

Orofacial Trauma Mini Series

Session 3: Minimally invasive jaw fracture fixation

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Minimally-Invasive Jaw Stabilisation

Initial Approach

1. ABC & emergency support.
2. Airway - establish secure airway to ensure full mouth closing & assess occlusion. Methods:
 - a. Short ET tubes with easily removable connector may suffice if incisors can close fully.
 - b. Pharyngostomy placement for ET tube to allow occlusion checks.
 - c. Transmylohyoid ET tube placement (parallel to lower M1/ carnassial)
3. Analgesia.
4. Antibiotics? Irrigate & debride.
5. Assess TMJ, soft tissue, bone, teeth
6. Stabilise – reduce movement of jaw fragments re pain & neurovascular trauma. Tape muzzle if treatment delay unavoidable, but treat asap.
7. Feeding support - may require oesophageal feeding tube. Avoid naso-oesophageal feeding tube (may pith patient if cribriform plate fracture!)
8. Oral Hygiene – calculus & plaque removal. Scale & polish (oil-free paste eg pumice & water).
 - a. Clean surgical field
 - b. Enable bonding to teeth

Treatment Principles

Stabilisation involves neutralisation of the forces acting on the jaws. This requires implants ideally placed at the zone of tension, with long axis parallel to the stresses acting.

Aims:

- Stabilise the jaw
- Neutralise tensile and compressive forces
- Relieve pain
- Reconstruct areas of soft tissue injury
- Restore occlusion
- Restore function

Maxilla

In the maxilla the 3D box created, with minimal muscular forces acting, is inherently relatively stable. Where fractures are stable, minimally or undisplaced, often no additional stabilisation is required.

Mandible

In contrast the mandible acts as a lever arm; masticatory muscles act caudally whilst gravity and resistance of prehended objects create opposing (ventral) forces rostrally. The net effect is bending forces upon the mandible, with tension across the dorsal aspect (crestal alveolar bone adjacent to teeth crowns) and compression ventrally.

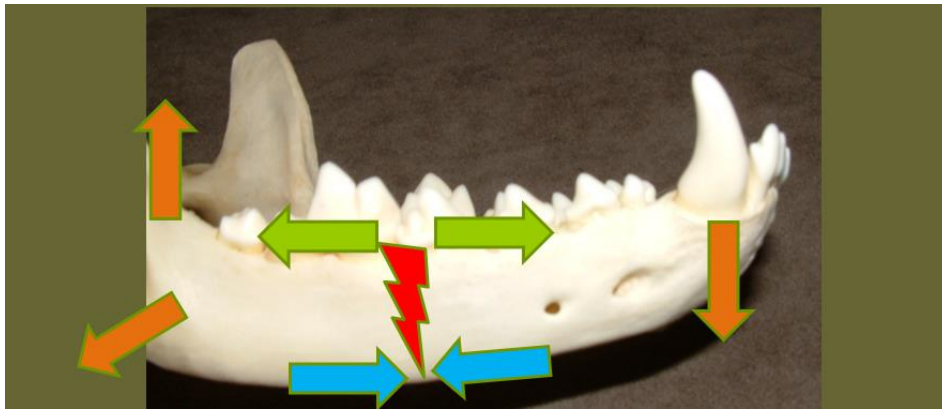


Fig 1: red = fracture line, orange arrow = forces acting on the mandible, green arrows = tension, blue arrows = compression.

Potential treatment options are considered in tandem with numerous factors to identify the ideal treatment plan for the individual concerned:

a. Welfare & Safety

b. Client

- Compliance (eg nutrition)
- Options
- Costs

c. Patient

- Injuries
- Mobility
- Age
- Species & breed
- Behaviour
- Compliance
- Occlusion
- Available bone
- Available teeth

d. Operator

- Experience & training
- Equipment & assistance
- Time
- ET tube placement
- Hospitalisation
- Feeding tubes
- Time periods

