Complications in Dentoalveolar Surgery

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Presentation Outline

• Intraop Complications
  • Local anesthesia issues
  • Soft tissue
    • Zones, punctures, friction burns
  • Hard tissue
    • Alveolar process fx, tuberosity fx, fat, sinus perforation
  • Displacement Problems
    • Maxillary sinus, infratemporal fossa, floor of the mouth, submandibular space
  • Injury to adjacent teeth
  • Hemorrhage

• Postop Complications
  • Postop pain control
  • TMJ injury/trismus
  • Antral osteitis
  • Dentoalveolar infections
    • Including osteomyelitis and bisphosphonate osteonecrosis
  • Nerve injuries

• Legal Issues
  • The law and dentoalveolar complications

Preparation

• Thorough prep assessment- clinical and radiographic

Follow Basic Surgical Principles

• Visualization
• Light
• Access
• Suction
• Tissue retraction

• Controlled force
• Aseptic technique
• Atraumatic surgery
• Hemostasis
• Debridement

Local Anesthesia Complications

• Paresthesia
• Ocular complications
• Allergies
• Toxicity
• Methemoglobinemia

“A man has to know his limitations” - Harry Callahan
**Paresthesia**

- As low as 1:850,000; as high as 1:20,000
- 0.15%-0.54% range for temporary; 0.0001%-0.01% for permanent
- L=R, lingual nerve 3x more likely to be injured than IA (probably due to lingual n. commonly being unifascicular)
- Theories for cause: needle trauma, volume of solution injected, repeated injections, type of anesthesia, neurotoxicity

**Paresthesia**

- Feeling “electric shock” during injection does not equate with severity of nerve injury
- Injection volume and repeated injections have not been associated with severity of nerve injury
- Causes remain unclear-direct trauma to the nerve, intraneural hematoma, neurotoxicity from the anesthetic itself

**Ocular Complications**

- Reported signs and symptoms: tissue blanching, hematoma, facial paralysis, diplopia, amaurosis, ptosis, mydriasis, miosis, enophthalmos, permanent blindness
- Proposed causes are stimulation of sympathetic vasoconstriction via arteries in the area of the injection that anastamose with vessels associated with ocular structures
- Fortunately these complications are rare and usually transient.
- Patient’s fear should be allayed
- Ophthalmology consult is warranted if symptoms persist

**Allergy**

- True allergy to amide anesthetics is less than 1%
- Patients with sulfite sensitivities should be anesthetized with local that does not contain a vasoconstrictor since sulfites are commonly used as a stabilizer
- Drug provocation test is the gold standard to diagnose drug allergy

**Toxicity**

- Can come from excessive dosing of the anesthetic or the vasoconstrictor
- Vasoconstrictors reduce systemic absorption
- Adherence to dosing guidelines is important in avoiding toxicity
- Be especially careful with children; Clark’s Rule: child’s dose=child’s wt/adult wt x adult dose (adult wt =150 lb)
- Rule of 25: 1 cartridge of any local anesthetic may be used for every 25 lb of patient weight
- 3% Mepivicaine with no vasoconstrictor has been most commonly associated with reports of toxicity reactions

**Anes. Dosage Chart**

- [Image of Anes. Dosage Chart]
### Treatment of Anesthetic Toxicity
- **Excitatory phase** may manifest as tremors, muscle twitching, shivering, clonic tonic convulsions.
- Central nervous system depression follows and possible respiratory depression followed potentially by cardiac depression.
- BLS should be utilized to support life threatening issues while awaiting emergency personnel.
- Benzodiazepines may be used for extended seizure activity.

### Methemoglobinemia
- Oxidation of the iron atom in hemoglobin from the ferrous to the ferric state restricting the delivery of oxygen to the tissue.
- Drugs used in dentistry that have been implicated—prilocaine, benzocaine, EMLA cream.
- Signs and symptoms occur 3-4 hrs after administration of large doses of local anesthetics—cyanosis, tachycardia, dyspnea.
- Treatment—support respiration prn; methylene blue 1-2mg/kg IV.

### Minimizing Adverse Outcomes
- Use the anesthesia appropriate for the situation.
- Calculate dosages to avoid toxicity.
- Aspirate to prevent complications.

### Soft Tissue Complications
- Soft tissue tears
- Puncture wounds
- Friction burns

### Soft Tissue Tears
- **Cause**
  - Inadequate flap
  - Excessive retraction force
- **Avoidance**
  - Longer envelope
  - Vertical release
- **Treatment**
  - Clean up ragged edges
  - Suture

### Puncture Wounds
- **Cause**
  - Uncontrolled force
- **Avoidance**
  - Controlled force
  - Finger support
- **Treatment**
  - Copious irrigation
  - Antibiotics
  - DON'T SUTURE
Friction Burns

- **Cause**
  - Poor retraction
  - “Tunnel vision”
- **Avoidance**
  - Attention to detail
- **Treatment**
  - Keep lubricated with antibiotic ointment
  - Inform/document

Hard Tissue Complications

- **Alveolar process fractures**
- **Tuberosity fractures**
- **Fractured roots**
- **Sinus perforation**
- **Injury to adjacent teeth**
- **Extraction of the wrong tooth**

Alveolar Process Fractures

- **Cause**
  - Excessive forceps force
- **More likely to occur in older patients, widely divergent roots, close sinus proximity, and heavy buccal cortical bone**
- **Most likely places for fxs to occur:**
  - Buccal cortical plate over maxillary canine
  - Buccal cortical plate over the maxillary molars (especially the 1st molar)
  - Floor of the maxillary sinus
  - Maxillary tuberosity
  - Labial bone of mandibular incisors

