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Orofacial Trauma Mini Series

Session 1: Orofacial trauma – case approach & investigation

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Orofacial Trauma

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Investigation of Orofacial Trauma

History

- age, species, breed, general health
- cause & timing of event, previous occurrences & treatments, frequency & pattern
- predisposing factors – species, breed & age; habits, periodontal & dental status; neoplasia; cysts; previous fractures
- owner present? Owner attitude and capabilities.

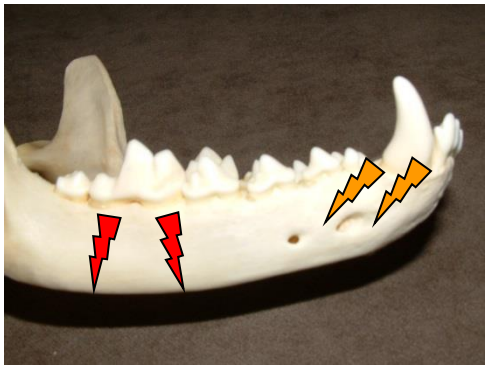
Injury Type

- Road traffic accidents
- High-rise syndrome
- Fights
- Non-accidental injury
- Iatrogenic during extraction
- 'Spontaneous'/ 'pathological'

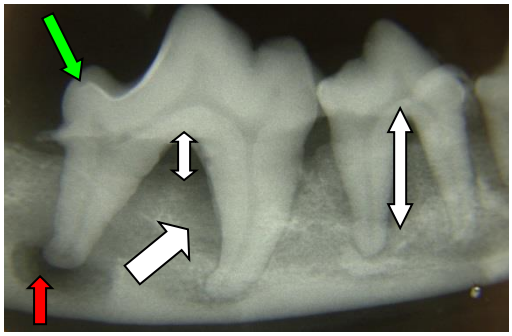
Jaw Fracture Predisposing Factors

Jaw fracture risk may be identified through assessment by probing and intra-oral radiography. Bone weakening or loss may be found in areas of periodontitis, cyst formation, unerupted dentition, structural dentition (large-rooted teeth eg canines, carnassials) or tumours.

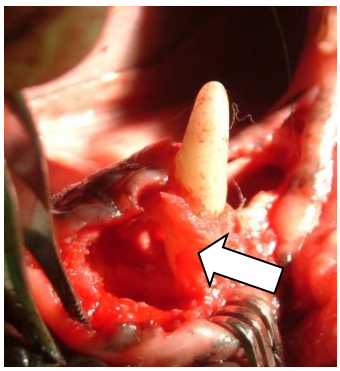
Fracture lines at sites of structural dentition.

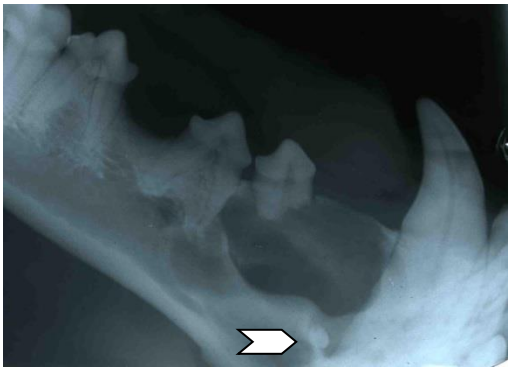


Bone loss via periodontitis (white arrows) and periapical pathology (red arrow). Note low level of bone supporting the roots of the large teeth (mandibular first molar, green arrow). Small breeds especially have low levels of bone support for their tooth size.

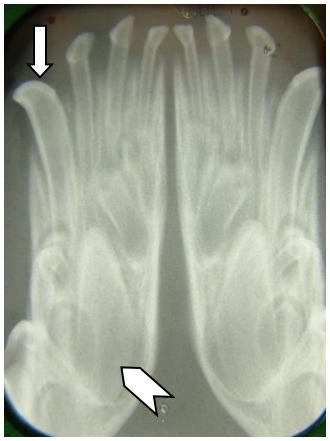


Bone loss around mandibular canine (arrow=root) of a boxer dog via dentigerous cyst centered on unerupted 305 (first premolar; chevron); only a weak bone ‘shell’ remains.