Techniques

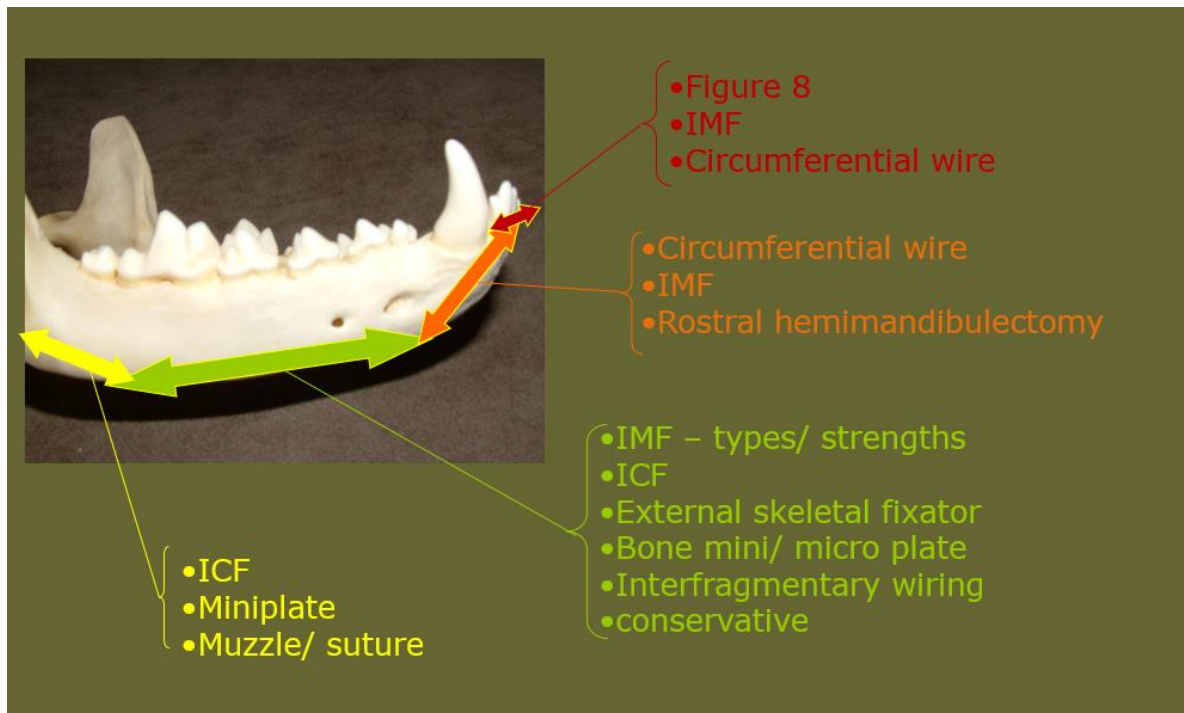


Fig 2: Jaw fracture locations and treatment options.
(NB INTRA-MEDULLARY PINS ARE CONTRA-INDICATED).

Equipment for Minimally-Invasive Jaw Stabilisation Techniques

Cerclage wire, interdental wiring, intra-oral splints, ICF/IMF.

Equipment

1. Acid etch – 30-40% phosphoric dental etchant gel.
2. Bonding agent – unfilled resin; combined prime & bond.
3. Dappens dish (holds resin) and micro-brush applicator.
4. Composite – light-cured dental composite material. Compule or syringe.
OR - dual-cure composite (chemical versus light curing).
5. Composite compule applicator gun.
6. Flat plastic +/- smooth plugger – composite placement tools.
7. Curing light – for light-cured composite (not required for dual-cure).
8. Orthopaedic wire - 0.4-0.6mm diameter orthopaedic wire (24gauge). Pre-stretch.
9. Wire benders, cutters, twistors.
10. Acrylic – temporary crown acrylic cartridge, cold-setting.
11. Acrylic applicator gun & mixing nozzles (ensure compatible pattern for 10 & 11!).
12. Low-speed straight handpiece & acrylic burs.
13. High-speed contra-angle handpiece & FG diamond or orthodontic burs.

Material Use

1. **Site Preparation** – clean tooth to enable surface preparation.
 - a) Scale
 - b) Polish
 - c) Flush

2. Tooth Preparation – enables adhesion of acrylic and composite to treated tooth surface.

- a) Clean, dry tooth
- b) Isolate – avoid moisture ingress.
- c) Acid etch 30s
- d) Rinse with clean water 20s
- e) Air dry – must repeat stages a)-e) if saliva, blood or crevicular fluid contact the surface.
- f) Prime & bond
- g) Apply for 20s
- h) Light cure for 10s (or according to manufacturer's instructions).

