The Pharma Innovation Journal 2022; SP-11(4): 247-250

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(4): 247-250

www.thepharmajournal.com
Received: 13-02-2022
Accepted: 15-03-2022

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Interdental wiring and epoxy-pin external skeletal fixation for mandibular fracture management in dogs

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Abstract
Three dogs aged between two and eight years were presented with a history of automobile accidents. Complete bilateral mandibular fractures between 3rd and 4th premolar teeth in two animals and between 2nd and 3rd premolar teeth in one dog were confirmed based on clinical and radiological examinations. Surgical reduction and fixation of the mandibular fractures using interdental wiring and Epoxy – pin external skeletal fixation techniques under general anaesthesia were carried out successfully.

Keywords: Dogs, mandibular fractures, Interdental wiring, epoxy, pin ESF

Introduction
Mandibular fractures represent 1.5 to 2.5% of all fractures in dogs and the most common location is between the premolar 1 and molar 2 (Harasen, 2008) [9]. Mandibular fractures usually occur secondary to trauma and fractures are often open with mucosal defects (Boudrieau, 2012) [5]. The dogs with fractured mandibles are unable to eat unless treated surgically. Various techniques have been used for fixation of mandibular fractures in dogs including tape muzzles, circumferential wiring, interdental wiring and intraoral splinting, intraosseous wiring, external skeletal fixators (ESFs) and plating techniques. Depending on the location, time of occurrence, severity of fracture, a technique or combination of techniques must be selected (Boudrieau, 2005 and 2012) [4, 5]. The interdental wiring is one of the most commonly used fixation methods (Siddiqui *et al.*, 2012 and Rastabi *et al.*, 2017) [13]. ESF involves placing K- wires or pins through the skin into the bone fragments and then connecting these K- wires or pins to a connecting rod that provides stability so that proper healing can occur. Reports on combination of interdental wiring and external skeletal fixation (ESF) for the treatment of mandibular fracture in dogs are rare. The present report records successful surgical management of bilateral mandibular fractures by combination of interdental wiring and ESF techniques in three dogs.

Materials and Methods
Three dogs (German shepherd n=2, Labrador n =1) aged between two and eight years were presented with the history of bleeding from the mouth, reluctant to eat and persistent open mouth after vehicular accident before 10 to 16 hours of presentation. Clinical examination revealed, blood tinged excessive salivation, abrasions around the mouth, local swelling, malalignment of the lower jaw, drooping of mandibles, tongue protrusion, tongue laceration and fracture at the mandibles (Fig.1). Clinical examination of the whole body was carried out to rule out injuries in other parts of body. Mandibular fractures were suspected and it was decided to give general anaesthesia for proper positioning to take radiographs. The dogs were premedicated with Inj. Atropine sulphate @ 0.04 mg/kg b.wt. s/c and Inj. Xylazine @ 1 mg/kg b.wt. I/m. General anaesthesia was induced and maintained with Ketamine hydrochloride @ 5 mg/kg b.wt. I/v. Radiological examination revealed complete bilateral fracture in between 3rd and 4th premolar teeth in two dogs and between 2nd and 3rd premolar teeth in one dog (Fig.2). Haematological and physiological parameters were found to be within the normal clinical range. Based on the history, clinical and radiological examination the cases were diagnosed as bilateral mandibular fractures. As the fractures were unstable, immobilisation with interdental wiring and Epoxy – pin ESF was preferred after fracture reduction and the animals were prepared for surgical correction.

Treatment and Discussion

Preoperative antibiotic was administered with inj. Amoxycillin sodium and Sulbactum sodium combination @ 10 mg/kg body weight. The dogs were positioned in sternal recumbency with head held high upon a table. The upper and lower jaw was secured using a muzzle tape to expose the oral cavity. The oral cavity was washed with 0.5% potassium permanganate solution to remove the debris, feed material and blood clots and the fractured site was debrided. The reduction of fractured mandibular fractures was performed with steady traction on lower jaw and maintained in proper alignment. Bilateral interdental wiring was performed using the first molars as anchor teeth. The holes for the wire placement were hand drilled into the furcation of the mandibular first molars with a Jacobs chuck and K-wire taking care of dental roots. 22 G orthopaedic wires were passed through these holes and wrapped around the anchoring teeth. Afterwards, each wire was twisted along the dental arch, and subsequently twisted together in the incisive bone region and the interdental wiring was positioned to bridge the fracture line. Orthopaedic wires were tightened using twist knot method to allow better control of tightening and the twist was bent over away from the gingival margin.

For ESF application, smooth trocar pointed 2 mm diameter K-wires were introduced through the soft tissues up to the level of bone by hand to prevent wrapping of K- wires with soft tissues, followed by bone drilling using a Jacobs hand chuck, the K- wires were inserted through bone with continuous dropping of cold normal saline solution to reduce thermal necrosis of bone. After passing the transcutaneous K-wires in the same plane, they were joined with the help of adhesive tape to form a temporary scaffold at 2 cm from the skin. The epoxy hardener and resin (M–Seal® Phataphat, Pidilite Industries Ltd., Daman, India) were mixed thoroughly for about 1-2 minute to make uniform dough. The epoxy–resin was then hand moulded and applied along the temporary scaffold incorporating the K- wire within, making a side bars of 1.5 to 2.0 cm diameter. The epoxy fixator was allowed to harden for 30 minutes to form connecting bars (Fig.3). A gap of about 1-2 cm was left in between skin and the side connecting bars (Fig.4 & 5). The soft tissue injury in the buccal cavity and the lacerated tongue were sutured with 1-0 PGA. No instability or malocclusion of tooth was noticed after fracture reduction. Post-operatively all the animals were administered with inj. Amoxycillin sodium and Sulbactum sodium combination @ 10 mg/kg b.w. i.m, b.i.d. for 5 days and Inj. meloxicam @ 0.1-0.2 mg/kg b.w., i.m, o.d. for three days. Daily antiseptic dressing with diluted Povidone iodine was performed by flushing at fracture site, wire and pin entry site till complete mucosal healing. All the animals were kept on liquid diet for one week followed by semi sold diet for one week and then solid diet. The K wires and Orthopaedic wires were removed on 45th day after complete clinical and radiographical union and all three cases recovered fully without any complications.

