Received: 31 May 2025 | Revised: 8 August 2025 | Accepted: 19 August 2025

DOI: 10.1002/vrc2.70190

Vet Record CaseReports

CASE REPORT

Wildlife

Treatment of pressure gun fractures and release in the wild of a caracara (*Caracara plancus*)

Guilherme Rech Cassanego | **Sheila Canevese Rahal** | **Bruno Oliani de Risso** | **Anita Marchionatti Pigatto** | **Maria Jaqueline Mamprim**

Department of Veterinary Surgery and Animal Reproduction, School of Veterinary Medicine and Animal Science, São Paulo State University (UNESP), Botucatu, Brazil

Correspondence
Guilherme Rech Cassanego, School of Veterinary Medicine and Animal Science, São Paulo State University (UNESP), Botucatu, Brazil.
Email: guilherme.rech@unesp.br

Abstract

This report aims to describe the treatment progression of a free-living southern crested caracara (*Caracara plancus plancus*) with gunshot-related fractures. Radiographic examination revealed a comminuted fracture in the mid-diaphysis of the humerus with displaced fragments, a comminuted fracture of the proximal third of the radius shaft, and the presence of bullet fragments. The humerus fracture was immobilised using a unilateral Type Ia acrylic resin pin skeletal fixator, which was applied without exposing the fracture site and remained in place for 4 weeks. A figure-of-eight bandage was used to stabilise the radial fracture for 1 week. The largest bullet fragment was also removed. After implant removal, the bird underwent a rehabilitation protocol that included flight training. Although physical examination revealed no motion at the fracture site, the humerus fracture line remained visible 5 months post-surgery. At that point, the bird was released into the wild, underscoring the importance of proper interventions for preserving native wildlife.

BACKGROUND

The caracara (*Caracara plancus*) is a diurnal bird of prey belonging to the Falconidae family.[1,2] It has a wide distribution, ranging from southern North America to southern South America, including Peru, northern Brazil, Tierra del Fuego and the Falkland Islands.[3,4] The caracara primarily feeds on carrion, but also hunts live prey.[1] Its feet are versatile for grasping prey, which are captured with the talons and killed with the beak.[1,2] The bird is also considered opportunistic, preying on chicks and eggs of other birds, as well as some reptiles, amphibians, fish and arthropods such as ticks, crabs and insects. It also feeds on carcases of dead animals and, occasionally, consumes fruit pulp.[5–7] There are also records of collective predation on medium-sized birds.[8]

The habitats of the caracara are varied, including open fields, savannas, mountainous areas, beaches, urban areas, agricultural lands, highway margins and pastures.[6] The bird is well adapted to walking and hunting on the ground, with its long legs suited for walking and running in pastures and scrublands.[1] In captivity, the carcara has been observed running by flapping its wings, walking with rhythmic steps, and jumping on both legs with the help of wing beats.[9] Its flight is direct, with constant wing beats.[1] The bird can live solitarily, in small family groups, or in mixed flocks with vultures, primarily *Coragyps atratus* (Cathartiformes).[6]

Although the species is considered Least Concern according to the IUCN Red List of Threatened Species, it has been subject to several traumatic processes and even trapping due to animal trafficking.[4] Thus, this report aims to describe the treatment progression of a free-living southern crested caracara with gunshot-related fractures.

CASE PRESENTATION

A free-ranging adult southern crested caracara (*C. plancus plancus*), of unknown sex and weighing 1 kg, was brought to the Center for Medicine and Research in Wild Animals due to an inability to fly. The bird had been found on a public road and was rescued by the Municipal Environmental Civil Guard. On general physical examination (Day 0), the bird was alert, active and in good body condition, but showed signs of dehydration (approximately 5%) and had a misaligned left wing. Palpation revealed crepitus in the left humerus and perforating skin lesions on the lateral and medial aspects of the radius, as well as the lateral humerus.

INVESTIGATIONS

Day 0: Preoperative radiographic examination (Figure 1a,b) of the left thoracic limb was performed in mediolateral, caudocranial and oblique projections under physical restraint. The images revealed a comminuted fracture in the mid-diaphysis of the humerus with displaced fragments, and a comminuted fracture of the proximal third of the radial shaft, while the ulna remained intact. Radiopaque points were observed at the fracture sites. Additionally, an amorphous structure with metallic radiopacity (0.49 × 0.79 cm), suggestive of a ballistic projectile, was identified in the coracoid area.