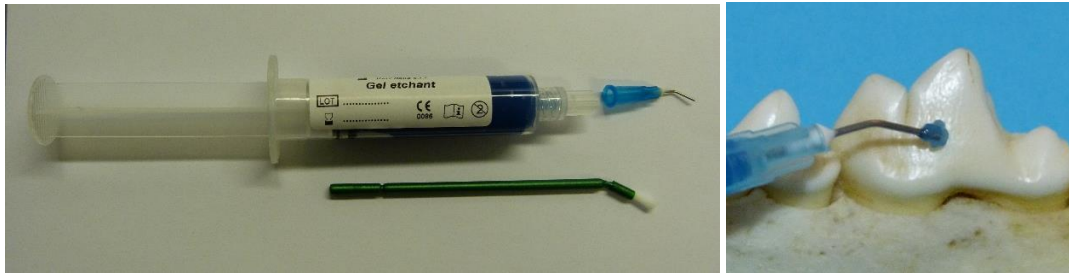


Fig3-4: acid etch



Fig 5-6: prime and bond



Fig 7-8: light-cure.

3. Retention Placement - alters tooth shape to enhance mechanical retention of wire +/- acrylic.

- a) Apply composite
- b) Shape & co-apt to tooth
- c) Light-cure (typically 40s – see manufacturer's instructions).
- d) Test to ensure good bond.



Fig 9-11: Lingual composite 'retention button' placement & light-cure.

4. Wire Placement – creates a scaffold to aid jaw alignment and mechanical retention of acrylic.

- Pre-stretch wire.
- Select wire twisters, benders and cutters.
- Apply wire according to appropriate wiring technique.

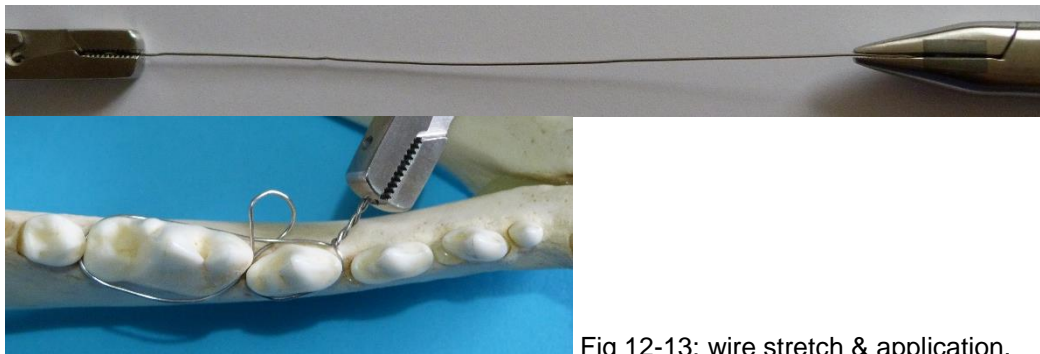


Fig 12-13: wire stretch & application.

5. Acrylic Application – confers stiffness and strength to the splint.

- Set-up correlating gun, acrylic cartridge and mixing tip
- With continuous action gradually apply acrylic over areas required

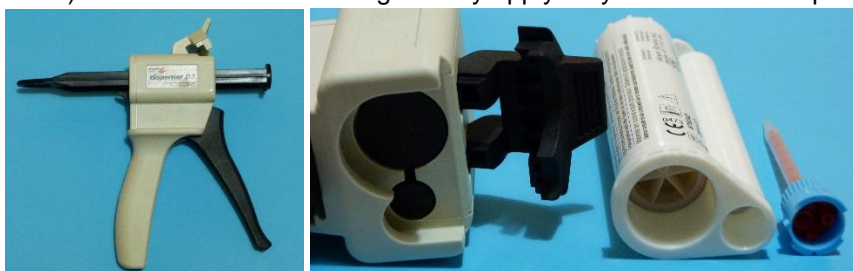


Fig 14-17: acrylic.



6. Contouring – creates smooth, comfortable splint enabling normal jaw movement and occlusion.

- a) Apply to avoid creating occlusal interference. Apply primarily to:
 - mandible – lingual surface
 - maxilla- buccal surface
- b) Trim with acrylic trimming bur in straight, low-speed handpiece.
- c) Remove any sharp/ spiked areas.