Fig 1: Bilateral mandibular fracture

Fig.2: Radiology of bilateral mandibular fracture

Fig 3: Interdental wiring and ESF with epoxy resin connecting bars for bilateral mandibular fractures

Fig.4: Interdental wiring and ESF with epoxy resin connecting bars for bilateral mandibular fractures in dogs

Fig 5: Interdental wiring and ESF with epoxy resin connecting bars for bilateral mandibular fractures in dogs

Discussion

Trauma due to automobile accidents is the most common cause of mandibular fractures. Free and wandering habit of dogs and increasing vehicular traffic may be the cause of mandibular fractures. Open fractures are common in mandibular fractures due to minimal amount of soft tissue covering in the mandible. The most common location for fracture in dogs is between the premolar 1 and molar 2. Due to the intensity of trauma associated with mandibular, maxillary, or skull fractures, the injuries may not be limited to the facial region and pets often require treatment for other injuries before the fracture is definitively addressed. In the present case also there were mucosal damage in the buccal cavity and tongue lacerations along with mandibular fractures in all the animals and they were also surgically corrected.

Fractures of the mandible in dogs present several unique challenges to the veterinarian since it withstands different forces compared with weight-bearing bones (Harasen, loc. cit) [9]. Mandibular fractures will heal as long as vascularity is protected, revascularization encouraged, and infection prevented even in the presence of fracture gaps and some mobility. Surgical treatment of mandibular fractures is recommended when the fracture is unstable or bilateral. Surgical techniques like intraosseous wire, intraoral splints, interosseous or inter fragmentary wiring, interdental wiring, interarcade wiring used alone or in combination with other skeletal fixation devices and bone plates and screws are used for mandibular fracture treatment. Ultimate goal of surgical stabilisation of mandibular fractures is to reduce the fracture into normal or near normal anatomic alignment and to provide adequate support to enable comfortable prehension and mastication during callus formation (Fubini and Ducharme, 2017) [8]. In the present study, interdental wiring and ESF were carried out for proper immobilisation as the mandibular fractures were unstable and bilateral. Interdental wiring is simple, inexpensive and quicker (Ahmed, 2011) [1] and is used on the basis of tension-band principle. Advantages of interdental wiring for stabilization of mandibular fractures include avoidance of iatrogenic trauma to tooth roots and neurovascular structures of the mandibular canal, minimal disruption of fracture fragment vascular supply, restoration of occlusion, and early return to function. A great deal of versatility is possible with the wire location due to the wire's small size. This permits the tooth roots to be easily avoided when placing wires on the biomechanically advantageous alveolar surface of the bone (Mark and Smith, 2004). ESF is less invasive than internal fixation and allows better access to open wound than internal co-optation (Marcellin-Little, 2003) [11].

For clinical acceptance, an ESF must be sufficiently rigid, well tolerated, easily applied and inexpensive (Aithal *et al.*, 2007 and Aithal *et al.*, 2010) [3, 4]. The major disadvantages associated with metallic ESF systems are high cost, heavy weight and not easily available in the field and have fixed frames leading to less versatility in size and direction. Free forms of external skeletal fixators like epoxy-pin ESF as a replacement for a metallic bar have advantages as it is mechanically strong, lightweight, economical and pins can be passed from any direction depending upon the clinical situation (Tyagi, *et al.*, 2015) [14] and they can be customized owing to better handling characteristics of epoxy resin is easier to construct (Tyagi *et al.*, 2014 and Corr, 2005) [15]. Epoxy-pin fixators provided stable fixation and the technique can be practiced at field conditions with minimal instrumentation (Kumar *et al*., 2012) [10]. In the present study interdental wiring with 22 G orthopaedic wire and ESF with 2mm smooth trocar pointed K-wires and epoxy putty connecting bars of 1.5-2.0 cm diameter were found to be strong in maintaining the stability and ensured immobilization of the fracture. Loosening of wires, development of submandibular abscess, ventral malalignment, buccal infection, intraoral ulceration, osteomyelitis, pin-tract infections, patient intolerance of the appliance and disruption of the fixator bar on household furnishings have been reported as potential complications after surgical repair of mandibular fractures (Basith *et al.*, 2017, Rastabi *et al*., 2017) [6, 13]. But in the present report there was no such complications observed. Hence it is concluded from the study that interdental wiring and Epoxy- pin ESF is effective for bilateral mandibular fracture repair as they are less invasive techniques, ensures early return to function and minimal postoperative care.

Summary

Management of mandibular fractures in 3 dogs using composite surgical techniques of interdental wiring and external skeletal fixation (ESF) with epoxy resin connecting bars is reported

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