Alveolar Process Fractures

- **Prevention**
  - Thorough clinical and radiographic evaluation
  - Avoid use of excessive force
  - Early decision to use an open technique that allows removal of bone and provides sectioning of the tooth as appropriate
- **Treatment**
  - If bone is removed with the tooth the area should be smoothed of any sharp edges and the soft tissue repositioned and sutured in the most acceptable position possible
  - If fx is noted before tooth has been totally removed an attempt should be made to separate the tooth from the bone and removing the tooth leaving the periodontal attachment intact on the fractured segment. Careful suturing will hopefully provide satisfactory healing of the fxd segment.
Tuberosity Fracture

- **Cause**
  - Uncontrolled force
  - Not palpating site with opposite hand

- **Avoidance**
  - Controlled force
  - Opposite hand
  - Flap and section

Tx of Tuberosity Fx contd

- Small fragment
  - Dissect tissue away from bone and remove tooth

- Large fragment
  - Wire to adjacent tooth and let heal 6-8 wks
  - If tooth is not infected section crown, let heal, and come back for roots in 6-8 wks
  - Check for sinus communication
  - Antibiotics

Fractured Roots (the most common ext complication)

- Can be avoided by using controlled forces and being quick to recognize the need for an open procedure

A Brief Review of Complex Exodontia

- Flap must be broader at free gingival margin
- Provide sufficient access
• Anticipate amount of bone removal so flap will be supported upon closure

3-Cornered vs 4-Cornered Flaps
• Envelope flaps are preferred, vertical incisions are more difficult to close and cause some mildly prolonged healing

Open Ext of a Single Rooted Tooth

Open Ext of a Single Rooted Tooth

Lower Molars

Maxillary Molars
**Root Fragments**

- Open window approach to maintain buccocrestal bone

**Fractured Roots**

- May be left if:
  - No more than 4-5 mm in length
  - No infection or periapical pathology
  - Must be deeply imbedded in bone and not loose
  - Risk of removal must outweigh the benefit
  - Inform the patient and document thoroughly in record

**Sinus Perforation**

- Cause
  - Anatomy
  - Uncontrolled force
- Avoidance
  - Study film
  - Section tooth
  - Finesse

**Diagnosis of Sinus Perforation**

- Bone at root tips at time of removal
- Nose blowing test?
- Do not probe site

**Treatment of Sinus Perforation (Healthy Sinus)**

- 2-6mm perforation- clot promotion (Gelfoam) ?, sinus precautions
- Over 7mm-probably needs repair (OMS ?)
- Sinus precautions
  - No smoking
  - No sucking through a straw
  - No forceful nose blowing/stifle sneezes
  - Antibiotics (H. influenza): amoxicillin (Augmentin), cephalexin, clindamycin for 5 days
  - Decongestants
  - Nasal spray
Treatment of Sinus Perforation (Diseased Sinus)
- Even small communications may not heal, refer to OMS
- Most communications heal if treated as outlined, there are probably a lot more communications than we are aware of that heal spontaneously
- If any communication has not healed in 2 weeks, an OMS referral is appropriate

Root/Tooth in Sinus
- Cause
  - Excessive apical pressure
- Avoidance
  - Careful preop planning
  - Sectioning tooth
  - Finesse

Treatment of Root Fragment in Sinus
- Healthy sinus?
- Periapical infection?
- Small fragment-2-3mm
  - Irrigate and try to retrieve thru socket
  - If sinus and root tip healthy, no further tx
  - Get x-ray
  - Inform/document
  - Sinus precautions

Treatment of Infected Root/Diseased Sinus
- Refer to OMS
- Large root fragment/whole tooth
  - Refer to OMS for Caldwell-Luc

Caldwell_Luc
Sinus Communication

- Infratemporal fossa
- Floor of the mouth
- Submandibular space
- Tooth/tooth fragment/foreign body in the stomach or airway

Displacement Problems

- Infratemporal fossa
- Floor of the mouth
- Submandibular space
- Tooth/tooth fragment/foreign body in the stomach or airway

Tooth in the Infratemporal Fossa

- Usually impacted maxillary 3rd
- Usually lateral to lateral pterygoid plate and lateral pterygoid muscle
- With good light and access if tooth is visible make one attempt with a hemostat to retrieve, further attempts may only serve to push the tooth into a less accessible region
- If unsuccessful
  - X-ray
  - Inform/document
  - Antibiotics
  - To OMS for removal after fibrosis

Tooth Root in the Floor of the Mouth

- Cause
  - Apical pressure with cryers
  - Thin lingual plate
- Avoidance
  - Avoid any apical pressure
  - Remove difficult root tips by removing bone around them with a small fissure bur rather than using an elevator
- Treatment
  - May be digitally pushed back in socket from the medial and removed with picks
  - Small uninfected tip may be left
  - X-ray, inform/document
  - To OMS for lingual flap dissection and removal

Tooth Root in the Submandibular Space

- Refer to OMS
- Subperiosteal dissection of the lingual of the mandible with extraoral finger pressure superiorly to help control fragment position
- As a last resort, the fragment may be approached from an extraoral route along the lingual mandibular border

Tooth Root in the Submandibular Space

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- Subperiosteal dissection of the lingual of the mandible with extraoral finger pressure superiorly to help control fragment position
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Foreign Body in Airway /Stomach
• Throat drape/don’t place patient in a prone position
• Head down, encourage coughing
• No cough or resp. distress-get belly film and document
• Violent coughing-get patient to ER, supplemental oxygen, CXR, document
• Let your liability company know

Other Displaced Objects
• Immediately discontinue the procedure
• Needles
  – Avoid repeated usage and burying to the hub
  – Radiology guided localization may be necessary for removal
• Keep an accurate count of suture needles, implant parts and pieces, etc.
• If all attempts to remove biocompatible items fail it is not unreasonable to leave the object and follow the patient

