Mandibular Fracture in Single-humped Camels

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Objective: To report the causes and classification of mandibular fractures in dromedary camels and outcome after treatment.

Animals: Single-humped camels (n = 116) with mandibular fracture.

Methods: At admission, cause, site, classification, and radiography of mandibular fractures were recorded. Factors affecting fracture healing were analyzed.

Results: Biting was the main cause of mandibular fractures in camels, which occurred more commonly in older males (P = .001) than in females. Open fractures were more common than closed ones (92.2% versus 7.8%, P = .0001) and single fractures were more frequent (82%) than multiple and comminuted fractures (18%; P = .001). Fractures were treated by interdental wiring (91.2%) or U-shaped aluminum bar (8.8%) and healing occurred in most (83.2%) fractures.

Conclusions: In dromedary camels, mandibular fracture is most commonly caused by bites and can be successfully repaired by interdental wiring or a U-bar technique with good outcome.

Mandibular fracture, typically involving the rostral third of the horizontal ramus,1, 2 is common in camels and is often associated with violent behavior during rut or careless handling.3 Reported repair techniques include interdental wiring4, 5; reinforced brass interdental wiring6; bone plating3, 7; transfixation of bone pins along with plaster of Paris bandaging4, 8; plaster of Paris bandage and a wooden plate as a splint9; and amputation of an irreparable fractured mandibular segment.10

Our objectives were to report the causes and classification of mandibular fractures in camels admitted to our clinic and to evaluate 2 repair techniques. Effect of camel age, sex, history, cause, age and type of fracture, and method of treatment on fracture healing were analyzed.

MATERIALS AND METHODS

Camels

All camels (n = 116) admitted (August 2008–December 2009) with mandibular fracture were included. Camel breed, age and sex, and fracture cause, type, and age were recorded.

Surgical Repair Techniques

Reduction and fixation were performed in the sitting (kush) position. The camel was restrained with ropes and deeply sedated by xylazine (0.3 mg/kg intravenously). Fractures were repaired by interdental wiring or application of a U-shaped aluminum bar (U-bar).

Interdental Wiring Stainless steel wire (0.8 mm diameter) was inserted between first and second mandibular cheek teeth or occasionally between second and third cheek teeth. The wire was then passed between the central incisors and the 2 branches of the wire were tied together by twisting using pliers. Excess wire was cut by using wire cutter, and the end was twisted toward the roots of incisors. The same technique was repeated on the other side of the mandibular fracture.

U-bar Application A 5-mm diameter aluminum bar, flattened where it made contact with the incisors and mandibular cheek teeth and curved to match the contour of the mandible was inserted in the mouth. Stainless steel wire (0.8 mm diameter) was passed at the gingival margins between first and second cheek teeth lateromedially and then mediolaterally to encircle the teeth and attach the U-bar. Drilling was occasionally needed when the space between adjacent teeth was too narrow to pass the wire. The wire was tied around the cheek tooth and aluminum bar. Excess wire was cut and the end was twisted toward the root of teeth. The rostral fragment of the mandibular fracture was reduced and aligned before tightening of the wires fixing the U-bar to the cheek teeth using pliers. The U-bar was then attached to the incisors in a similar manner.

After fracture repair, acute oral mucosal wounds were cleaned and sutured and chronic wounds were cleaned and left open. Purulent wounds were debrided, lavaged with povidone iodine solution, and dressed daily using povidone iodine solution and antibiotics (penicillin–streptomycin). Antibiotic (penicillin–streptomycin [30,000 U/kg penicillin, 10 mg/kg streptomycin], Penstrep, Norbrook Laboratories, Corby, Northamptonshire, NN18 9EX, UK) was administered intramuscularly for 5 days.

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Phenylbutazone (4.4 mg/kg intravenously) was administered for 3 days. Camels had free access to water after fracture repair and were fed milk and barley porridge for 2 weeks, then roughage in the form of green or dried (according to season) alfalfa were fed.

Camels were examined for wire loosening and radiographed weekly for evaluation of healing. In a sitting position, camels were sedated and the mouth washed with water then with dilute povidone iodine solution. Loose wires were retightened and broken wires were replaced. An abscess was developed in all camels with open fractures 1 week after treatment. The abscess was drained and washed with dilute povidone iodine solution.

Data Analysis

Camels were categorized by age: 0–180 days, 181–365 days, 366–600 days, and >600 days. Fracture age (time elapsed from fracture to admission) was categorized as 0–3 days, 4–7 days, and >7 days. Fracture type was described according to clinical and radiologic findings and were classified as rostral to the canine teeth, caudal to canine teeth (in the interdental space where the left and right rami are separate, resulting in fracture of both rami), caudal to first premolar, interdental space where the rami are fused, resulting in a single fracture), rostral to first premolar (in the interdental space region where the left and right rami are separate, resulting in fracture of both rami), caudal to first premolar, and fracture of the incisive bone.

