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# Equine Skull Fractures: A Review of 13 Cases Managed Conservatively (2018–2022)

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**Abstract**

This retrospective study reviews the clinical features, computed tomography (CT) findings, complications and outcomes of horses with skull fractures involving the facial bones. Medical records from the Royal Veterinary College, Hatfield, United Kingdom, and the Universidad Complutense, Madrid, Spain, were reviewed to identify horses presented for head CT with a history of skull fracture involving the facial bones between 2018 and 2022. Thirteen horses were included. Secondary sinusitis was present in 10 of the horses with the rostral maxillary, caudal maxillary and ventral conchal sinuses being the most commonly affected. There was associated fracture of dental structures in three cases. Treatment was conservative in seven cases, while in six horses some minimal surgical intervention was undertaken and included the removal of loose bony fragments and trephination for sinoscopy in two cases, fragment removal and sinus flush through a Foley catheter in three cases and dental extraction in one case. Prognosis was reported to be good to excellent in 10 horses. Among the most common complications, cosmetic sequalae was recorded in three cases. Overall conservative management of skull fracture should be considered a viable option for cases where perfect cosmetic results are not expected and where economics may be a limitation.

**Keywords:** equine; skull; fracture; computed tomography

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## 1. Introduction

Skull fractures are common in horses and are usually secondary to trauma. In one study, fractures involving the horse's head following a kick from another horse comprised 12% of all incidents and were the second most common type of fracture, after splint bone fractures [1]. There is little soft tissue coverage over the skull predisposing fracture of that area to be open (in as much as 80% of cases) and therefore contaminated/infected [2]. Good anatomic knowledge of the equine skull is essential as fractures can be complex and can involve structures such as the sinuses, lacrimal duct and cerebrum [3,4]. Skull fractures can be grouped into different categories such as fracture of the hyoid, the mandible, the cranium and the facial bones. The most common bones injured in skull fracture are the nasal, frontal and maxillary bones together with the zygomatic process of the frontal bone. As they are often traumatic in origin, they are usually open, displaced and comminuted fractures with numerous fragments of various sizes. It is also not uncommon for these fractures to involve the sinuses or nasal cavity. Clinical signs of skull fracture are variable and depend on structures and tissue involved (eyes, nasal structures, ethmoid, infra-orbital canal), the

chronicity and extent of the injury, but can vary from facial swelling to neurological signs. Skull fractures should be examined thoroughly to obtain a comprehensive evaluation of the extent of the damages. A thorough examination should include a general physical assessment as well as specific ophthalmic, neurological (including evaluation of the cranial nerves) and oral examination [5,6]. In some cases, further advanced diagnostics such as upper airway endoscopy, radiography, ultrasonography and CT will help characterise the extent and configuration of the fractures [7–10].

The good blood supply and low physical load on the fracture site allows for a good prognosis following treatment, even if the fracture is considered open, or if the fracture site involves the sinuses or upper airways. Several treatment options have been described over the years, the majority looking at stabilisation of the fracture site [11]. Functional problems may arise with or without treatment. Surgical treatment has been reported to be the optimal choice for open fractures as it has been postulated that inadequate reduction would result in an inferior cosmetic outcome, especially if a prominent callus formation is present. Surgical treatment involves the selection of specific prosthetic material selected case by case. Internal fixation using cerclage wires and implants such as plate and cortical screws has been described extensively in the literature [11–17]. There are also isolated reports describing the use of polydioxanone sutures [18], intrasinus bolstering using balloon Foley catheters [19] and titanium rosettes [1].

While conservative management has been reported to be associated with greater risks of wound infection, delayed wound healing, suture exostosis [20] and sequestrum formation, there is little published reference to that regard [1,2,4].

## 2. Materials and Methods

Medical records from the Royal Veterinary College, Hatfield, United Kingdom, and the Universidad Complutense, Madrid, Spain, were reviewed to identify horses presented for head computed tomography (CT) with a history of head trauma or head swelling. Horses diagnosed and treated for skull fractures involving the facial bones between 2018 and 2022 were included in the study. Inclusion criteria consisted of a fracture of at least one of the facial bones comprising the skull and cases that were subsequently treated without internal fixation.