Fig 18-19: Acrylic contouring.

7. Cleaning – oral hygiene reduces gingivitis and mucositis associated with splint plaque-trapping.

- a) Daily toothbrushing
- b) 0.12% chlorhexidine BID-TID



Fig 20-21: Cleaning teeth.

8. Removal – typically after xray healing confirmation at around 6weeks after splint application.

- a) High-speed cutting bur - section acrylic between teeth.
- b) Elastic removing forceps - remove acrylic.
- c) Wire cutters & wire bending forceps – remove wire.
- d) Orthodontic/ fine diamond bur - remove composite.



Fig 22-24: Acrylic, wire and composite removal. Fig 23: elastic removing forceps.

Jaw Stabilisation Techniques

1. Muzzle

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

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

Muzzle – Tape/ Commercial ‘Mikki’	
✓ Advantages	× Disadvantages
Cheap	Limited support
Non-invasive	Chafing
Light	Poor hygiene
Temporary or longer-term support	Require several
Easy release	

Labial Suture – cat or brachycephalic where traditional muzzle not possible.

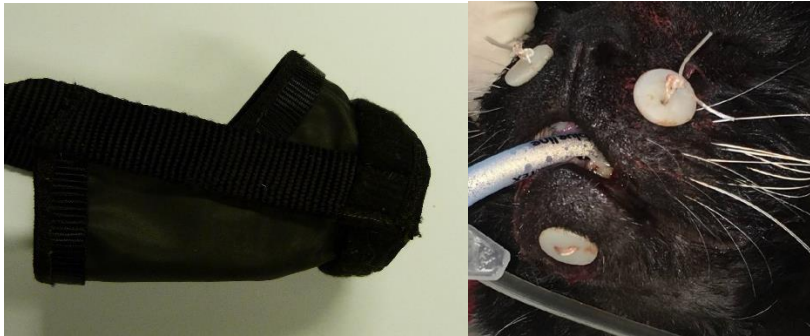


Fig 25-26: Reversed muzzle & labial suture.

2. Intraosseous & Cerclage Wiring

Placed along line of tension stress – provides compression for simple, stable fractures where perfect alignment is possible. Pre-stretch wire. Approx 0.4-0.6mm diameter orthopaedic wire (24gauge).

Intraosseous Wiring	
✓ Advantages	× Disadvantages
Cheap implant type	Limited support
Light	Invasive
Compressive	Limited application – Simple, stable, aligned fractures only
	Care re nerve & bv damage

Symphyseal / Parasymphyseal

Cerclage wire – position re middle mental foramen

- blood supply to rostral/ anterior jaw & ischaemia
- nerve trapping

- Wire versus suture material – wire preferred
- Avoid over-tightening re – occlusion & function of symphysis in carnivores; some movement

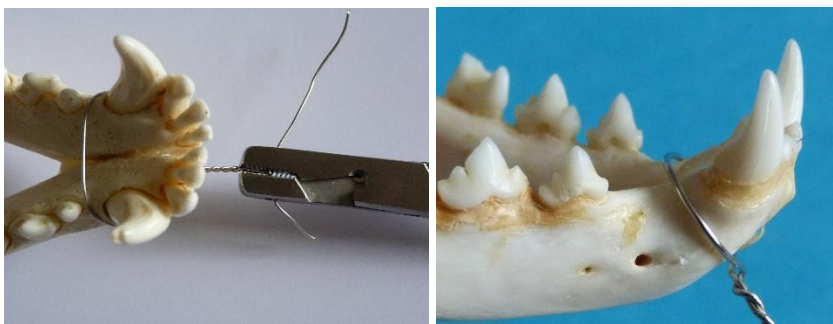


Fig 27-28: Cerclage wire placed via a hypodermic needle inserted from ventral skin.

3. External Fixators

Pins + connector/ frame.

External Fixators	
✓ Advantages	× Disadvantages
Good support	Cost
Custom-shaping relatively easy	Invasive
	Damage to teeth, foraminae, bone canals

- **Immature** – deciduous or mixed dentition
- very little free bone thus trauma to teeth likely -> pulpitis, non-vital, impaction
- **Edentulous** - care re position of inferior alveolar canal ('moves dorsally'), reduced bone height & width.