For outcome, a healed mandibular fracture was defined as clinically acceptable fracture union without deformity, whereas no healing was defined as unacceptable fracture union with deformity or no union at all.11

Statistical Analysis

Goodness-of-fit $\chi^2$ analysis was used to detect frequencies that differed from equality. Frequency distributions were examined by $\chi^2$ for differences between sexes (male, female), breed (Wadheh, Mejhem, Ashaal, Asfar), fracture cause (bites, trauma, falling, trapped in a rope, stepped on), fracture type (open, closed; single, multiple), age (0–180 days; 181–365 days; 366–600 days; >600 days), fracture age (0–3 days; 181–365 days; 366–600 days; >600 days). Fracture type (open, closed; single, multiple), age (0–180 days; 181–365 days; 366–600 days; >600 days) and site of fracture (rostral to canines, rostral to first premolar, caudal to canines, caudal to first premolar).

Satisfactory healing was the primary dependent variable. Main effects in the model were sex, breed, age, cause, fracture type, fracture site. Kruskal-Wallis nonparametric test was used for this model.

Effects of age and sex on type and cause of fracture were tested by $\chi^2$ test.

Significance was set at $P < .05$. A statistical program (SPSS for Windows, Version 16.0. SPSS Inc., 2007, Chicago, IL) was used to perform the statistical analysis.

RESULTS

Of 116 camels, there were significantly more males (94 [81%]) than females (22 [19%]; $P = .001$). Breed distribution was Wadheh (white-colored camels, $n = 53$; 45.7%), Mejhem (brown- to black-colored camels, $n = 33$; 28.4%), Ashaal (reddish brown-colored camels, $n = 17$; 14.7%), and Asfar (light brown-colored camels, $n = 13$; 11.2%). There were more older camels (>600 days; $n = 108$; 93.1%; $P = .01$) than in other age groups: 0–180 days ($n = 3$; 2.6%); 181–365 days ($n = 4$; 3.4%); and 366–600 days ($n = 1$; 0.9%). Fracture age was distributed as: 0–3 days ($n = 52$; 44.8%), 4–7 days ($n = 38$; 32.8%), and >7 days ($n = 26$; 22.4%).

Biting other camels ($n = 79$; 68.1%) was the most common cause of mandibular fracture ($P = .0001$) followed by trauma from another camel ($n = 32$; 27.6%), falling down a hill ($n = 2$; 1.7%), trapping in a rope ($n = 2$; 1.7%), and being stepped on by the mother (1; 0.9%). Open fractures were most common ($n = 107$; 92.2%; $P = .001$) with closed fractures occurring in 9 (7.8%) camels. Single fractures were occurred in 95 camels (82%) and multiple and comminuted fractures in 21 (18%). Healing was better in acute fractures (≤3 days) than chronic (>7 days) fractures ($P = .0001$; Table 1). There were no significant effects of camel breed, sex, age, cause, site of fracture, and treatment method on the fracture healing (Table 1).

| Table 1 Factors Affecting Mandibular Fracture Healing in Camels ($n = 113$). |
|---------------------------|-----------------|-----------------|-----------------|
| Factor       | Variable       | Total | Healed n (%) |
| Breed        | Wadheh         | 52   | 44 (84.6) |
|              | Mejhem         | 31   | 26 (83.9) |
|              | Ashaal         | 17   | 13 (76.5) |
|              | Asfar          | 13   | 11 (84.6) |
| Sex          | Male           | 92   | 76 (82.6) |
|              | Female         | 21   | 18 (85.7) |
| Age (Days)   | 0–180          | 3    | 3 (100)  |
|              | 181–365        | 4    | 4 (100)  |
|              | 366–600        | 1    | 1 (100)  |
|              | >600           | 105  | 86 (81.9) |
| Fracture Age | 0–3            | 51   | 50 (98)a |
| Days         | 4–7            | 38   | 35 (92.1)a |
| Fracture Cause| Biting         | 77   | 65 (84.4) |
|              | Trauma         | 31   | 24 (77.4) |
|              | Fall Down      | 2    | 2 (100)  |
|              | Trapped in Rope| 2    | 2 (100)  |
|              | Stepped by Mother| 1 | 1 (100)  |
| Fracture Site| Rostral to Canines| 97 | 81 (83.5) |
|              | Rostral to FirstPremolars | 9 | 7 (77.8) |
|              | Caudal to Canines | 3  | 3 (100)  |
|              | Caudal to FirstPremolars | 2 | 1 (50)   |
|              | Partial IncisiveBone | 2 | 2 (100)  |
| Single/Multiple| Single        | 93   | 77 (82.8) |
|              | Multiple       | 20   | 17 (85)  |
| Closed/Open  | Closed         | 9    | 9 (100)  |
|              | Open           | 104  | 85 (81.7) |
| Treatment    | IDW            | 103  | 85 (82.5) |
| Method       | U-bar          | 10   | 9 (90)   |