DIFFERENTIAL DIAGNOSIS

Due to the inability to fly, in addition to fractures, bone luxations—such as scapulohumeral or elbow luxations—should be considered. Luxation may be suspected during palpation of the limb; however, radiographic imaging or computed tomography is required to confirm the diagnosis.

Brachial plexus avulsion should also be considered as a differential diagnosis, particularly in birds that are unable to move the affected wing. Characteristic clinical signs include the absence of pain in the wing and the wing being dragged on the ground.

TREATMENT

To treat the humerus fracture, the bird was first tranquillised with morphine (1 mg/kg intramuscularly [IM]; Dimorf, Cristália), then placed in a pre-oxygenation box, followed by induction with isoflurane (Isoforine, Cristália). A no. 3 uncuffed endotracheal tube was then inserted to maintain the airway while continuing isoflurane anaesthesia. During the surgical procedure, the bird received Ringer's lactate solution (5 mL/kg/h intravenously; Ringer com lactato, Equiplex) via the lateral metatarsal vein. The bird was placed in dorsal recumbency, and the feathers over the surgical site were removed by plucking. The area was then aseptically prepared using 2% chlorhexidine degermant (Riohex 2%, Rioquímica) and 0.5% alcoholic chlorhexidine (Riohex solução alcoólica, Rioquímica). A unilateral Type Ia skeletal fixator using acrylic resin was applied without exposing the fracture site. Smooth Kirschner wires were inserted laterally—two in the proximal fragment and two in the distal fragment of the fracture (Figure 1c,d). The wire ends were bent to improve the adhesion of the acrylic resin. A projectile located in the coracoid region was removed. The entry and exit wounds caused by the ballistic projectiles were cleaned and left open. Additionally, a figure-of-eight bandage was applied to stabilise the radius fracture.

Empirical antimicrobial therapy consisted of enrofloxacin (10 mg/kg IM every 12 hours; Floxiclin, Biofarm) and metronidazole (50 mg/kg orally every 24 hours; Metronidazol, JP), both administered for 10 days. The bird also received dipyrone (25 mg/kg IM every 12 hours; Analgex, Agener) for 10 days, as well as meloxicam (1 mg/kg IM every 24 hours; Flamavet, Agenere) and morphine (1 mg/kg IM every 12 hours), both for 5 days. Skin wounds and pin sites were cleaned regularly with 0.2% aqueous chlorhexidine, followed by application of an ointment containing gentamicin, sulfadiazine, sulfanilamide, urea and vitamin A (Vetaglos, Vetnil).

LEARNING POINTS/TAKE-HOME MESSAGES

- Gunshot fractures in wild birds require case-specific orthopaedic treatment.
- External skeletal fixation is effective when fracture site exposure is inadvisable.
- Rehabilitation, including flight training, is essential for the successful reintroduction of raptors post-treatment.
- Radiographs may show persistent fracture lines despite clinical stability, underscoring the need to assess both healing and function.
- Anthropogenic trauma remains a major threat to native wildlife, reinforcing the need for conservation awareness.