Gunning Splint

Edentulous areas: connector plus circumferential wires (around bone+connector) rather than pins.

Cerclage wires are placed via a sufficiently long 18g hypodermic needle inserted from ventral skin.

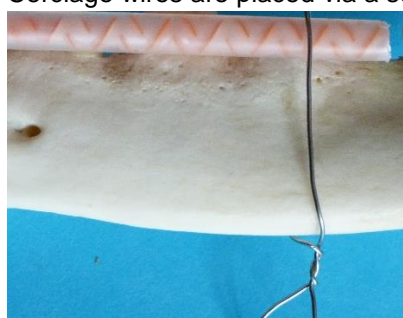


Fig 29: Gunning splint where teeth are absent.

4. Mini Plates

Maxillofacial kits with mini & microplate systems.

Mini Plates	
✓ Advantages	× Disadvantages
Excellent support correctly placed	Cost - expensive
	Custom-shaping relatively difficult
	Invasive
	Damage to teeth, foraminae, bone canals

5. Interdental Wire & Acrylic/ Intraoral Splinting

Combines techniques of interdental wiring with acrylic to give stiffness & strength.

Elements: wire scaffold, retention techniques, cold-cure acrylic.

✓ Advantages	× Disadvantages
Good support	Tension-side only
Low cost	Technique sensitive
Light	Potential fracture/ loosening
Custom shaping easy	Occlusal interference if incorrect contour
Non-invasive	Soft tissue irritation
Generally well tolerated	May not be well tolerated??
	Requires teeth
	Damage to teeth on removal?

a) Luxation & Dentoalveolar Stabilisation

Semi-rigid splint

- wire & composite

- 2-6weeks

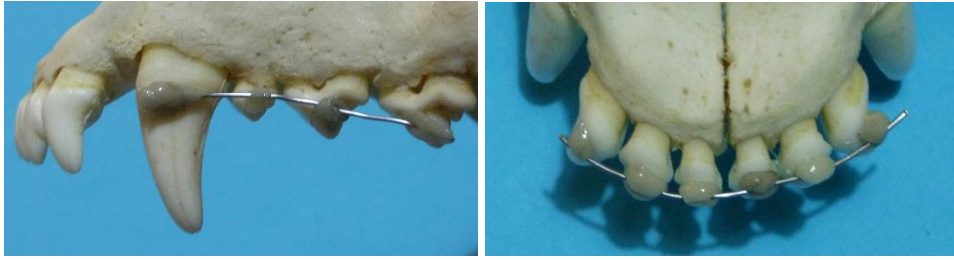


Fig 30-31: Wire and composite splint

b) Symphyseal/ Parasymphyseal

Figure of 8 – modified cerclage

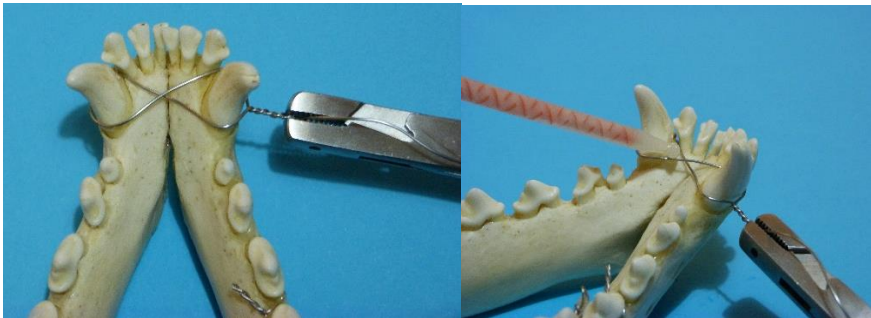


Fig 32-33: Acrylic & figure 8

Essig wiring – cerclage plus interdental connectors. May add acrylic.