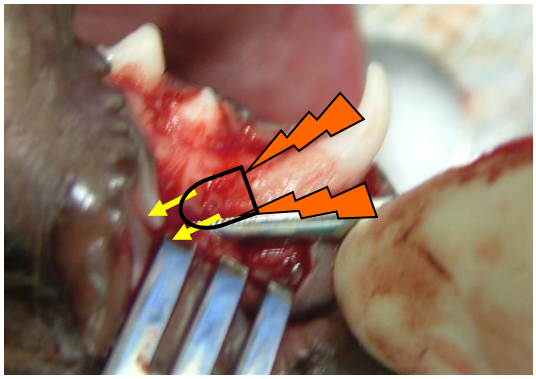




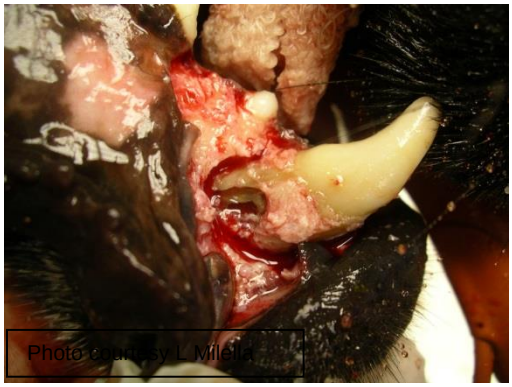
Juvenile showing deciduous (arrow) and unerupted, permanent dentition (chevron). Surrounding bone is soft and minimal; folding and compression injuries are likely. Unerupted teeth are susceptible to trauma during extraction, trauma or fracture fixation.



A straight, cutting only action (avoid rotation) during lower canine extraction minimises likelihood of fracture along the lines of weakness (lightning). The buccal bone window is made with a rounded base (black outline) to prevent fracture propagation lines (arrows).



Abscessation of mandibular canine secondary to drill-hole in root from jaw fracture fixation. While fixation is the primary goal, teeth must be avoided and/ or treated appropriately.



Examination

For trauma cases remember that it takes a lot of force to fracture a mandible ordinarily!! Multiple injuries are likely, of both the facial area and other e.g. internal bleeding, neurological.

- Remove gross blood from the facial region.
- Check for CSF contamination – 'tram lines' with blood.
- May be limited by gross swelling; check airway patency and anticipate multiple fractures.
- Palpation is useful but may require sedation/ GA of patient. Repeat once swelling has reduced for potentially missed fractures.

General

- Airway, Breathing, Circulation
- consciousness & mentation
- pain
- bleeding, dehydration
- neurological compromise....cranial nerve examination

Head & Neck

- compliance
- symmetry, swelling (& cause), bruising
- cranium palpation – 'boggy depressions', step deformities
- facial buttresses
- lacerations, abrasions, degloving injuries, foreign bodies
- laryngeal/ tracheal deviation, emphysema
- lymph nodes
- Ocular – enophthalmus (orbital fat pad herniation)

  -exophthalmus (retrobulbar haematoma, fracture impingement, abscess)

  - telecanthus - increased distance between medial canthi (midline suture open)

  - pupillary light reflex, movements, haemorrhage, laceration

- Nasal – wide, flat or deviated nose
  - blood, CSF, haematoma. Suction useful.

- Aural - lacerations, blood pooling +/- CSF (cranial base fracture)
  - tympanic membrane patency, haematoma

- Jaw - movement: opening/ gape, fixation.
  - zygoma & coronoid process movement (symmetry, clunks, clicks)
  - mechanical versus pain; TMJ versus inflammation; trismus

  OPEN – swelling, haematoma, abscess, fracture, TMJ dislocation
  CLOSED/ PAIN ON OPENING – trismus, inflammation, abscess, joint effusion, condylar fracture, coronoid / zygoma fracture.
- rostral & lateral views, mandible ventral border: 'step defects', thickening
- Fracture types & locations

Intra-Oral

Detailed oral examination will always require sedation or, ideally, general anaesthetic.

A dental chart is required to record detail or vital facts will be missed or forgotten.