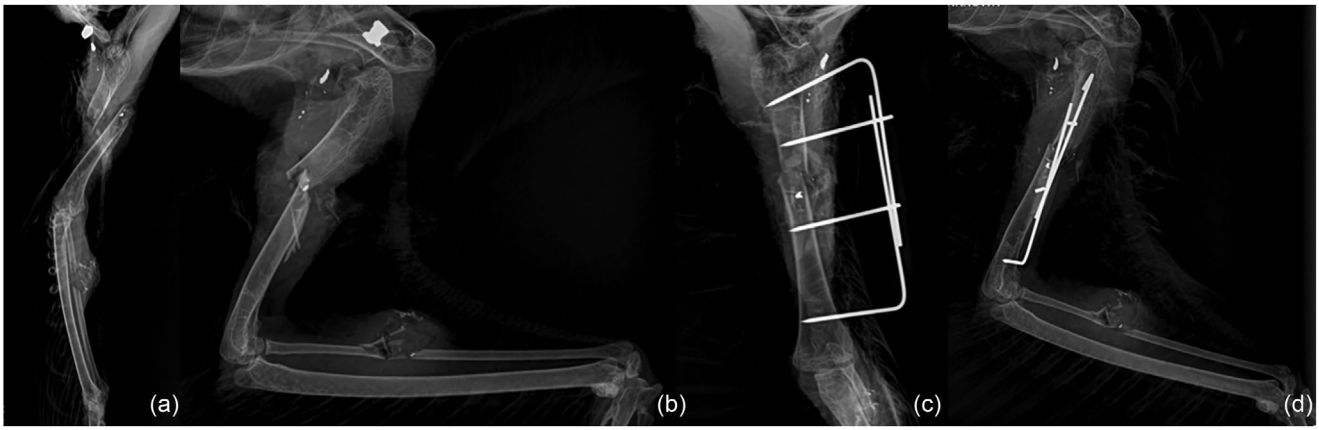

FIGURE 1 Radiographs of the left thoracic limb in caudocranial (a and c) and mediolateral (b and d) views. Preoperative images (a and b): comminuted fracture in the mid-diaphysis of the humerus with displaced fragments, and comminuted fracture of the proximal third of the radial shaft. Postoperative images (c and d): humeral fracture stabilised with a unilateral Type Ia external skeletal fixator.

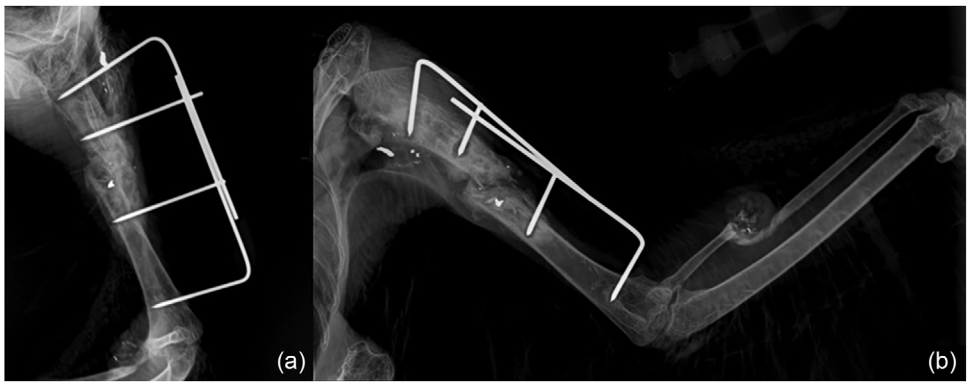

FIGURE 2 Radiographs of the left thoracic limb in caudocranial (a) and mediolateral (b) views, 4 weeks postoperatively. Observe external callus formation and a visible fracture line in the humerus, and external callus bridging the two fracture ends in the radius.

OUTCOME AND FOLLOW-UP

Immediate postoperative radiographic examination showed 85% alignment at the humeral fracture site. During the postoperative period, the bird was initially housed in a 120 × 60 × 82 cm enclosure. The enclosure was spacious enough to allow limited wing movement, which was important for maintaining some degree of mobility and reducing stress, even with the external fixator and figure-of-eight bandage in place. The figure-of-eight bandage was removed after 1 week due to the absence of motion at the radial fracture site. Four weeks after surgery, a follow-up radiographic examination revealed external callus formation on the humerus, a visible fracture line and lysis around the pins—more pronounced in the proximal ones—with no signs of infection (Figure 2a,b). Physical examination revealed no motion at the fracture site upon palpation. However, due to loosening of pins, the external fixator was removed under the same anaesthetic protocol. Additionally, radiographic examination of the radial fracture revealed external callus formation bridging the two fracture ends (Figure 2c). The following day, the bird was transferred to an enclosure measuring 3 × 3.5 m, equipped with two closely positioned perches on the ground to facilitate flight training. This setup allowed the bird to safely practice short-distance flights while gradually rebuilding its strength and coordination. However, radiographic examination revealed that the humerus still showed a visible fracture line and early remodelling of the external callus. The radius also exhibited callus remodelling, but a visible fracture line remained at the distal end. The bird was subsequently banded and transferred to a larger enclosure, which included a fenced open area measuring 14.7 × 3.5 m and a sheltered area measuring 3 × 3.5 m. Only three perches were provided to further encourage flight (Video 1). At 22 weeks postoperatively (approximately 5 months), radiographic examination revealed evidence of callus remodelling and a fracture line less visible on the humeral fracture (Figure 3a,b). The radius had healed with a slight alignment deviation, but no synostosis was observed (Figure 3c). The following day, the bird was released into a forested area (Video 2).