Information obtained from medical records included the date of presentation, age, sex, breed of the horse, major problem list/clinical presentation, computed tomography findings, treatment and follow up including complications and repeat CT.

All cases underwent standing CT of the head except for one case that was only 2 months old at the time of first presentation; therefore, the first head CT was performed under general anaesthesia. An intravenous catheter was placed in the left jugular vein of each horse and, following premedication with acepromazine (0.02 mg/kg bwt i.v., Dechra, Cheshire, UK), sedation was administered to effect using a combination of romifidine (0.05 mg/kg bwt i.v., Dechra) and methadone (0.1 mg/kg bwt i.v.) for the standing CT in one institute. In the other institute, premedication with acepromazine (0.02 mg/kg bwt i.v., Labiana Life Science, Barcelona, Spain), and sedation administered to effect using detomidine (0.012 mg/kg bwt i.v., Braun VetCare, SA, Barcelona, Spain) was performed. For the one filly that underwent general anaesthesia, sedation was administered using a combination of romifidine (0.08 mg/kg) and morphine (0.1 mg/kg) intravenously to effect. Induction was performed using ketamine intravenously (2.3 mg/kg). The horse was then intubated and maintained on isoflurane in oxygen air mixture, $FiO_2$ 0.4–0.7 after intubation. Mechanical ventilation was performed with a tidal volume of 1 L/100 kg and a respiratory rate of 8–12 bpm. Computed tomography was performed using a 16-slice multidetector CT scanner, 120 kV, 400 mA, and a 65 cm variable field of view (either GE

Medical Systems, LightSpeed RT 16 or GE Revolution ACT depending on the establishment). Images were reconstructed in a bone window (slice thickness 0.6 mm, interslice interval 0.3 mm, WW: 2800, WL: 800, bone kernel) and soft tissue window (slice thickness 3.75 mm, interslice interval 1.5 mm, WW: 350, WL: 80, soft tissue kernel. Images were viewed using a DICOM viewer (OsiriX, version 11.0, Pixmeo SARL, Bernex, Switzerland) with multiplanar and three-dimensional reconstructions. A total of four board certified European College of Veterinary Diagnostic Imaging (ECVDI) diplomates reviewed the studies and all the information was gathered in an excel sheet.

A repeat CT was performed in 6 out of the 13 horses (46%). The repeat CT was performed between one month and two years from the first CT.

Follow up was obtained for all 13 horses. The referring veterinarian were contacted using a questionnaire and/or through Figure 1. Presence of complications (such as suture periostitis, sequestrum formation, head shaking. . ., etc.), cosmetic appearance (excellent, good, fair and poor), return to function (similar, decreased, no return) and outcome (excellent, good, fair and poor) were evaluated in the questionnaire.

Dear Colleagues,

Thank you for taking time to participate in this study. We are trying to obtain follow up information on horses you have referred for a head CT following a head trauma and who were subsequently diagnosed with skull fracture. We would like to obtain more information regarding any noted complications and outcome.

Do not hesitate to contact me if you have any questions.

Sincerely,
Melanie Perrier

| | |
|---|---|
| (1) How is the horse performing?<br>a. Back to normal<br>b. Not back to normal | (2) Has the horse shown clinical signs of chronic nasolacrimal duct abnormalities such as continuous tearing? If so, for how long?<br>a. Yes<br>b. No<br>c. Present for …. days |
| (3) Did the horse develop a suture periostitis?<br>a. Yes<br>b. No | (4) If yes, is it associated with any clinical signs such as pain, head shaking, continuous tearing, nasal discharge, inspiratory noise, or other possible associated signs?<br>a. Yes<br>b. No |
| (5) Was any treatment initiated to resolve the suture periostitis and, if so, which one?<br>a. Yes<br>b. No<br>c. Treatment: | (6) Did the suture periostitis resolve?<br>a. Yes<br>b. No<br>c. Incomplete resolution |
| (7) If there were any fractured teeth, was treatment performed by referral vet? If yes, what was performed?<br>a. Yes, ……<br>b. No | (8) Are there any remaining clinical signs of the previously fractured teeth? If yes, what are the clinical signs?<br>a. Yes, ……<br>b. No |
| (9) Is chronic nasal discharge present?<br>a. Was present after discharge/treatment<br>b. No<br>c. Yes | (10) Are there any chronic neurological signs such as head shaking?<br>a. Was present after discharge/treatment<br>b. No<br>c. Yes |
| (11) What is the current cosmetic appearance?<br>a. Completely back to normal<br>b. Scar tissue of the skin<br>c. Chronic swelling of the skull<br>d. Chronic deformation of the skull | (12) Was the horse treated surgically or conservatively?<br>a. Surgically<br>b. Conservatively |