- Occlusion – FOR RELEVANT BREED!
  - dental interlock, canine interdigitation
  - cross bites, step defects
  - midline deviation (mandible relative to maxilla)
- Counting teeth – missing, supernumerary/supplemental
- Dental status – periodontal disease, fractured teeth (type of fracture), abscess
- Oral status – hygiene, neoplasia
- Involvement & status of teeth in fracture line; 'step defects'
- Fracture types & locations –assess if mobile premaxilla/ maxilla portion ie level of fracture
  -portions may move ventrocaudally to obstruct airway.
  - palatal haematoma indicates possible palatal fracture
- Bilateral rostral mandibular fracture -> loss of anterior tongue anchorage
- Sublingual swelling/ haematoma/ emphysema may occlude airway & -> infection
- Palpate in buccal sulcus for zygomatico-maxillary fracture
- Usually compound even if not visible due to tight adherence of mucosa to bone
- Soft tissue exam - lacerations, abrasions, degloving injuries, foreign bodies (e.g. teeth!)

- Antibiotics – oral microbiota - broad spectrum eg amoxicillin (+/- anaerobes – metronidazole)

Identify fracture types & locations

Assume fractures of tooth-bearing bone are compound fractures.

- Closed – simple; no communication to outer environment
- Compound – open; communication of fracture to outer environment
- Comminuted – complex; multi-fragment, no direct contact between proximal & distal portions
- Complicated – involvement of major blood vessel or nerve
- Pathological – secondary; underlying bone pathology -> reduced bone strength
- Location
- Favourability
- Favourable - direction & position of fracture. Muscle versus gravity/ downward forces
- Unfavourable – re-align required
- Displacement – depressed, compressed, impacted, folded, fissure, greenstick
- Fracture line – direction (transverse, oblique, spiral); complete & incomplete; fragment no.

Radiography

Usually multiple fractures thus combination required.
To estimate a 3D picture requires several views at 90degrees.

Plain

Generally low resolution with much superimposition. Survey radiographs useful for maxilla, ramus, condylar process.

- ✗ Difficult to assess complex 3D structures of orofacial regions – CT superior.
- ✗ Poor dental detail.
- ✓ Good assessment of mandibular body (superior to CT).

Jaws

- Lateral
- VD – good for zygoma
- Lateral oblique- right & left

Maxilla - thin bones thus hide prior fracture
Mandible – non-weight bearing thus minimal callus

TMJ

- Open-mouth
- DV/ VD
- Latero-lateral
- Lateral oblique- right & left

Increased joint space likely due to subluxation or luxation.

- ➢ Condyle rostrodorsal – most common luxation.
- ➢ Condlye caudal – usually with fracture of retroarticular process.

Intra-oral

- High resolution. Non-screen. Digital DR sensor (size 2) or CR phosphor plate (size 2, 4 etc.
- Reduced superimposition.
- Size of film/sensor/ phosphor plate – 0/1, 2, 4. Most common for dental purposes is size 2.
- Dental X-ray machine – reduces movement of head required.
- Parallel technique – mandibular molars & caudal premolars; limited by symphysis.
- Bisecting angle technique - required for maxilla & rostral premolars, canines & incisors.

1. Jaws

- Dogs - Detail of fracture and involvement of teeth. Size 4 or 2
- Cats –Size 4 film good for cat TMJ, jaw/ skull views. Size 2 for detail plus palatal/ nasal view.

2. Dento-alveolar process

- Dental trauma - tooth fracture, avulsion, luxation, concussion
- Periodontal health
- Pulp health, periapical status, vitality
- Dento-alveolar fracture
- Proximity to/ involvement in fracture line

CT Imaging

- ✓ Easy to assess complex 3D structures of orofacial regions.
- × Poor dental detail.
- × Assessment of mandibular body inferior to Xray.

<u>Comparison of Xray and CT Imaging Diagnostic Yield</u>

(Verstraete et al 2008)

Feature	Detail	X-ray	CT
26 features	**easy**	**17**	**26**
	moderate	**3**	**0**
	impossible	**6**	**0**
Injuries	**cat**	**3.8**	**7.7**
	dog	**4.8**	**7.6**

Initial Approach to Jaw Instability

First Aid

ABC
May require tracheostomy for airway security initially & later for fixation.