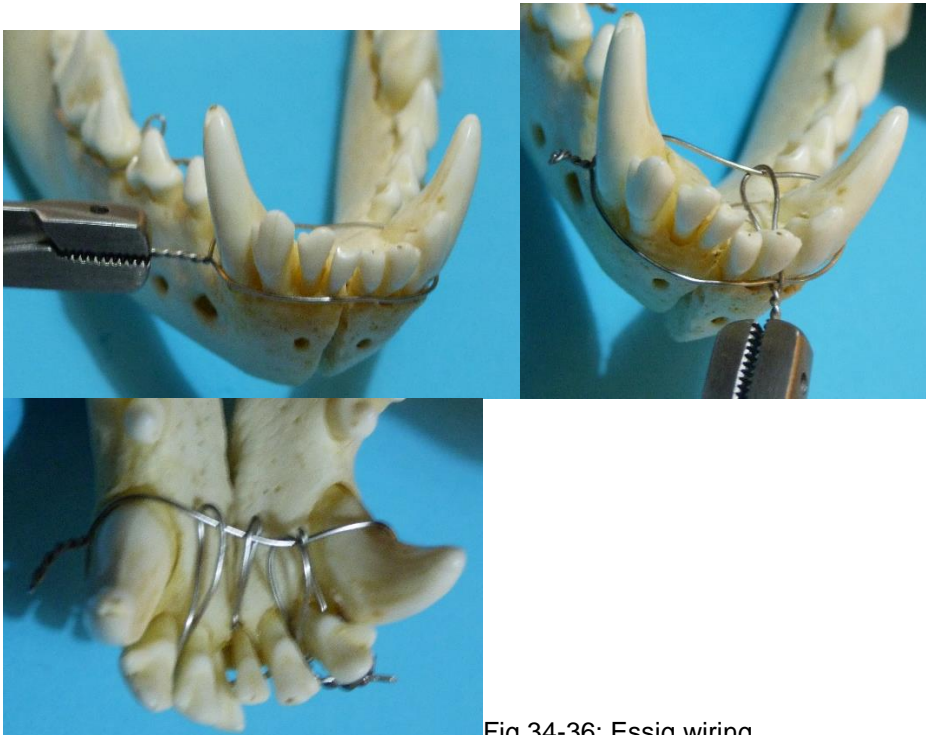


Fig 34-36: Essig wiring.

c) Mandibular Body

Rigid splints

- wire 'scaffold' (do not tighten) + acrylic support

- combined to give greater strength & support
- adherence increased by tooth preparation & retention techniques

Types:

- **Ivy Loop**
- **Stout Loop**
- **Risdon Wire**
- **Figure of Eight**

NB Diagrams of each wiring system are shown on skull models for clarity. The wire may be directed through interdental gingiva to confer greater initial wire stability and retention. The wire is passed via the bore of an appropriately sized hypodermic needle (18gauge needle for 22-24gauge wire) inserted through the gingiva from buccal to lingual. The author prefers minimal trauma by using retention buttons where possible. Once complete acrylic covers the wires and tooth surface to give sufficient bulk for strength but avoid interference with occlusion.

Ivy Loop

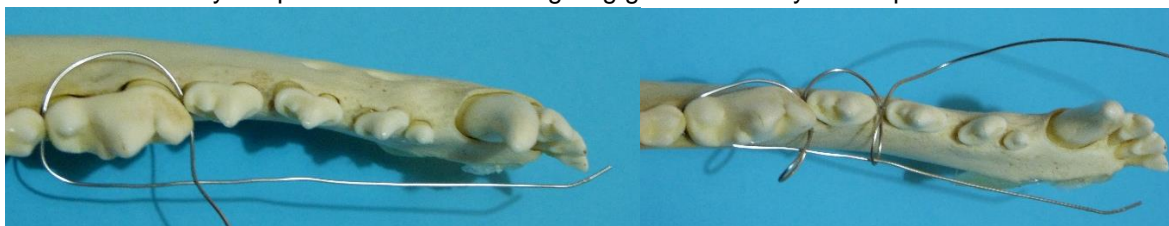
Alignment of two adjacent teeth. Alone it is minimally stabilising thus often used in combination with other techniques to confer strength and stability. Unsuitable if comminuted or unstable.



Fig 37-40: Ivy loop wire & initiating acrylic coverage.

Stout Loop

Continuation of Ivy Loop over additional teeth giving greater stability for simple fractures.