VIDEO 1 The bird is shown being stimulated to fly.

DISCUSSION

The humerus is a commonly fractured bone in birds of the Falconidae family, often presenting with a comminuted fracture pattern,[10] as observed in this report. Although various methods exist for immobilising fractures in birds,[11–13] an external fixator was used in this case due to the classification of the humeral fracture as open. A fracture is generally classified as open when one or more bone fragments are visible or when a skin wound is present.[12] In the present case, although the fractured bone ends were not externally visible, entry and exit wounds from ballistic projectiles were observed; therefore, antimicrobial therapy was initiated. Enrofloxacin was chosen due to its availability and bactericidal activity against both Gram-positive bacteria, such as *Staphylococcus* spp., while metronidazole was also included to address its limited efficacy against anaerobes.[14] The protocol was adequate because the bird did not develop osteomyelitis.

As the surrounding area had already been compromised by the trauma, the humeral fracture was treated using a closed approach to minimise iatrogenic soft tissue damage. Recovery generally occurs more quickly and with fewer complications when both soft tissues and bone are protected.[12] Additionally, the periosteal blood supply is crucial for the vascularisation of avian bone.[15] As humeral fractures require unilateral fixator application due to anatomical constraints, a unilateral Type Ia configuration was chosen. The tie-in or hybrid construct, combining an external fixator with an intramedullary pin, offers superior control of mechanical forces, providing three-dimensional stability, increased robustness, better load distribution to the bone and improved durability.[12] In a pigeon humerus fracture model, the tie-in configuration was found to be stronger and more rigid in flexion compared to both non-locked and locked plates.[16] Despite these biomechanical advantages, this method could not be applied in the present

FIGURE 3 Radiographs of the left thoracic limb in caudocranial (a) and mediolateral (b) views, 22 weeks after surgery. Note callus remodelling and fracture line less visible in the humerus, and healed radius fracture with a slight alignment deviation, but no synostosis.

VIDEO 2 The bird is being released into its natural forested habitat.

case due to the contaminated nature of the fracture, where the use of an intramedullary pin should be avoided, especially considering that the humerus is a pneumatic bone.

Due to pin loosening, the external fixator was removed 4 weeks postoperatively, despite radiographic evidence of non-union. Avian fractures typically become clinically stable within 2–3 weeks, with radiographic healing generally observed between 3 and 6 weeks. In this case, the fracture showed progressive radiographic improvement; however, at the time of release—5 months postoperatively—a visible fracture line remained, suggesting a functional hypertrophic non-union. Despite this, no motion was detected at the fracture site during palpation. As avian fractures primarily heal through endosteal callus formation and fibrous tissue development, a radiolucent fracture line may persist, and follow-up imaging is recommended for up to 12–16 weeks after injury.[17,18] Even minor rotational deformities of the humerus can significantly impair flight.[11] Given that the bone was well-aligned and the bird demonstrated full wing mobility, the decision was made not to delay its release back into the wild.

Several factors can interfere with bone healing, including insufficient blood supply, inadequate fracture reduction or stabilisation, movement at the fracture site, infection and bone loss.[11,19] In this report, trauma caused by lead ballistic projectiles contributed to delayed bone healing. However, although open fractures are commonly associated with osteomyelitis, this complication was avoided in the present case through proper immobilisation and the administration of antibiotics. Furthermore, the heat generated by ballistic projectile injuries may help reduce the risk of osteomyelitis.[18]

The use of only two proximal pins in the assembly may have contributed to pin loosening, as bone lysis was observed around them. Additionally, the presence of periosteal callus, as noted in this case, suggests potential motion at the fracture site or poor alignment,[15] which is consistent with the postoperative displacement of the fracture. Using more pins could have distributed mechanical forces more effectively, particularly as the use of an intramedullary pin was not feasible. Moreover, the thin cortical bone in birds predisposes them to premature pin loosening,[11] and the use of smooth pins, less effective at maintaining the pin–bone interface over time, may have further contributed to this outcome.[15] Frequent wing movement may also have exacerbated pin loosening. On the other hand, the transfixing pins were connected using a polymethylmethacrylate bar, which is lightweight, does not require precise pin placement in the same plane,[12,13] and serves as a cost-effective option, particularly suitable for a free-living bird.