Pain
- high - jaw fractures
- moderate – high – tooth fracture
- low – symphyseal separation

Analgesia – opioids, NSAIDs, local analgesia (nerve blocks, infiltration), paracetamol (dogs).

Initial Handling
Establish airway to ensure:
- Secure
- Enables full mouth closing to assess occlusion

Methods -
1. Short ET tubes with easily removable connector may suffice if incisors can close fully.
2. Pharyngostomy placement for ET tube to allow occlusion checks.
3. Transmylohyoid ET tube placement (parallel to lower M1/ carnassial)

Tuck tongue back into oropharynx temporarily to assess occlusion.

Trauma
- Occlusion, reduction of contamination, prevention of infection.
- Avoid excessive movement of jaw fragments re pain & neurovascular trauma.
- Reduce swelling and haematoma (thus infection).
- Ability to eat. May require oesophageal feeding tube.
- Avoid naso-oesophageal feeding tube (may pith patient if cribriform plate fracture!)
- Stabilise with tape muzzle if treatment delay required but treat asap.

TMJ Luxation
- May require sedation/ GA
- Pen between molars across mouth, close mouth & push backwards -> ‘clunk’ back
- Treat asap to prevent swelling, inflammation, fibrous tissue preventing reduction
- Homecare = soft food, muzzle, no toys

Muzzle
Tape – customised. Make multiple – rotate & clean for hygiene.

Material – commercial eg Mikki. Ensure correct sizing. Place inside-out (minimise chafing). Clean for hygiene.

Soft tissue
- Haemostasis – pressure, ligation of vessels
- Debride – physical – remove avascular/ necrotic tissue
  -irrigation - copious physiological solution (Hartmann’s solution, saline)
  - 10ml syringe, 21gauge needle

Bone

- Haemostasis – pressure, ligation of vessels, bone wax (minimise)
- Debride – physical – remove avascular/ necrotic tissue; prevent sequestrae
  -irrigation - copious physiological solution (Hartmann's solution, saline)
  -10ml syringe, 21gauge needle
- Stabilisation – reduce & prevent further distraction OR consider removal (partial mandibulectomy).

Teeth

- Extraction if deleterious to fracture healing e.g. periodontitis, abscess, cyst
- Gentle technique, no root remnants
- Retain if useful for fixation/ vital
- Require monitor & likely further tx – extract, root canal therapy, restore etc

Oral Hygiene

Calculus

Gross removal required for: visualisation, ability to apply materials to teeth, enable plaque removal.

- Hand scaling – scalers & curettes
- Ultrasonic & sonic
- Calculus forceps BUT care re force on fractures, weak regions, TMJ, teeth

Plaque

Gross removal required to lower bacterial load, reduce likelihood of infection & wound breakdown, enable material bonding.

Mechanical disruption of biofilm

- Intra-operative – polishing. Care not to heat teeth. Oil-free paste for bonding.
- Homecare - long term by brushing. Daily, soft-medium bristle brush, animal-specific paste.

Chemical

Chlorhexidine digluconate 0.12-0.20%

- ✓ Pre & post-operative. BID. Substantive effect 12hr.
- × Superficial effect. Taste! Short-term (weeks) only. Staining.

Antibiotics

- Not required?
- Most important timing is pre-operative (perioperative 24hr).
- Course conveys no benefit?

Analgesia

- Pre-emptive
- Multimodal eg opiate + NSAID + local analgesia

Local Analgesia

- simple, quick and effective - routine.
- Needle tip bevel faces outwards. Slide tip slide gradually towards the bone to its destination. This method reduces risk of neurovascular trauma.
- Aspirate to ensure intravascular injection does not occur.
- Required volume slowly injected and gentle finger pressure utilised over the area, on needle withdrawal, to minimise leakage and dispersion away from the target area.

One study demonstrated that larger needles may cause greater nerve damage and should thus be avoided. Needles should only be used once, ie new needles used for each injection, should bone be contacted at any stage. Even minimal distortion of the tip can cause nerve and soft tissue injury.