a,bValues with different superscripts in the same column are significant ($P < .05$). n = number.
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There was a significant effect of age on fracture type with more open (n = 102; 98.1%) than closed mandibular fractures (n = 6; 1.9%; P = .006) in older camels. Bites (n = 77; 71.3%) and trauma (n = 27; 25%) were more frequent causes of mandibular fracture in old camels (>600 days) than other causes (n = 4; 3.7%; P = .006). There was a significant association between sex fracture type (P = .0001) and cause (P = .001). Males were more frequently affected by open (n = 92; 96.8%) than closed (n = 3; 3.2%) fractures and more frequently had single (n = 85; 89.5%) than multiple (n = 10; 10.5%) fractures (P = .0001). Fractures caused by biting (n = 72; 75.8%) were more common than other causes (n = 2; 2.1%). Fracture sites were rostral to the canines in 98 (84.5%) camels, rostral to the first premolar in 10 (8.6%), caudal to the canines in 3 (2.6%), caudal to the level of first premolar in 3 (2.6%), and fracture of the incisive bone in 2 (1.7%) camels (P = .0001).

Three camels (2.6%) were not treated and slaughter was recommended. The other 113 (97.4%) camels were treated by interdental wiring (IDW) (n = 103; 91.2%) or U-bar (n = 10; 8.8%).

Camels started prehending liquid food after recovery from xylazine sedation and started eating roughage after 2 weeks. There were oral mucosal wounds at the pathway of the IDW in all camels and wires were partially embedded under the oral mucosa at the end of healing period. Small wounds were noticed at the contact sites of the U-bar with gingiva of incisors (Fig 2D) after its removal in 2 of 10 camels. Manual palpation revealed mobility at fracture site up to 4 weeks after treatment but none by week 6, suggesting clinical union. Radiographically, good reduction and alignment of the fractured mandible were achieved after treatment (Fig 1D, 2B) and formation of uniting callus was noticed at 7–12 weeks (Fig 3). Satisfactory healing occurred in 94 (83.2%) camels and there were 19 (16.8%) malunions. IDW wiring resulted in healing of mandibular fractures in 85 (82.5%) camels whereas 9 (90%) fractures managed with a U-bar healed. Overall healing time ranged from 7–12 weeks.

DISCUSSION

We found that mandibular fractures were frequent in male camels and most commonly caused by camel biting. During rutting, sexually excited camel bulls often bite other camels and hard objects that causes mandibular fracture in some camels. Trauma from another camel or handlers was the second common cause of mandibular fracture; these causes are similar to previous reports. Fracture age had significant effect on healing, with more acute fractures (<3 days) healing faster. Treatment by either IDW and U-bar had a good healing outcomes in most camels.

We found most fractures occurred just rostral to the canines (tusks or tushes). This is likely the weakest point of the mandible because of the relatively small cross-sectional diameter, the presence of the canine alveoli, and rostral mental foramina. Further, the tightly applied oral mucosa is easily wounded resulting in an increase in frequency of open mandibular fractures.

Of the 2 techniques used for fracture repair, IDW was simple, inexpensive, and quicker than the U-bar technique. Stable fractures, in particular, were good candidates for repair by IDW, which has also been recommended for treating...
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Figure 2  External fixation by U-shaped aluminum bar (A) and lateral radiographic projection (B), an abscess (arrow) developed at the fracture site (C), however, the fracture healed (D).

Figure 3  Lateral radiograph of a healed mandibular fracture.

transverse fractures.\textsuperscript{14} This technique is not suitable for all mandibular fracture types,\textsuperscript{15} and perfect reduction is difficult with oblique and multiple mandibular fractures,\textsuperscript{14} as we found. A disadvantage of IDW is development of intraoral ulceration where wires compress the gingiva. The U-shaped aluminum bar was also relatively simple but took longer than IDW; however, it provided good stability and was suitable for transverse and oblique mandibular fractures.\textsuperscript{6} U-bar alone has been used successfully for treatment of fractured mandible in horses\textsuperscript{16} and in combination with IDW for the repair of mandibular fracture in camels.\textsuperscript{6} A combination of U-bar and IDW might be more efficacious than a single technique in the treatment of mandibular fractures. Intraoral ulceration did not occur with the U-bar technique; however, small wounds occasionally occurred where the U-bar contacted the gingiva.

Summantly, we found was no significant effect of breed, sex, or camel age on fracture type or outcome; however, acute fractures (<3 days) healed significantly faster than more chronic fractures. Rostral mandibular fractures in camels can be repaired by either interdental wiring or a U-bar technique with good outcome.

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REFERENCES