The radial fracture was immobilised using a figure-of-eight bandage, as there was minimal displacement of bone alignment despite bone loss due to the comminuted nature of the fracture. This method of coaptation has been recommended when only the radius or ulna is fractured,[20] and is contraindicated in cases of poor bone alignment due to the risk of developing radioulnar synostosis,[21] as both bones function together to extend and flex the manus.[13] Conversely, some authors advocate for immobilising the radius with an intramedullary pin, regardless of whether the ulna is intact.[13] However, this protocol was not adopted in the present case due to the comminuted nature of the fracture caused by a ballistic projectile. The bandage remained in place for 1 week, providing sufficient stability for the bird to use its wing. The ulna, being larger than the radius,[21] contributes to maintaining overall limb length. It should also be noted that prolonged immobilisation can lead to joint dysfunction, muscle atrophy due to disuse, and contraction of the propatagium.[13,20] The prognosis is generally more favourable when only one of the two bones—the radius or ulna—is fractured.[21] In this case, healing of the radial fracture occurred within 4 weeks, progressing more quickly than is typical for humeral fractures.

Due to the challenge of removing smaller particles, only the largest visible ballistic projectile on radiographs was extracted. A study found that the risk of direct lead poisoning

in free-living animals with embedded lead fragments is low.[22] To prevent fracture disease,[15] the bird was not confined to a cage, enabling it to start wing exercises 1 week after surgery. No formal physical therapy protocol was followed as the bird showed adequate wing mobility.

However, physiotherapy and pre-release conditioning were essential components of the bird's postoperative recovery. Initially, the bird was transferred to a 3 × 3.5 m enclosure equipped with two closely spaced perches to initiate controlled flight and gradually restore wing mobility, muscle strength and coordination through short, repeated flights. At 8 weeks postoperatively, the bird was moved to a larger enclosure with widely spaced perches to promote sustained and more demanding flight. This progression was designed to build endurance and better simulate natural flight conditions. As the bird consistently demonstrated natural behaviours such as flying and perching during this phase, it was deemed fit for release. Consequently, a hard release into a suitable natural habitat was carried out.

This clinical-surgical case highlights the successful treatment of air gun fractures in a *C. plancus*. After stabilisation, rehabilitation and flight training, the bird was successfully released into the wild, underscoring the importance of proper interventions for preserving native wildlife.

AUTHOR CONTRIBUTIONS

Guilherme Rech Cassanego, Bruno Oliani de Risso and Anita Marchionatti Pigatto conceived and designed the project, and acquired the data. Sheila Canevese Rahal and Maria Jaqueline Mamprim analysed and interpreted the data. Sheila Canevese Rahal, Guilherme Rech Cassanego and Anita Marchionatti Pigatto contributed to the writing and final revision of the manuscript.

ACKNOWLEDGEMENTS

The authors thank FINEP (Financiadora de Estudos e Projetos; grant 01.12.0530.00), CNPq-PQ (no. 305813/2023-4) and Fapesp (nos. 2025/08860-6, 2024/21341-5).

The Article Processing Charge for the publication of this research was funded by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) (ROR identifier: 00x0ma614).

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

FUNDING INFORMATION

The authors received no specific funding for this work.

ETHICS STATEMENT

This is a case report that does not require any ethical approval.

ORCID

Guilherme Rech Cassanego https://orcid.org/0000-0003-2632-2465
Sheila Canevese Rahal https://orcid.org/0000-0002-9211-4093
Bruno Oliani de Risso https://orcid.org/0009-0009-2541-9207
Anita Marchionatti Pigatto https://orcid.org/0000-0002-0521-7984
Maria Jaqueline Mamprim https://orcid.org/0000-0002-2238-5584