**In case of CT only, answer the following questions as well:**

(1) Was the horse treated after discharge/imaging procedure at the RVC?
   a. Yes, conservatively
   b. Yes, surgically
   c. No

If the horse was treated conservatively after CT, were there any complications noted that required surgical intervention?
   a. Yes
   b. No
   c. Treatment:

(2) If a surgical procedure was performed, what procedure was performed (internal fixation, sinoscopy, tooth extraction, sequestrum removal…)?

**Figure 1.** Follow up questionnaire sent out to referring veterinarian to obtain update on cases included in the study.

Questionnaire purpose: Investigating horses referred for head CT and diagnosed with skull (facial bones) fractures: presentation, findings, treatment and outcome.

## 3. Results

Information obtained from medical records included the date of presentation, age, sex, breed of the horse, major problem list/clinical presentation, computed tomography findings, treatment and follow up including complications and repeat CT findings (Table 1).

**Table 1.** Summary of horses presented for head CT with a complaint of skull fracture including signalment, affected bone and structures, treatment, complications and outcome.

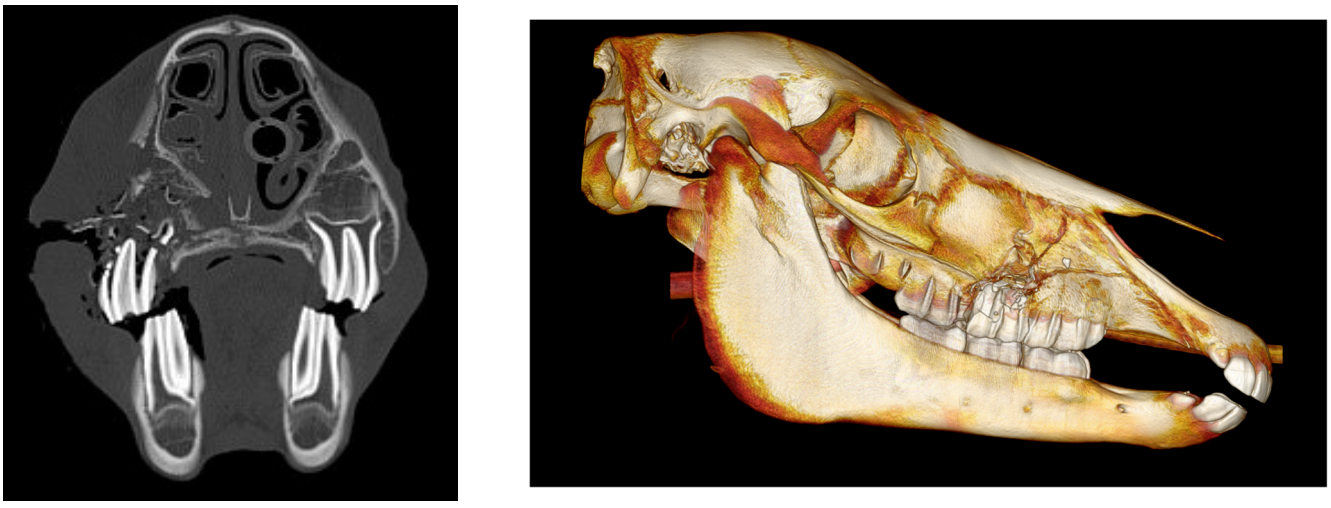
| Horse | Signalment | General | Affected Bone | Structures Involved | Treatment | Follow up CT | Complications | Outcome |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 yo, G, WB | Unilateral Closed | Maxillary | | Conservative | No | No | Good |
| 2 | 18 yo, G, Unknown | Unilateral Closed | Maxillary | Maxillary Sinus<br>Ventral conchal sinus<br>Nasolacrimal duct | Conservative | No | No | Good |
| 3 | 12 yo, G, WB | Unilateral Open | Maxillary | Caudal maxillary sinus<br>Nasolacrimal duct<br>Root fracture 210 | Sinoscopy<br>Bone fragment removal | No | No | Good |
| 4 | 9 yo, G, WB | Unilateral Open | Frontal<br>Lacrimal<br>Maxillary<br>Nasal | Conchofrontal sinus<br>Orbit<br>Retrobulbar fragments | Sinoscopy | Yes | Sequestrum | Good |
| 5 | 12 yo, M, Polo Pony | Bilateral Closed | Nasal<br>Frontal | Maxillary, conchofrontal, ventral conchal sinus<br>Orbit<br>Nasal septum collapse | Conservative | Yes | Narrowing left conchofrontal sinus<br>Cosmetic | Fair to Good |
