Veterinary Integrative Sciences 2026; 24(1): e2026012-1-8. DOI: 10.12982/VIS.2026.012

Veterinary Integrative Sciences
ISSN; 2629-9968 (online)

Case Report

Composite resin and silver cavity filling for the canine teeth fracture in Puma *(Puma concolor)*

Kavitha Jayaseelan[1], Mat Naim Ramli[1], Rozanaliza Radzi[2], Mira Farhana Razlan[2], and Azlan Che-Amat[2,3,*]

[1] Zoo Veterinary Hospital, Zoo Negara, Hulu Kelang, Ampang, Selangor 68000, Malaysia
[2]Faculty of Veterinary Medicine, University Putra Malaysia, UPM Serdang, Selangor 43400, Malaysia
[3]Avian and Exotic Animal Unit, University Veterinary Hospital, Faculty of Veterinary Medicine, Universiti Putra Malaysia, UPM Serdang, Selangor 43400, Malaysia

Abstract

A 12-year-old captive Puma concolor was found to have tooth fractures on both maxillary canines (104, 204) and the left mandibular canine (304), as well as decay on the right maxillary canine (104). The puma was losing weight gradually, but was peaceful, vigilant, and receptive when observed from a distance. The puma suffered from generalised osteopenia as well as a right mid-humeral fracture. The blood result showed hypocalcaemia, although the other parameters were within normal limits. Upon a dental examination, the puma was diagnosed with a severe crown fracture caused by nutritional secondary hyperparathyroidism due to an imbalanced diet and a lack of vitamin D due to a lack of sunlight exposure, resulting in hypocalcaemia. All three dental crown fractures exposed the pulp chamber. Dental restoration and filling were performed using either a composite resin or silver (amalgam) filling to keep the functional teeth, relieve discomfort, and improve quality of life. Animal is clinically healthy post-operatively and has improved quality of life with no pain and normal appetite.

Keywords: Canine teeth fracture, Dental filling, Hypocalcaemia, Puma, Secondary hyperparathyroidism

[*]**Corresponding author**: Azlan Che-Amat, Faculty of Veterinary Medicine, University Putra Malaysia, UPM Serdang, Selangor *43400,* Malaysia.
E-mail: c_azlan@upm.edu.my

Article history; *received manuscript: 6 April 2024,*
revised manuscript: 18 May 2024,
accepted manuscript: 17 April 2025,
published online: 18 April 2025,
Academic editor; *Korakot Nganvongpanit*

INTRODUCTION

According to The IUCN Red List of Threatened Species (Nielsen et al., 2015), puma is the solitary member of the Felidae genus. Despite their size, they are more closely linked to smaller cats than lions or leopards. Unlike other cats, pumas are the most versatile felines in the Americas and live in many settings. This genus has enormous, powerful predators. Pumas are capable of hunting large prey, but available small to medium-sized prey are more important in their diet including feral pigs, raccoons and armadillos. In captivity, certain feeding regimes solely provide meat without bones and live-prey feeding are not allowed due to animal welfare issue.

Felids' dental anatomy is separated into four compartments: right upper, left upper, right lower, and left lower, with incisors, canines, premolars, and molars with dental formulas of I3/3, C1/1, P3/2, and M1/1 (American Veterinary Dental College, AVDC). Each tooth has two parts: the crown and the root, which are located above and below the gingival edge, respectively. Inside the dentin of the crown and root lies a hollow chamber loaded with soft tissue called pulp, hence this chamber is referred to as the pulp chamber within the crown and root of the tooth. Carnivores' canine teeth are typically fractured as a result of trauma and frequently require endodontic treatment. Fractures to the tooth are classed based on the level of exposure of the tooth structure, such as enamel, dentine, and root, as well as if the pulp tissues are immediately exposed. Other classifications may include enamel damage or infraction; enamel loss with intact dentine; enamel and dentine exposure without pulp exposure; crown and root involvement without pulp exposure; root fracture with intact crown and pulp; and whether there is pulp exposure, isolated to the crown or involving both crown and root. (Thrall, 2017; Bellows et al., 2019).