Broken Needle

Final Comments on Displacement
• Proper planning and surgical technique
• Anticipation of untoward events and knowledge of their management
• Proper informed consent that includes most common potential complications
• Honesty in the occurrence of complications
• Appropriate referral
Injury to Adjacent Teeth

- **Cause**
  - "Tunnel vision"
  - Inappropriate elevator forces
  - Injudicious handpiece use
  - Failure to protect opposing dentition
  - Large restoration/extensive decay (advise patient of potential before surgery)

- **Avoidance**
  - Diligent surgical planning
  - Light and access
  - Surgical prudence
    - Watch out using straight elevators
    - Place finger or suction tip between tooth being extracted and opposing arch
    - Thin narrow beaked forceps

Treatment of Injured Adjacent Tooth

- Temporize
- Interdental wiring if luxated
- Inform/document

- **REMOVAL OF THE WRONG TOOTH**
  - Most common malpractice suit against dentists
  - Attention to detail
  - Non rigid reimplantation or stabilization of luxation to avoid ankylosis or external resorption
  - Inform/document
  - Give malpractice carrier a heads up

Other Complications

- Injury to the TMJ
- Intraoperative hemorrhage

Injury to the TMJ

- **Cause**
  - Excessive force
  - Torquing movements
  - Overstretching

- **Avoidance**
  - Lid block
  - Counter pressure/controlled force
  - Quick, efficient surgery

- **Treatment**
  - Warm moist packs/soft diet/pint rest/NSAIDS
  - 600-800 mg ibuprofen every 6 hrs for several days
  - 500-1000 mg of acetaminophen if nsaid not tolerated

Hemorrhage

- **Health/family history**
- **Drugs that may impact:**
  - Anticoagulants
  - ASA
  - Broad spectrum antibiotics
  - ETOH
  - Anticancer drugs

- **Labs**
  - PT/PTT, INR
  - Platelet count
Patients at Thromboembolic Risk

- Greatest risk: prosthetic heart valves; risk for aortic <mitral
- Atrial fibrillation-risk increases with addition of other factors, i.e. age, HPT, DM, left ventricular dysfunction, hx of stroke, TIA
- Risk/History of PE, DVT, unstable angina, MI

Anticoagulants

- Coumadin (warfarin sodium)
- Lovenox (enoxaprin sodium)

Coumadin (warfarin sodium)

- Indirect acting anticoagulant that competitively inhibits vitamin K which is essential for coagulation factors in the liver
- Results in production of nonfunctional factors II, VII, IX, and X (vitamin K dependent factors)

Coumadin (warfarin sodium)

- 40 hr elimination ½ life
- Takes 2-3 days to take effect
- Any alteration in gut flora can decrease vitamin K synthesis and increase sensitivity to coumadin (antibiotics)

Lovenox (enoxaprin sodium)

- Low molecular weight heparin derivative
- May be used for bridging therapy if coumadin must be stopped in high risk patients
- Administration is by subcutaneous injection so patient must learn to inject themselves
- Unlikely that there is a bridging requirement for dentoalveolar procedures

Platelet Inhibitors

- Aspirin
- NSAIDS
- Plavix (clopidogrel)
- Ticlid (ticlopidine)
- Pradaxa (dabigatran)
### Aspirin
- Irreversible acetylation of cyclooxygenase
- Often used for MI prophylaxis especially in patients with unstable angina
- Although it inhibits platelet aggregation, once a clot has formed it does little to affect the clot
- Even 325 mg can double the normal bleeding time for several days, and take effect in as little as 20 min.
- May have significant interaction with coumadin, heparin, and ethanol

### NSAIDS
- Transient and reversible platelet aggregation
- Inhibits the COX enzyme system preventing formation of prostaglandins and thromboxanes, creating an analgesic, antipyretic, and anti-inflammatory effect
- Ibuprofen half life is 2 hrs, Naproxen half life is 10-13 hrs
- Ideally wait 3 half lives to ensure no operative bleeding complications
- Try and avoid in patients with coagulation disorders

### Plavix (clopidogrel)
- Consult patient’s physician
- Effect continues for several days and effects decrease proportionally to platelet renewal
- Discontinue 7 days prior to surgery?
- Maximum effect on platelet function is 3-7 days
- There seems to be little need for altering regimen for dentoalveolar procedures

### Ticlid (ticlopidine)
- Used in patients at risk for stroke, in ischemic heart disease, DVT, aortocoronary grafts (same indications as Plavix)
- May increase effect/toxicity of ASA, anticoagulants, and NSAIDS
- Consultation with patient’s physician may be warranted, but as with Plavix, dentoalveolar surgery seems to be of little risk for bleeding

### Pradaxa (dabigatran)
- Direct thrombin inhibitor; dose - 150 mg bid
- New agent to prevent stroke and systemic emboli in patients with nonvalvular atrial fibr
- Few if any drug or food interactions
- INR not necessary
- Nonreversible; most is gone 1-2 days after last dose
- 1-2 teeth can be extracted without altering dose, or skip prior evening’s dose and morning dose on day of procedure

### Managing Patients Using the INR
- Consult patient’s physician
- Effect continues for several days and effects decrease proportionally to platelet renewal
- Discontinue 7 days prior to surgery?
- Maximum effect on platelet function is 3-7 days
- There seems to be little need for altering regimen for dentoalveolar procedures
International Normalized Ratio (INR)

- 1978-WHO recommended standardization
- 1983-INR came into use
- INR=PT/mean normal PT X ISI (international sensitivity index)
- ISI-corrects for the sensitivity of the thromboplastin
- This makes all INRs equivalent regardless of sensitivity of thromboplastin