Infiltration

- sub-mucosal deposition of local anaesthetic around and within the area for surgery.
- works most effectively in the maxilla where bone density is lower & in the mandibles of juveniles (lower bone density).

✓ low risk of nerve damage or intravascular injection.

Splash Block

✓ dripping local anaesthetic into the wound.
✓ Maxillofacial surgery cases would be most likely to benefit.
✓ simple and no evidence of wound healing delay
× inherent timing of usage makes it suitable only as an adjunct, rather than pre-emptive.

Nerve Block

This technique results in lack of sensation (except pressure) to the area supplied by the nerve blocked. The area size and location is thus dictated by the nerve or nerves blocked and level at which the block occurs. A more posterior block will provide analgesia to a greater area since branches anterior to this will be affected.

Maxilla

1. Infraorbital

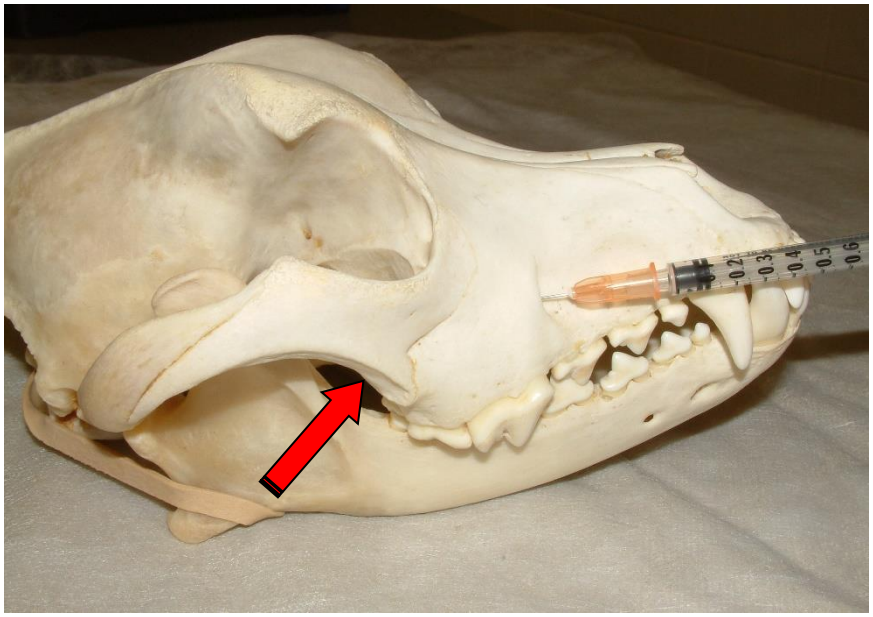
The infra-orbital nerve runs within the infraorbital canal in bilateral fashion, exiting the canal at the infraorbital foramen. This foramen is located rostro-ventral to the orbit and directly above the mesial (anterior) roots of 108 and 208 (maxillary carnassials). It supplies buccal and nasal tissues, the cheeks and towards the eyes. The area of tissue blocked depends on position of deposition of local anaesthetic agent along the canal. An appropriate location of local anaesthesia must be chosen for the surgery and its estimated margins anterior to the block.

- foramen level – rostral premolars, canines, incisors (of treated side)
- posterior canal – premolars, canines, incisors (of treated side)

WARNING! If a posterior deposition is used care must be taken to pre-measure the distance from foramen to the medial canthus of the eye and ensure that an appropriately short needle or marker is employed to prevent iatrogenic ocular damage. It should also be noted that injection within the canal is considered by some authorities to increase risk of intravascular injection or nerve damage by injection into the nerve or pressure from the injected volume. A neuropraxia and paresthesia may result. Slow injection of appropriate volumes is thus advised.