According to AVDC, dental fractures are classified into four types: enamel infraction (the presence of micro cracks in the enamel without loss of tooth structure), enamel fracture (fracture with loss of crown substance confined to enamel), uncomplicated crown fracture (fracture of the crown that does not expose the pulp), and complicated crown fracture (fracture of the crown that exposes the pulp). DuPont (2010) has simplified dental fracture classification into two which are uncomplicated crown fractures, a direct dentin damage but no pulp exposure and complicated crown fractures which have dentin damage with direct pulp (nerve) exposure. Meticulous debridement avoids deep penetration of the pulp tissues. The walls are carefully prepared free of debris circumferentially. A lining material is applied at location of the preparation with "near pulp exposure". The lining material is "light cured" to activate and harden the material. The composite restoration is placed in 2 mm layers. Each layer is light cured. The final restoration is covered by four layers of "light cured" bonding agent.

For dental restoration, the pulp cap must be physically and mechanically protected. A sandwich approach is utilised with a base made of glass-ionomer cement because of its high durability and impermeability to leakage, which protects the pulp cap and supports the repair (Girard, 2021). The crown opening is then repaired with a composite resin or amalgam to improve mechanical and/or aesthetic qualities (Girard, 2021; Kressin and Honzelka, 2023). This report covers the treatment of a complex bilateral canine tooth fracture in a captive puma (*Panthera concolor*) utilising several types of dental cavity filling. To the best of our knowledge, this is the most thorough dental procedure ever documented in Malaysia for large wild felids kept in captivity that received a guidance from the medical dentist.

CASE MANAGEMENT

A 12-year-old male puma, weighing 27 kg, was brought to the Zoo Veterinary Hospital complaining of problems ingesting food. The animal was kept in captivity at Zoo Negara. The patient was generally provided a red meat diet, with the occasional bone meal. There is little sunlight exposure in the patient cage with estimated penetration rate less than 20% based on the individual subjective gross visual estimation. During the immobilisation five months prior due to complaint of reduction in appetite and inactive, a fracture to the right maxillary canine teeth was discovered upon dental examination. The weight of the body at that time was 34 kg. With the exception of a stress leukogram and hypocalcemia, all blood parameters were within normal limits; hence, a calcium supplement was started by mixing in food and given for 5 months and analgesic meloxicam was given daily for 1 week by orally or injection (darting).

Following to that and a much detail dental management plans, an in-depth examination was planned, and the animal was put under anaesthesia by intramuscular blow pipe administration of dose 1 mg/kg of xylazine hydrochloride (Ilium Xylazil-100, Troy, Australia) and 6 mg/kg of tiletamine hydrochloride-zolazepam hydrochloride (Zoletil® 100, Virbac, France). Puma was kept on 3.0% to 3.5% isoflurane after being intubated using an 11-mm cuffed endotracheal tube. Upon physical examination, the mucosal membrane was pink, the capillary refill time was less than two seconds, and all the vital signs were within normal range. With a precise body weight of 27 kg, the body condition score was 2.5 out of 5. Upon dental examination, it was discovered that the right maxillary canine had tooth decay and that the left mandibular (304) and bilateral maxillary (104, 204) canine teeth were fractured.

Beginning with the right maxillary canine (104) that had a crown fracture that exposed the pulp chamber, dental restoration work was done. It was determined that the fracture was complex and that tooth decay was present (Figure 1a). To ensure that all of the caries was removed, the method (see Figure 1) involved utilising a dentin excavator fitted with gauze to remove the carious dentin. After that, cavities were inspected with a dental mirror, and any leftover caries debris was removed by irrigation with regular saline. Following cleaning, Ledermix®, an antibiotic mixture of triamcinolone acetonide and demaclocycline, was injected into the cavity to prevent pulpitis and slow down its resorption. The use of Ladermix® was based on the availability at the facility. Silver/amalgam dental filling was employed as the primary filling, with glass ionomer cement used as a foundation.