Stern and Karlis, JADA, 8/97
- "The dental practitioner can help prevent unnecessary bleeding complications by discontinuing coumadin therapy 2-3 days before treatment"

Wahl, Howell; JADA, 5/96
- 95 hematologists, cardiologists, internists, and GPs surveyed
  - 50-50 split on altering coumadin dose in patients with a history of thrombosis, embolism, or altered left ventricular function
  - 11% would modify coumadin for routine cleaning, 33% for restorative work, and 42% for endo

Limitations of the INR

- Not suited for assessing hemostatic function in liver disease
- Lab equipment must be accurately calibrated
- Estimated error of 11-13.5% using thromboplastin with an ISI of 1

In Summary

- For most patients the ideal INR is 2.5-3.5
- For prosthetic heart valves the ideal value is 4.0 with a range of 3.5-5.3
- For dental treatment the upper limit should be 3.5 for simple extractions, and 3.0 for procedures with risk for significant blood loss such as an FMX with alveoplasty

Bottom Line

- Never hesitate to consult the managing physician
- Seek help of your friendly oral surgeon
Treatment Suggestions

• Consult managing physician and educate them on the kind of bleeding expected with the procedure
• Never alter coumadin dose yourself

Treatment Suggestions

• Moderate bleeding anticipated (mult. exts., 3rds)-consider getting INR to 3
• Significant bleeding expected (full mouth exts)-get INR to 3 or below if possible
• Use local measures to help insure hemostasis for all cases

The High Risk Patient

• Alternative approach for high risk patient- hospitalize, switch to heparin to a PTT of 1.5-2, discontinue 6 hrs before surgery, resume 12-24 hrs post-op and return INR to optimal range

Warfarin Algorithm

Management of Bleeding

• Primary closure
• Pressure
• Epinephrine
• Electrocautery
• Hemostatic agents
• Parenteral agents

Hemostatic Agents

• Microfibrillar collagen (Avitene)
• Gelfoam/surgical impregnated with topical thrombin
• Packed collagen (CollaPlugs)
• Fibrin glue
• Sutures
• Gauze packs
Intraoperative Considerations
- Careful tissue handling
- Remove granulation tissue; smooth sharp bone
- Check for bone bleeder (crush peripheral bone)
- Hemostatic agents
  - Bone wax
  - Gelfoam
  - Surgicel
  - Avitene
- Suturing

Hemostatic Agents
- Bone wax
  - A thin veneer may be burnished over a bone bleeder that cannot be controlled by crushing
- Gelfoam (absorbable gelatin sponge)
  - Least expensive, keep in socket with figure of 8 suture
- Surgicel (oxidized regenerated cellulose)
  - Promotes coagulation better than gelfoam, but is more expensive, is more difficult to handle, and causes some delayed healing

Hemostatic Agents contd.
- Topical thrombin
  - Enzymatically converts fibrinogen to fibrin to form a clot
  - Saturate gelatin sponge before placing in socket
- Collagen (Collaplug, Collatape)
  - Promotes platelet aggregation
- Microfibrillar collagen (Avitene)
  - Fluffy consistency, may be sutured into a socket
  - Expensive

Postoperative Complications
- Postoperative hemorrhage
- Postoperative pain control
- Ecchymosis
- Trismus
- Alveolar osteitis
- Dentoalveolar infections (including osteomyelitis and bisphosphonate related osteonecrosis)
- Nerve injuries

Preparation of the Patient for Post-Operative Sequelae
- Swelling - amount and consistency
- Hemorrhage - normal amount to be expected
- Dysfunction
- Temperature
- Nutritional considerations
- Known drug side effects
**Specific Instructions**

- Pressure packs
- Ice packs
- Drugs
- Diet
- Heat packs
- Warm saline rinses

**Post Operative Pain**

- Great variability between patients
  - Pre-operative and post-operative conversation very important in preparing patient’s post-operative expectations
  - These conversations will provide insight into the patient’s requirements
  - The patient must understand that the pain med will manage the pain, but will not eliminate all of the soreness

**3 Post-extraction Pain Characteristics**

- Usually not severe, and can usually be managed with mild analgesics
- The peak post-op pain occurs at about 12 hours and diminishes after that
- The pain from extraction rarely persists for longer than 2 days

**The First Dose**

- Take before the local wears off; Marcaine block
- Take at regular intervals to avoid breakthrough pain
- By taking the medicine this way the patient will take less of the drug and lessen the chance of G.I. problems
Patient Warnings

- Advise of chance of drowsiness, especially if medication is abused
- Advise of the chance for stomach upset, and the need to take the med with something in their stomach

The Common Drugs (often used in combination)

- Peripherally Acting
  - Aspirin
  - Acetaminophen
  - NSAIDS
- Centrally Acting
  - Codeine
  - Oxycodone
  - Hydrocodone
  - Dydrocodeine

Aspirin

- Interferes with prostaglandin synthesis
- Effective dose is 500-1000mg; so if using in combination drug you must deliver this size dose for maximum efficacy
- Disadvantages- G.I. upset, decreased platelet aggregation
- Remains the drug of choice for mild-to-moderate pain after tooth extraction

Acetaminophen

- Does not interfere with platelet function
- Like aspirin 500-1000mg required for best results
- Good for patients who are intolerant of aspirin
- Maximum dose- 4000 mg/day

NSAIDS

- Effective against mild to moderate pain
- Ibuprofen- maximum dose of 3200 mg/day
- NSAID subcategory, COX-2 inhibitors (Celebrex)
  - Cause less G.I. upset, effects platelet function less, and provides longer periods of analgesia
  - May be better for pain that is expected to last for several days
  - No published data to indicate they are superior to other NSAIDS for routine post-extraction pain

Narcotic Analgesics

- Centrally acting
- Well absorbed from the gut
- Produce drowsiness, pain relief, G.I. upset, decreased respiratory drive
- Rarely used alone, but usually in combination with aspirin or acetaminophen
- Codeine compounds- #1=7.5mg, #2=15mg, #3=30mg, #4=60mg
Combination Drugs

- 500-1000mg of aspirin or acetaminophen q 6hrs required for greatest efficacy
- Almost ideal combination is a combo with 300mg of aspirin/acetaminophen and 15mg of codeine taken 2 tabs q4hrs; a third tablet may be taken if necessary

What can I prescribe over the telephone?