REFERENCES

1. Harrison CJO, Greensmith A. Birds of the world. New York: Dorling Kindersley; 1993. p. 416.
2. Nishida SM, Lopes LF, Bacchim GT, Boato JPS, Pagnin D, Fonseca RCB, et al. Guia de aves: Botucatu e São Manuel. Botucatu: FUNDIBIO; 2018. p. 288.
3. Arlott N, Perlo B. Collins birds of the world. London: William Collins; 2021. p. 2348.
4. BirdLife International. *Caracara plancus*. The IUCN Red List of Threatened Species 2023: e.T22729784A232384538. IUCN; 2023. Accessed May 3, 2025. https://dx.doi.org/10.2305/IUCN.UK.2023-1.RLTS.T22729784A232384538.en
5. Paula WS, Souza RN, Santos EG. Fruit consumption and seed dispersal of *Caryocar brasilense* (Caryocaraceae) by *Caracara plancus* (Falconidae). Braz J Biol. 2021;81(4):1127–28. https://doi.org/10.1590/1519-6984.234498
6. Pallinger F, Menq W. Aves de rapina do Brasil—Diurnos. São Paulo: Edição do autor; 2021. p. 184.
7. Panter CT, Naude VN, Barbar F, Amar A. Continental scale dietary patterns in a New World raptor using web-sourced photographs. PLoS One. 2024;19(7):e0304740. https://doi.org/10.1371/journal.pone.0304740
8. Godoy FI, Macarrão A, Costa JC. Hunting behaviour of southern caracara *Caracara plancus* on medium-sized bird. Cotinga. 2020;42:28–30.
9. Oliveira HS, Souza DRA, Silva MN. Etograma do Carcará (*Caracara plancus*, Miller, 1777) (Aves, Falconidae), em cativeiro. Rev Etol. 2014;13(2):1–9.
10. Fernandes MC, Rahal SC, Teixeira CR, Mamprim MJ, Freirias CD, Lima HC, et al. Retrospective study of fractures in both appendicular and axial skeletons of birds belonging to the families Falconidae and Cariamidae. J Anim Sci Res. 2022;6(1):1–5. https://doi.org/10.16966/2576-6457.156
11. Bennett RA, Kuzma AB. Fracture management in birds. J Zoo Wildl Med. 1992;23(1):5–38.
12. Carrasco DC. Fracture management in avian species. Vet Clin North Am Small Anim Pract. 2019;22(2):223–38. https://doi.org/10.1016/j.cvex.2019.02.002
13. Orosz SE, Echols MS, Redig PT. Avian surgical anatomy and orthopedic management. Florence: Teton NewMedia; 2023. p. 424.
14. Flammer K. Antibiotic drug selection in companion birds. J Exot Pet Med. 2006;15(3):166–76. https://doi.org/10.1053/j.jepm.2006.06.003
15. Doneley B. Surgery. In: Avian medicine and surgery in practice. Australia: Manson Publishing; 2010. p. 255–84.
16. Darrow BG, Weigel JP, Greenacre CB, Xie X, Liaw PK, Biskup JJ. Ex vivo biomechanical comparison of titanium locking plate, stainless steel non-locking plate, and tie-in external fixator applied by a dorsal approach on ostectomized humeri of pigeons (*Columba livia*). J Avian Med Surg. 2019;33(1):29–37. https://doi.org/10.1647/2017-305
17. Grosso FV. Orthopedic diagnostic imaging in exotic pets. Vet Clin North Am Exot Anim Pract. 2019;22(2):149–73. https://doi.org/10.1016/j.cvex.2019.01.003
18. Williams J. Orthopedic radiography in exotic animal practice. Vet Clin North Am Exot Anim Pract. 2002;5(1):1–22. https://doi.org/10.1016/s1094-9194(03)00043-4
19. González MS. Skeletal bone structure and repair in small mammals, birds, and reptiles. Vet Clin North Am Exot Anim Pract. 2019;22(2):135–47. https://doi.org/10.1016/j.cvex.2019.01.002
20. Degernes LA. Trauma. In: Ritchie BW, Harrison GJ, Harrison LR, editors. Avian medicine: principles and application. Florida: Wingers Publishing; 1994. p. 417–33.
21. Orosz SE. Clinical considerations of the thoracic limb. Vet Clin North Am Exot Anim Pract. 2002;5(1):31–48. https://doi.org/10.1016/s1094-9194(03)00045-8
22. LaDouceur EE, Kagan R, Scanlan M, Viner T. Chronically embedded lead projectiles in wildlife: a case series investigating the potential for lead toxicosis. J Zoo Wildl Med. 2015;46(2):438–42. https://doi.org/10.1638/2015-0026R.1

How to cite this article: Cassanego GR, Rahal SC, de Risso BO, Pigatto AM, Mamprim MJ. Treatment of pressure gun fractures and release in the wild of a caracara (*Caracara plancus*). Vet Rec Case Rep. 2025;13:e70190. https://doi.org/10.1002/vrc2.70190