2. Maxillary

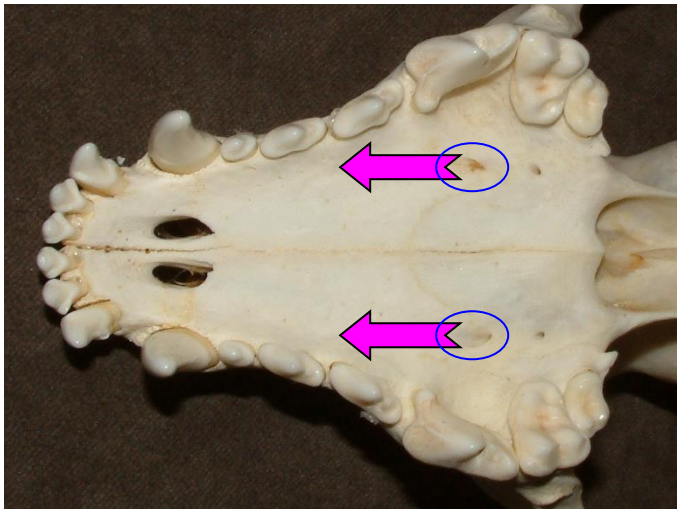
This location may be used to block all dentition (pulps), soft and hard tissues of one maxillary side. The location between zygomatic arch and jaw body is highly complex with a mass of neurovascular tissue present and globe beyond. Placement precision is essential to minimise the risk of trauma.



Maxillary block (red arrow). Caution must be taken to avoid nerve damage, venipuncture or eye trauma.

3. Major Palatine

The major palatine neurovascular bundle is located mid-way between each maxillary arcade and the palatal midline. It runs within the palatine canal caudally, exiting at approximately the level of the distal root of 108,208 (right and left maxillary 4th premolar respectively) in the dog and mesial roots of 108,208 (right and left maxillary 4th premolars) in the cat.



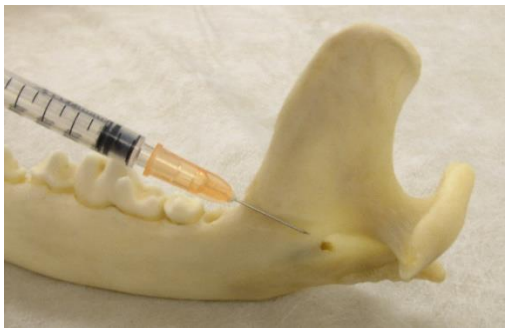
MANDIBLE

1. Mental

exit middle mental foramen located just below the mesial root of 306,406 (left and right mandibular 2nd premolars), at the root-tip of 304,404 (left and right mandibular canines) and posterior/caudal to the labial frenulum. It innervates the first premolars, the canines and ipsilateral incisors making block at this level excellent for extraction of these teeth or small rostral mandibulectomy. Deposition at the foramen level is advised for this purpose.

2. Inferior Alveolar/ Mandibular

The inferior alveolar/ mandibular nerve enters the mandibular canal at this point. It may be located by palpating the ventral border of the jaw in slim animals, locating the slight concavity and moving to the medial/ lingual aspect of the jaw at this point. Local anaesthetic may be injected around the foramen via both intra and extra-oral techniques, resulting in block of the ipsilateral mandible and its dentition. Since clipping is required for the latter method, preparation is reduced by intra-oral technique. Patients for posterior extractions or mandibulectomies will benefit from this analgesia.



Inferior alveolar/ mandibular block – the foramen is located caudo-ventral to the last molar (cats and dogs)

Extra-oral technique for inferior alveolar block

Care should be taken to deposit anaesthetic adjacent to the nerve and avoid medial injection affecting the lingual nerve since the risk tongue and cheek biting may be increased.

Bupivicaine

- Onset = 10-30min (close nerve proximity gives most rapid onset)
- Duration = up to 6hr (in foramen); 4-6hr (diffusion infiltration); 1.5hr(pulp)
- Maximum dose = 2mg/kg
- Formulation = 0.5% (5mg/ml)

Lidocaine

- Onset = 5-10min
- Duration = 1-2hr
- Max dose = 4mg/kg
- Formulation = 2% (20mg/ml)

Ensure that the total dose of all blocks is well below the animal's overall maximum dosage!

Complications

The likelihood of complication is reduced by gentle, accurate technique and anatomic knowledge. Differences in species and specific breeds must be borne in mind when locating position for nerve blocks. Injection within the confined space of a canal may increase risk.