- Antibiotics
- Most commonly used drugs
- Class III controlled substances
  - Codeine combinations-Tylenol #3
  - Hydrocodone combinations-Vicodin

What requires a written prescription?

- Schedule II narcotics
- Morphine
- Demerol (meperidine)
- Oxycodone (single drug or in combination)

Doctor, nothing works for me except______!

- Need to set an office policy and stick to it
- More and more State Board actions are being taken due to inappropriate narcotic prescriptions
- Understand difference between acute and chronic pain and treat accordingly
How long should I prescribe a narcotic?
• As long as necessary for the acute surgical pain which is not controlled by NSAIDs
• Do not use for chronic pain problems in your office
• If long term use is necessary, get medical consultation

Pressure Packs and Postoperative Bleeding
• Proper size
• Proper placement
• Proper duration

Management of Postop Hemorrhage
• Rinse gently with cold water
• Place moist gauze pack over the area, bite firmly, sit quietly for 30 min
• If bleeding persists, repeat the cold water rinse, and bite firmly on a moist tea bag for 30 min
• If these techniques are unsuccessful return to the dentist

At the Dentist’s Office
• Suction mouth removing all liver clots and other blood to determine precise sight of hemorrhage
• If ooze is generalized, hold a moist gauze with firm pressure for at least 5 minutes at the site
• If this fails, anesthetize region with block anesthesia, curette out the extraction site and then proceed as you would with an intraoperative bleed
• If these measures fail consult OMS
### Ecchymosis
- Caused by submucosal or subcutaneous oozing
- More common in elderly with increased capillary fragility
- Does not increase pain or infection
- Onset 2-4 days following surgery, usually resolves in 7-10 days
- Anxiety prevented by appropriate postop instructions

### Trismus
- Normal I/I: 40-60mm
- Cause
  - Injection hematoma
  - Hematoma in muscle followed by fibrosis
- Treatment
  - Warm moist packs
  - NSAIDS
  - Tongue blade exercises for 5 min 4X/day

### Sequestra/Spicules
- **Cause**
  - Loss of periosteal blood supply
  - Sharp unsupported bone
  - Uncontrolled force
- **Avoidance**
  - Controlled force
  - Trim and smooth bone
  - Conservative periosteal reflection
  - Avoid closure of flaps with tension and lack of underlying bony support
- **Treatment**
  - Treat conservatively/counsel patient
  - Avoid mylohyoid ridge procedures

### Alveolar Osteitis
- **Incidence**
  - Third molar surgery carries the highest incidence
  - Maxillary involvement rare
- **Symptoms**
  - Radiating pain, low-grade fever, halitosis, exposed bone, regional lymphadenopathy
  - Onset ~3-5 days after surgery, pain that begins after 1 week post surgery more likely due to food debris impaction or acute osteomyelitis

- **Description**
  - Premature fibrinolysis of the clot, which may result in local and radiating pain, and halitosis
  - Presently not categorized as a true infectious process of the bone

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AO Risk Factors

- Preexisting infection
- Periodontal disease
- Poor oral hygiene
- Partial impaction of the tooth
- Lack of operator experience
- Oral contraceptive use
- Tobacco use
- Increased patient age

Alveolar Osteitis

- Cause
  - Loss of clot?
  - Mandible much more common than maxilla
  - Longer and more difficult procedures increase chances
- Avoidance
  - Surgical finesse
  - Patient postop compliance
  - Preop rinse
  - Tetracycline in socket

Alveolar Osteitis Diagnosis

- 72 hrs postop
- Empty socket?
- Foul odor
- Throbbing pain
- Pain worse now than at 24hr mark

Treatment of Alveolar Osteitis

- Don’t use antibiotics
- Remove sutures
- Irrigate/pack Dressol-x dressing (place and dissolve dressings like Alvogyl, have been shown to produce delayed healing)
- Pack daily until patient stays comfortable for 2 days on same pack
  - “Everyone gets packed on Friday”
  - Explain to patient
  - More narcotics seldom needed
  - Don’t anesthetize to irrigate and pack

Canfield’s Dressing 1-800-446-2444

The Perfect Patient

- Male, or non-menstruating women not on BC pills
- Preop antibiotic dose
- Preop rinse, and for several days postop
- Under 25 yrs old
- Non smoker/drinker
- No meds
- Tetracycline in site
Dentoalveolar Infections

- The perils of tooth extraction in the presence of swelling is a myth.
- Surgical removal of the cause of the infection with appropriate incision, drainage, and debridement are absolutely necessary for effective infection management.

Pericoronitis

- 30% of mandibular 3rd molars are removed due to this problem.
- Don't confuse with simple eruption pain.
- Degrees of severity ranging from mild pain and local inflammation to considerable pain, trismus, lymphadenopathy, and fever.
- In almost all instances the tooth should be removed as soon as is safely possible given the patient’s overall medical condition.
- Often prudent to remove the opposing 3rd molar at the same time.
- Post operative antibiotic therapy is indicated.