| 6 | 17 yo, M, Welsh | Bilateral Closed | Frontal<br>Nasal<br>Lacrimal | Caudal maxillary, dorsal conchal sinus<br>Suture periostitis | Conservative | Yes | Suture periostitis<br>Cosmetic | Fair to Good |
| 7 | 14 yo, M, TB | Unilateral Open | Nasal | Sinusitis dorsal conchal sinuses | Bone fragment removal<br>Sinus Flush | No | Wound dehiscence | Good to Excellent |
| 8 | 2 months, filly, WB | Unilateral Open | Maxillary | Fracture tooth 507 | Fragment removal<br>PMMA packing | Yes | Granuloma socket 507 | Excellent |
| 9 | 12 yo, G, WB | Unilateral Open | Maxillary<br>Zygomatic | Maxillary and ventral conchal sinusitis<br>fracture 210<br>Infraorbital canal | Sinoscopy fragment removal | Yes | No | Good |
| 10 | 5 yo, M, WB | Unilateral Closed | Maxillary<br>Nasal<br>Frontal<br>Lacrimal | Orbit<br>Rostral maxillary/ventral conchal sinusitis | Conservative | No | No | Excellent |
| 11 | 7 yo, G, WB | Bilateral Closed | Nasal | Suture periostitis<br>Nasolacrimal duct | Conservative | No | No | Good |
| 12 | 7 yo, S, Lusitano | Unilateral Open | Nasal<br>Maxillary<br>Incisive | Rostral maxillary and ventral conchal sinusitis | Conservative | Yes | No<br>Cosmetic | Good |
| 13 | 15 yo, G, WB | Unilateral Closed | Maxillary<br>Nasal | Periapical infection 106, 107 and 108 | Oral extraction 106, 107 and 108 | No | Orocutaneous fistula | Fair |

The 13 horses that met the inclusion criteria ranged in age from 2 months to 18 years and included eight Warmbloods, one Thoroughbred, one Polo Pony, one Lusitano, one Welsh pony and one horse of unknown breeding. There was a total of seven geldings, five mares and one stallion. The fractures were unilateral in 10/13 cases and open in 6/13 cases (Figure 2).



**Figure 2.** Picture of the 2 months old filly head trauma on presentation.

The orbit was involved in 3/13 cases. One of the paranasal sinuses was involved in 9/13 cases but the affected sinus was flushed in only 4/13 cases. A dental structure was involved in 4/13 cases and was treated with oral extraction in one case. The nasolacrimal duct was involved in 3/13 cases and the infraorbital canal in 1/13 (Figure 3).

