesioangular wisdom tooth.²² Mesioangular and horizontal wisdom teeth should be considered for the risk they pose to the adjacent molar.

Cost of Care

Wisdom teeth impactions were described using the ADA CDT oral surgery categories. A dollar cost value can be estimated from these CDT codes. According to the DHA CY2020 Guidelines for Dental Procedure Codes, Surgical Procedure Codes and Dental Weighted Values, a relative value for one DWV=\$100.²³ Based on these guidelines, the costs for surgery are erupted tooth \$163, partially bony \$409 and completely bony \$484.²³ Given that most patients present a full complement of four wisdom teeth, the cost could range from \$652 to \$1936, if all wisdom teeth were fully erupted or completely impacted, respectively. These are variable costs can be used to estimate treatment for a dental emergency.

The cost of Dental-DNBI can also be estimated in time lost from work and total dollar cost (TDC). In the OIF theater, Dental-DNBI cost the Army an estimated \$1.8 Million dollars per month.²⁴ This averaged to \$21.4 M from July 2009 to June 2010 and \$21.9 M from July 2010 to June 2011.²⁴ The TDC was based on transportation to the dental treatment facility (DTF),

Soldier's time away from their unit and fixed treatment costs. Colthirst also estimated that a Soldier will be gone from their unit for 3 days.²⁴

Clinicians and medical planners should consider that each DRC 3 in garrison may become a Dental-DNBI in an austere environment. We must also consider the readiness of each component. Simecek evaluated Dental-DNBI rates for every 1,000 SM in Iraq and Afghanistan. In OIF, the USAR incurred the highest Dental-DNBI at 183 per 1,000.²⁵ In OEF, the USAR and ARNG had 129 per 1,000.²⁵ In Afghanistan, USAR had a 51% higher risk and ARNG had a 73% higher risk of experiencing a Dental Emergency.²⁶ These numbers illustrate the needs that exist within the USAR and ARNG.

Weaknesses of this study include the limited population size and a greater proportion of USAR and ARNG. Strengths include evidence-based parameters used to define a DRC 3. Additionally, the results from this study validated the findings from previous authors. Future projects could more evenly distribute the active, guard and reserve components. A prospective study could compare the effects, if any, of smoking, e-cigarettes or chewing tobacco on caries or pericoronitis.

The MTOE distribution of organic dental officers should be reviewed to identify shortcomings in access to care. In a contested airspace, the forward deployment of a dentist-dental tech team may be more cost effective and practical than activating a medical evacuation. A consensus statement could be generated among the Army dental community to inform current policies on readiness. Doing so may improve the delivery of care in garrison and prevent Dental-DNBI while deployed.

Conclusion

Wisdom teeth are the second most common dental emergency in a deployed setting. Treatment often requires medical evacuation. If dental services are outside the AO, a Soldier may be absent from their unit for up to 10 days.² This study proposed DRC 3 criteria for wisdom teeth and measured concurrence among dental providers' diagnoses. DRC 3 criteria were: Caries, Pericoronitis, Pathology and Infection.

This study observed that caries and pericoronitis are the most frequent diagnosis for a DRC 3 wisdom tooth. Caries and pericoronitis are also the leading causes for dental emergencies in a deployed setting.^{10,18} Caries was observed in 37.1% of the population, the majority of whom were E1-E5 in rank. Caries was observed more in tobacco users than non-tobacco users. Pericoronitis was observed in 12.8% of the population. Vertical and mesioangular orientations accounted for 82% of all mandibular wisdom teeth. These angulations most frequently develop pericoronitis.^{11, 19, 20} The proposed DRC 3 criteria may help standardize wisdom tooth diagnosis and prioritize care which may prevent Dental Emergencies on deployment.

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Glossary:

AAOMS: American Association of Oral and Maxillofacial Surgeons

AD: Active Duty

ADA: American Dental Association

AO: Area of Operations

ARNG: Army National Guard

Caries: A dietary, carbohydrate modified bacterial infectious disease.

CDT: Code on Dental Procedures and Nomenclature

CENTCOM: Central Command

D7140- Extraction, erupted tooth or exposed root (elevation and/or forceps removal). Includes removal of tooth structure, minor smoothing of socket bone, and closure, as necessary.

D7230- Removal of impacted tooth – partially bony. Part of crown covered by bone; requires mucoperiosteal flap elevation and bone removal.

D7240- Removal of impacted tooth-completely bony. Most or all of crown covered by bone; requires mucoperiosteal flap elevation and bone removal.

DHA: Defense Health Agency

DNBI: Disease and Non-battle Injury

DRC: Dental Readiness Classification

DRC2: DRC 2 indicates a current dental exam and non-urgent treatment needs which are unlikely to result in a DE within 12 months. Soldiers with DRC1 and DRC 2 are considered worldwide deployable.

DRC3: DRC 3 indicates a Soldier requires urgent or emergency dental treatment. DRC3 Soldiers are not worldwide deployable.

Horizontal: The angulation of the tooth where the roots and crown are on the same horizontal plane.

Pathology: Deals with the nature, identification, and management of diseases affecting the oral and maxillofacial regions.

Pericoronitis: Defined as inflammation of the gingiva associated with an impacted or partially impacted third molar. Symptoms include pain, swelling and tenderness at the site. Severe pericoronitis may also include fever, dysphagia, lymphadenopathy, limited opening, and an unpleasant breath/taste. Purulence is a common finding

Periodontal Disease: An inflammatory disease that affects the soft and hard structures that support the teeth. Bone and teeth may be lost depending on the extent of disease progression.

OEF: Operation Enduring Freedom

OIF: Operation Iraqi Freedom

SM: Service member

Tobacco Use: "Smoking" described inhalational tobacco use, which included cigarettes, cigars, e-cigarettes, vaping or hookahs. "Chewing tobacco" described snuff, loose leaf, pouches or any noncombustible tobacco product

USAR: United States Army Reserves

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