Subperiosteal Infection

- Cause
  - Inadequate flap debridement
- Avoidance
  - Inspection
  - Bone filing
  - Copious irrigation under flap
- Treatment
  - I and D, debridement
  - Antibiotics

Odontogenic Infection

- Pericoronitis
- Post surgical subperiosteal infections
- Odontogenic infections
- The irradiated patient
- The bisphosphonate patient
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<th>HISTORICAL PERSPECTIVE</th>
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<tr>
<td>Modern advances and concerns</td>
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<tr>
<td>– Improved culture methods</td>
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<td>– Improved diagnostic imaging</td>
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<tr>
<td>– Pharmaceutical research</td>
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<tr>
<td>– Resistant flora</td>
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<td>– Increased numbers of geriatric patients</td>
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<tr>
<th>Microbiology of odontogenic infections</th>
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<tr>
<td>Polymicrobial, most commonly indigenous species</td>
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<tr>
<td>5% totally aerobic, 35% totally anaerobic, 60% mixed</td>
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<tr>
<td>Aerobes-70% strep, 5% staph</td>
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<tr>
<td>Anaerobes-30% anaerobic strep and peptostrep, 50% bacteroides, 20% fusos</td>
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<tr>
<th>Progression of odontogenic infections</th>
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<td>Two major origins-periapical and periodontal (periapical most common)</td>
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<td>Spread affected by two major factors-bone thickness and muscle attachments</td>
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<tr>
<td>The most common odontogenic infection is the vestibular abscess</td>
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<th>Progression of odontogenic infections</th>
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<tr>
<td>Most maxillary infections erode through the buccal plate and below the buccinator attachment; lingual plate erosion common with mandibular molars with the mylohyoid determining whether drainage will be into the submandibular or sublingual space</td>
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<thead>
<tr>
<th>Principles of therapy</th>
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<tr>
<td>Determine the severity</td>
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<tr>
<td>Evaluate the state of host defense mechanisms</td>
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<tr>
<td>Determine if specialty referral required</td>
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<tr>
<td>Treat the infection surgically</td>
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<tr>
<td>Support the patient medically</td>
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<tr>
<td>Choose and prescribe the appropriate antibiotic</td>
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<th>Principles of therapy</th>
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<tr>
<td>Administer the antibiotic properly</td>
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<tr>
<td>Evaluate the patient frequently</td>
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</table>
Referral to specialist?

- Rapid progression
- Breathing/swallowing difficulty
- Space involvement
- Temp >101
- Trismus <10mm
- Toxic appearance
- Compromised host defenses

Incision and drainage

- Goals
  - remove cause
  - drain purulence
  - decompress pressure
  - improve circulation to the area
  - alter local oxidation-reduction potential
- Whenever an abscess cavity with pus is diagnosed, it must be drained

Incision and Drainage contd

- Although an infectious process caught in the cellulitis phase may respond favorably to antibiotic therapy there is no evidence that an I and D performed before actual pus formation has a negative impact on the outcome

Surgical principles of incision and drainage

- Incise in healthy tissue for more rapid healing and a more cosmetic scar
- Incise in a cosmetically and functionally acceptable place
- Use blunt dissection (spread hemostats in direction parallel to vital structures)
- Thoroughly explore involved spaces
- One way drains in intraoral cases; through and through in extraoral

I and D technique

- Local anesthesia
- Disinfect
- Aspirate for culture
- Incise to gain dependent drainage
- Bluntly explore entire space and adjacent spaces
- Irrigate
- Place and secure drains
- Remove drains when they are no longer productive

Incision and Drainage (I and D)
Antibiotic Therapy

- Of the antibiotics commonly used for orofacial infections no one is clearly superior to all others
- Antibiotic choice should be based on cost and safety, with individual consideration to the patient’s medical history
- SURGICAL TREATMENT IS OF PRIMARY IMPORTANCE

Empiric Antibiotics of Choice for Orofacial Infections

- Pen VK or Amoxicillin
  - Safe and low in cost
  - Amoxicillin may provide more rapid improvement in pain and swelling and is slightly less expensive, and longer dosage interval may improve compliance
- For the pen allergic
  - Clindamycin-antibiotic associated colitis an unlikely complication
  - Azithromycin has fewer drug interactions than the other macrolides
  - Metronidazole as effective as pen when combined with appropriate surgery even though it kills anaerobic species
  - Moxifloxacin-effective against oral strep and anaerobes, especially Eikenella corrodens, which is uniformly resistant to clindamycin
- Excellent bone absorption when given orally, so may be effective in treating osteomyelitis in the outpatient setting, thus avoiding central line
- Avoid use in pregnancy and children

Use empiric therapy routinely

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Antibiotic problems

- Patient noncompliance
- Drug not reaching the site
- Drug dosage too low
- Wrong bacterial diagnosis
- Wrong antibiotic

Costs of Oral Antibiotics
72 hour rule
• If there is no improvement in the patient’s condition in 72 hrs, look for another cause or consider changing the antibiotic regimen

Other antibiotic considerations
• Should prophylactic antibiotics be used for patients having removal of erupted teeth?
  – The medical risk factors fall into 2 categories
    • Those with an existing condition that makes them more susceptible to developing a postoperative infection
    • Those associated with the consequences of the bacteremia that follows tooth extraction

Systemic Conditions Predisposing to Postoperative Infections
• Poorly controlled DM
• ESRD
• Severe alcoholism
• HIV
• Leukemia
• Lymphoma
• Advanced malignancy
• Chemotherapeutic agents
• Immunosuppressive drugs

Consequences of Extraction-Induced Bacteremia
• Studies have shown that even with prophylactic antibiotic use, bacteria are still in the blood stream one hour after the procedure, therefore, prophylaxis is not 100% effective
• However, due to medicolegal ramifications, the published AHA guidelines should be followed