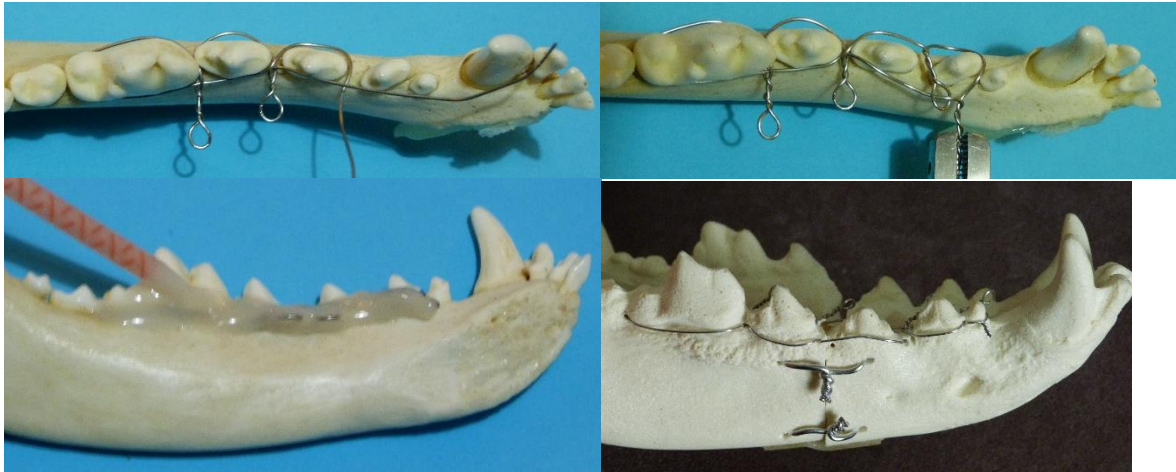


Fig 41-45: Stout loop Fig 46: Stout loop combined with intraosseous wires.

Risdon Wire

Bilateral technique especially suited to rostral fractures. Master/ base wires, with auxiliary interdental wires, link left and right mandibles.

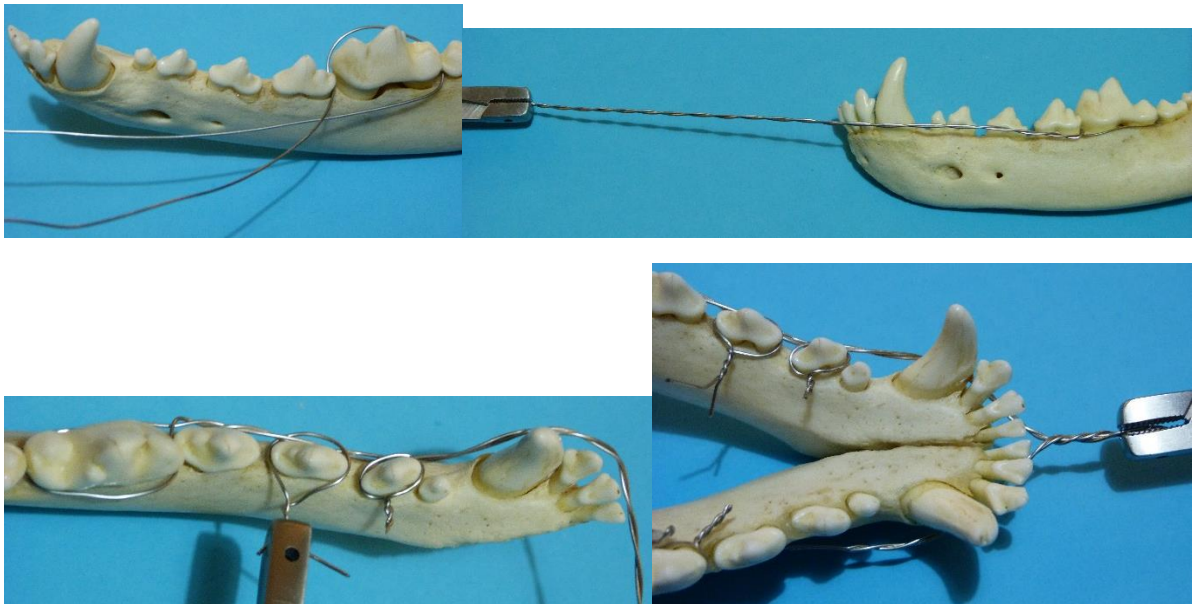


Fig 47-50: Risdon wire; acrylic is then added.