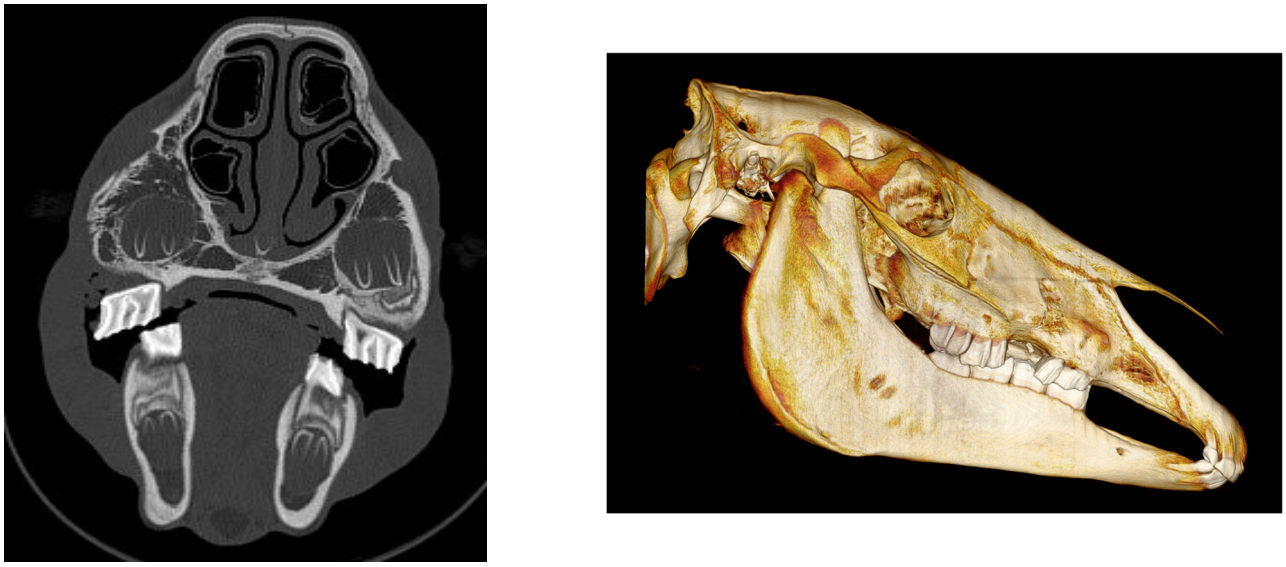


(**A**) (**B**)

**Figure 3.** (**A**) Transverse images of head CT of 2 months old filly on presentation identifying a comminuted, open, displaced and indented complete fracture of the right maxillary bone also involving a dental structure (507); (**B**) 3D reconstruction of the above CT.

Finally, antibiotics were used in 8/13 cases; they were not used in 3/13 cases that were chronic and there was no information available for two cases.

A repeat CT was performed in 6 out of the 13 horses (46%). The CT was performed between one month and two years from the first CT (Figure 4).



(**A**) (**B**)

**Figure 4.** (**A**) Transverse images of repeat head CT of the same filly 6 months later identifying adequate healing; (**B**) 3D reconstruction of the CT shown above.

Follow up was obtained for all 13 horses (Figure 5).



**Figure 5.** Cosmetic appearance of the filly shown above 8 months post-injury.

The referring veterinarian was contacted using a questionnaire and/or through phone call to obtain follow up information (Figure 1). Presence of complications (such as suture periostitis, sequestrum formation, head shaking…), cosmetic appearance (excellent, good, fair and poor), return to function (similar, decreased, no return) and outcome (excellent, good, fair and poor) were evaluated in the questionnaire (Figure 1).

## 4. Discussion

Wounds are a common occurrence in equine patients and are usually traumatic in origin, resulting from a kick or running through fences. Most wounds involve the distal limbs, with the head being the second most common location. Very often, due to the nature

of the trauma, skull wounds are associated with a fracture of one or more of the facial bones and usually have an open configuration [1].