Endocarditis prophylaxis recommended
• High risk
  – Prosthetic valves, previous endocarditis, complex cyanotic congenital heart disease, surgically constructed pulmonary shunts or conduits
• Moderate risk
  – RHD, hypertrophic cardiomyopathy, MVP, most other congenital cardiac malformations

• The literature does not support the need for prophylactic antibiotic therapy in the conditions noted on the previous slide
• The main indications to support this in the current literature are:
  – Patients at high risk of endocarditis
  – Patients who have had total joint replacement and are at high risk for infection

Other situations where prophylaxis is recommended

• First 2 yrs following total joint replacement
• Total joint replacement along with one or more of the following conditions:
  – Inflammatory arthropathies
  – Rheumatoid arthritis
  – SLE
  – Disease, drug, or radiation induced immunosuppression

Prophylaxis not recommended

• Pins, plates, screws
• Isolated secundum atrial septal defect
• Surgical repair of defects beyond 6 mos without residua
• Previous CABG, MVP w/o regurg, innocent murmurs
• Previous Kawasaki disease or RF w/o valvular dysfunction
• Cardiac pacemakers and implanted defibrillators

Dental procedures for which prophylaxis recommended

• Extractions, perio probing/scaling/surgery, implant placement, reimplantation
• Endo tx beyond the apex, subgingival packing, placement of ortho bands (not brackets)
• Prophylactic cleaning of teeth or implants where bleeding is anticipated

Dental procedures for which prophylaxis is not recommended

• Restorative dentistry involving no subgingival activities
• Local anesthetics (noninterligamentary), rubber dam placement (supragingival), suture removal
• Placement of removable appliances, intracanal endo tx, impressions
• Fluoride txs, oral radiographs, ortho appliance adjustment, shedding of primary teeth

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Prophylactic regimens

• Standard regimen
  – Amoxicillin adults - 2gm po 1h prior; children - 50mg/kg po 1h prior
• Unable to take oral meds
  – Ampicillin adults - 2gm IV/IM 30min prior; children - 50mg/kg IV/IM 30min prior
• Allergic to PCN
  – Cindamycin adults - 600mg po 1h prior; children - 20mg/kg po 1h prior
  – Cephalexin adults - 2gm po 1h prior; children - 50mg/kg po 1h prior
Prophylactic regimens

- Allergic to PCN and unable to take po meds
  - Clindamycin: adults - 600mg IV 30min prior
    children - 20mg/kg IV 30min prior
  - Cefazolin: adults - 1gm IV/IM 30min prior
    children - 25mg/kg IV/IM 30min prior
  - NEVER HESITATE TO CONSULT THE PATIENT'S PHYSICIAN

Impacted Third Molar Considerations

- Do antibiotics reduce the frequency of surgical site infections after impacted mandibular 3rd molar surgery?
  - Best available data – Healthy patients undergoing extraction of at least 1 impacted mandibular molar in an ambulatory setting would benefit from a preop dose of antibiotic (2 gm Amoxicillin or 600mg Clindamycin) 1 hour prior to surgery followed by a 2-7 day course postoperatively to prevent surgical site infections

Implant Considerations

- Does the use of prophylactic antibiotics decrease implant failure?
  - Best evidence indicates that in a healthy patient a 2 gm Amoxicillin preop dose or a 1 gm Amoxicillin preop dose followed by 500 mg Amoxicillin 4 times a day for 2 days can significantly reduce the rate of early implant failure

Osteomyelitis of the Jaws

- Relatively uncommon due to the vascularity of the region
- Most commonly seen in patients with
  - Vascular insufficiency and immune dysfunction
    - DM, fibrous dysplasia, florid osseous dysplasia, osteopetrosis, Paget's disease, sickle cell anemia, osseous malignancies, leukemia, agranulocytosis, systemic steroids, intravenous drug use, renal and hepatic failure, HIV
  - Radiation therapy
  - Bisphosphonates

Acute Osteomyelitis

- Pain, swelling, trismus, purulent discharge, febrile episodes with potential hypoesthesias
- Lymphadenopathy, fistulous tracts, exposed bone, sequestra formation
- Mandible>maxilla
- Spread via the marrow spaces compromising blood supply
Empirical Antimicrobial Therapy in Acute Osteomyelitis

- First line agents: Clindamycin or amoxicillin/acylcalvulanic acid combos (Augmentin) for at least 6 wks

Osteoradionecrosis (ORN)

- Hypovasularity, hypocellularity, hypoxia
- 10-48% occur with no history of precipitating trauma

Prevention of ORN

- Before radiation therapy
  - Extract teeth with pocket depth ≥5 mm, extensive decay or periapical lesions
  - Extract partially impacted and incompletely erupted teeth
  - Remove exposed residual root tips
  - Remove significant tori and exostoses
  - Aggressive alveoplasty and primary closure
  - Best to wait 3 weeks before starting radiation

Prevention of ORN

- Following radiation therapy
  - Encourage meticulous hygiene, fluoride trays
  - Avoid tooth extraction if possible (HBO?)
  - Avoid tobacco and alcohol
- Once ORN is diagnosed referral to an OMS is probably prudent
Oral Bisphosphonates

• Less than 10% of the documented cases of BRONJ
• Few cases related to oral drugs have occurred in patients who have taken the drug for less than 3 years
• Patients with no other significant health issues and no history of jaw bone problems can be treated as a regular patient, this includes implant placement.

Oral Bisphosphonates contd.