Figure of Eight

Simple technique similar to Stout Loop.

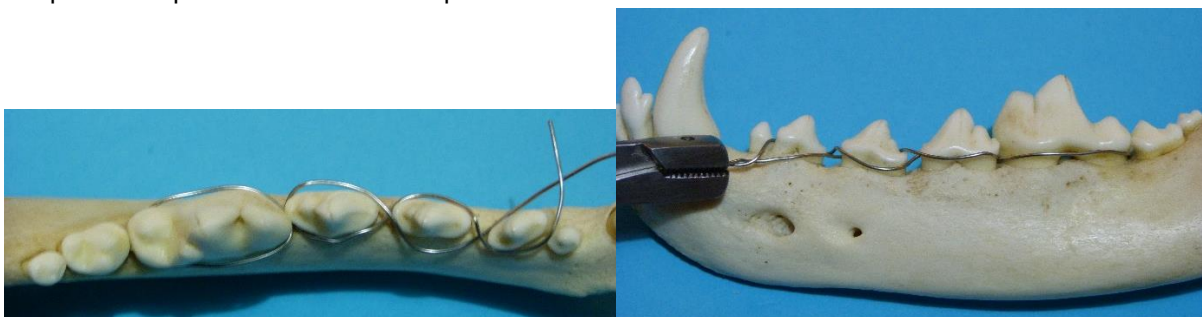


Fig 51-52: Simple figure of eight may be equal in stabilisation potential to more complex wiring techniques. Author recommends retention button placement.



Fig 53-54: Acrylic application – bulk lingual, minimal buccal. Especially avoid buccal & occlusal surfaces of molars as this will create significant occlusal interference, preventing jaw closure.

6. Intercanine & Intermaxillary/ Maxillomandibular Fixation

Bonding of upper and lower canines or other teeth (eg carnassials) to each other to stabilise the lower jaw via fixation to the upper.

ICF / IMF / MMF	
✓ Advantages	× Disadvantages
Moderate support	Awkward to place
Caudal fractures with few options	May not be well tolerated – feeding tube
Low cost	Potential choking hazard
Non-invasive	Potential damage to teeth on removal
	Requires teeth

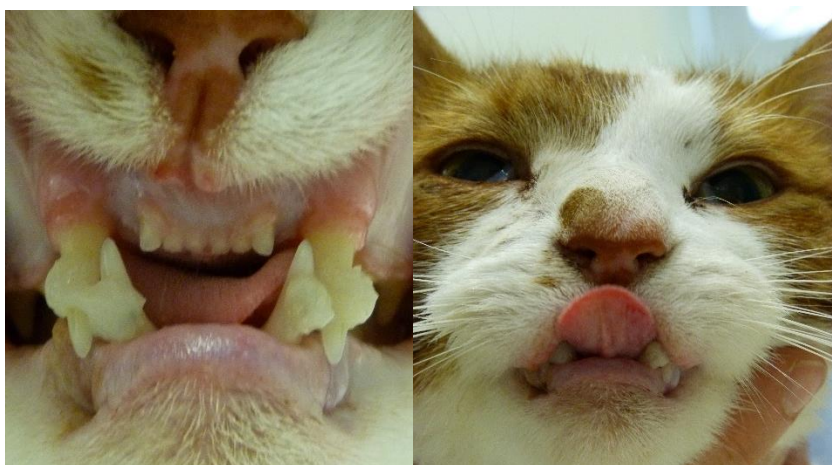


Fig 55-56: Upper and lower canines aligned, overlapped and bonded together with composite. Fixed open (approx 7mm) to allow lapping. Avoid excessive opening of mouth – reduces swallowing ability

Healing Period & Post-op Care

- Feeding tube – not nasal!
- Analgesia – NSAIDs, paracetamol (dogs only), buprenorphine transmucosally.
- Antibiotics.
- Healing
 - Typically 4-8weeks.
 - Depends on age & forces; younger generally more rapid healing. Geriatric delayed.
- Soft food 6-8weeks.
- No toys or object carrying.
- Daily tooth brushing +/- mouth rinse SID-BID.
- Monitor radiographs at approx 6weeks. Callus formation.

- Remove fixator without trauma to teeth.
- Check occlusion.