While there is sufficient information on surgical repair of these fractures [1–4], there is little evidence detailing conservative management of these fractures. With the increasing availability of CT as an advanced diagnostic tool in equine medicine, evaluation of skull fracture has also become more accurate. Until recently, conventional radiographs were used to diagnose head trauma in equine patients, but superimposition of various structures in the skull often made interpretation of the images difficult. Moreover, radiographs would sometimes underestimate the extent of the structures involved, making treatment and prognosis less accurate [5–8]. The aim of our study was to evaluate the common clinical signs, fracture configuration, complications and outcome for skull fracture in horses that were treated conservatively following a head CT.

In this study, all skull fractures were complete and comminuted. The maxillary bone was the most frequently affected osseous structure, which is in agreement with previous publications.

It is also interesting to note that associated sinusitis was present in the majority (77%) of cases, but treatment with a sinus flush or a sinoscopy was only required in 4 out of 13 cases (31%).

Complications were noted in almost half of the cases in this study. Although all fractures in this study were comminuted, sequestrum formation was only reported in one case. Similarly, suture periostitis, which has been reported as a common complication of trephination for sinoscopy and skull fractures, was only noted in two cases. The other complications noted in this study were directly related to the initial injury and included narrowing of the conchofrontal sinus, orocutanenous fistula formation and development of a granuloma. Except for the orocutaneous fistula formation, complications either did not affect the horse clinically or responded to further additional treatment including sharp resection of the granuloma.

Cosmetic sequelae were reported in 23% of horses, which remains a significant proportion of the cases and is higher than what has been previously reported with surgical management. Despite this, most owners were satisfied with the results, especially since functional outcome was obtained even with an altered cosmesis.

Should cosmetic results be of paramount importance (in show horses for instance) options for surgical reduction and fixation should be discussed in detail with the owner with the aim of improving cosmesis versus conservative management. For those horses where cosmetics results are not a priority and for which finances are limited, the conservative management should still be offered as a viable treatment option (Figure 5).

Most of the current literature states that surgical management is the preferred treatment option for skull fractures as conservative management carries a greater risk for complications such as wound infection, sinusitis, sequestrum formation, delayed wound healing, head shaking and narrowing of the nasal passage. In this study of horses with facial fractures that were managed conservatively, a favourable outcome is reported in 77% of cases, which is comparable to that reported for surgical repair [1,11,12,18,19].

For management of equine skull fractures using fixation with polydioxanone sutures, 9 out of 10 horses returned to their previous intended use and all had excellent cosmetic outcomes [16]. For the intrasinus bolstering of traumatic maxillary sinus fractures by using a Foley catheter in two foals, the result was excellent in both cases [17], and similar to the one foal in our study.

The main limitation of this study was the relatively low number of cases and the availability of repeat CT in only 6 of 13 (46%) cases. Given the low number of cases, it was

not possible to compare treatments for specific fracture morphologies. Further studies may be needed with a larger population of horses to extrapolate these results.

## 5. Conclusions

While cosmetic sequelae were noted in three (23%) horses, conservative treatment yielded a good to excellent outcome in 10 of 13 (77%) cases. There was no difference in prognosis between closed and open fractures. Therefore, we believe that conservative management is a viable treatment option for equine skull fractures, especially in circumstances where perfect cosmetic results are not expected and where economics may be a limitation.

**Author Contributions:** Conceptualization, M.P., M.L. and G.M.-D.; methodology, M.P., M.L. and G.M.-D.; data curation, M.L. and G.M.-D.; writing—original draft preparation, M.P.; writing—review and editing, M.P. All authors have read and agreed to the published version of the manuscript.

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**Institutional Review Board Statement:** The study is based on existing clinical records (2018–2022) from the Royal Veterinary College and the Universidad Complutense Madrid. Data were not collected prospectively for the purpose of this research. The study received retroactive approval from the Social Science Research Ethical Review Board (SSRERB) at the Royal Veterinary College (Ref: URN SR2025-01162309; approval date: 23 September 2025). The SSRERB explicitly permits retroactive ethical approval for studies of this nature.

**Data Availability Statement:** The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

**Conflicts of Interest:** The authors declare no conflicts of interest.

## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| CT | Computed Tomography |
| RVC | Royal Veterinary College |

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