• Patients should be counseled concerning the fact that although there should be no problems with invasive procedures there is a greater potential for implant failure or altered post surgical healing due to their bisphosphonate therapy.
• This should be documented in the record and be included on the consent form

Dentoalveolar Nerve Injury

• Recovery from nerve injury can be unpredictable
• Risk factors
  − Advanced age
  − Difficulty of the operation
  − Surgeon's experience
  − Anatomic proximity of the tooth to the nerve canal (most critical)
Incidence of Dentoalveolar Nerve Injury Following Lower 3rd Molar Surgery

- World wide:
  - IA: 0.26% to 8.4%
  - LN: 0.1% to 22%
- Teaching Hospital 1998-2005, 4338 lower 3rds
  - IA: 0.35%; LN: 0.69%
  - Distoangular impactions significantly increase risk of LN deficit
  - Half of IA injuries recovered in 3 months; LN in 6 months

Paresthesia

- Avoid via careful preop planning, flap design, prudent surgery, and gentle flap retraction
- Nasopalatine and buccal nerve may be sectioned without sequelae
- Mental-usually returns
- Inf. Alveolar usually returns unless transected
- Lingual nerve usually does not regenerate

Identifying Risk

- Panorex (CBCT?)
  - Interruption of the of the white cortical outline
  - Diversion of the mandibular canal
  - Darkening at the root apices (most significant indicator)
- At Surgery
  - Visualization of the neurovascular bundle
  - Brisk hemorrhage from depth of ext site
Identifying Risk

• Mention findings in your notes
• Warn patient of potential for nerve injury in your informed consent
• If neural deficits continue more than just a few weeks postop it may be wise to involve your OMS

The Law and Dentoalveolar Complications

Legal Principles

• Oral surgery malpractice is determined by the state where surgery is performed
• Oral surgery malpractice requires proof of 3 elements:
  – Negligence
  – Cause
  – Injury
• Professional negligence-failure to meet or adhere to the standard of care

The Law and the Standard of Care

• To prevail in a malpractice claim, the patient must prove 4 elements:
  – The surgeon owed a duty to the patient
  – The surgeon failed to meet the standard of care
  – The failure was the legal cause
  – An injury

Written Standards of Care

• Written guidelines can be used as the standard of care if they were so intended by the authors, i.e. ASA guidelines, manufacturer’s guidelines

Written Laws: Code

• Violation of a statute intended to prevent harm is presumptive evidence of a violation of the standard of care or professional negligence, so expert testimony is not required, i.e. an infection caused by failure to autoclave instruments
Damages
• General damages - physical and emotional pain and suffering
• Special damages - for financial losses i.e. medical bills, wages, travel expenses
• Therefore, it is important to note and chart the details and specifics of a patient’s postsurgical complaints and track their course, especially neurologic issues

Comparative Fault/Contributory Negligence
• Patient negligence reduces the amount of damages and may even extinguish the malpractice claim
• Therefore, it is important to document missed appointments, failure to follow instructions, providing a false or deceptive history

Burden of Proof
• The patient’s attorney is responsible for providing a violation of the standard of care
• Unlike a criminal trial where the evidentiary level is beyond a reasonable doubt, the plaintiff in a malpractice case only has to provide a preponderance of evidence (> 50%)
• In effective resolution of conflicting testimony, juries favor the doctor’s testimony when it is supported by detailed and legible documentation

Informed Consent
• Requirements include:
  – Significant risks
  – Benefits
  – Alternatives to recommended treatments, therapies, or medications
• Should be in writing

Informed Refusal
• When a patient refuses to accept recommended treatment or advice an informed refusal should be placed in the record
• This documents the discussion of risks, benefits, and alternatives to refusing recommended treatment or selecting a less than ideal treatment plan

Standard of Care for Referrals
• Whether a patient can be treated or needs to be referred to another specialist is determined by whether the surgeon can:
  – Predict the potential for complications
  – Recognize the occurrence of a complication in a timely fashion and initiate appropriate treatment
  – Recognize the occurrence of a complication and make a timely referral
Documenting Medical Consultations

- Should be in writing, signed, and placed in the patient’s record
- A telephonic medical clearance may be made by way of a confirming FAX which is placed in the patient’s record

Complications

- Risk - a surgical complication that cannot be reduced or eliminated by skill, care, or technology
- Skill - physical surgery and the use and control of instruments
- Care - refers to the diagnosis, planning and follow-up of a patient

Extractions

- Most claims involve issues of whether the complication is a risk or a result of substandard care
- Nerve injuries, infections, and jaw fractures after dental alveolar surgery compromise many of the claims for malpractice despite the fact that complications can and do happen in the absence of negligence

Nerve Injuries

- Tips:
  - Chart and photograph any unusual findings noted at surgery i.e. absence of lingual plate, a tenacious follicular sac, nerve tissue noted at the crest of the bony socket
  - Call patients at risk the evening of the surgery and chart their responses to questions regarding neurologic status, + and –
  - If the response is positive, schedule patient for a neurologic eval using the AAOMS exam form
  - Keep good records as you follow the injury including patient’s declining surgical repair

Infections

- Document the clinical and radiographic findings that support the need for extractions and whether preoperative or prophylactic antibiotics are indicated, document refusal if patient declines
- Be available and concerned as you offer care and advice
- Keep good records with notes on specific findings and clinical course

Implants

- Reverse of extraction with the same risks
- Document implant candidacy and indication
- Indicate if adjunct procedures are required, and document if the patient declines
- CBCT may help avoid neural injury, but it is not a substitute of good surgical planning
- Document why a particular length of implant was chosen
Sinus Infections

- Good consent usually adequate, however, failure to diagnose and treat such infections in a timely manner can cause claims for malpractice
- Careful charting during follow-up with photos and imaging as necessary
- Consider referral to ENT, document refusal if patient declines