The second treatment was administered to the left maxillary canine (204). Figure 2 shows in detail how the tooth fracture identified during the dental examination only affected the crown and exposed the pulp chamber. The first four treatments were identical to the previous ones, which comprised excising cavities and applying pressure to achieve pinpoint bleeding hemostasis. Following a thorough cleaning, the cavity was examined, irrigated, and treated with an antibiotic. On the other hand, flowable dental composite was utilised in this technique to fill the restricted canal, and UV radiation was used to harden it and promote the composite's polymerisation. The most recent treatment was performed on the lower left canine, where a fracture had exposed the pulp chamber, which was bloody. As shown in Figure 3, the broken tooth was restored, and as a follow-up, the exposed cavity was filled with dental composite. The puma was monitored daily and post-operative recovery was good with normal appetite, bowel and urination. Post-dental procedure radiographic and follow-up examination were not performed and the animal is clinically healthy through a daily subjective gross examination.

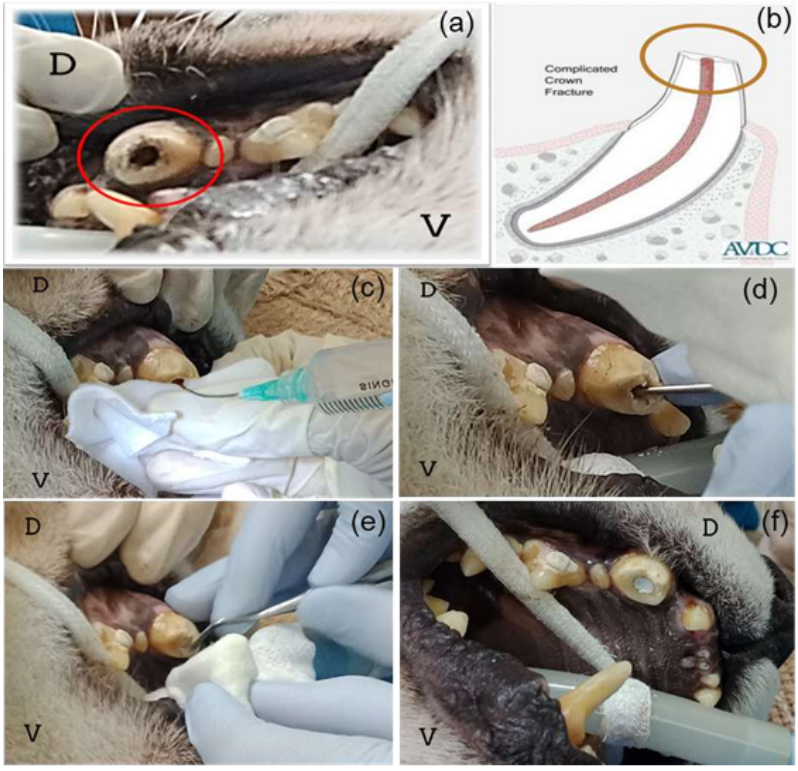

Figure 1 (a) Right upper canine tooth fracture with presence of tooth decay. (b) Illustration of a complicated fracture occurs when the crown of the tooth is fractured and the pulp is exposed (image adapted from AVDC.org). (c) Irrigation with normal saline after caries excavation. (d) Ledermix® filling as medicament. (e) Glass ionomer cement (GIC) was applied as base. (f) Silver/amalgam filling used as main filling for canine tooth fracture. (Positioning: D, Dorsal; V, Ventral).

DISCUSSION

Puma are sympatric carnivores who eat meat as their primary food (Kitchener 1991; Sunquist and Sunquist, 2002). Red meat is one of the food groups with the greatest phosphorus/calcium ratio (D'Alessandro et al., 2015). Calcium insufficiency in wild felids can be avoided by feeding bones with attached meat on at least two days per week when slab meat is not provided (Vosburgh et al., 1982). Feeding bones keeps the animal's teeth and gums in condition while also removing tartar, which is a serious concern in captive large felines (Vosburgh et al., 1982). Feeding bones such as femoral part, oxtails, or rawhide promotes periodontal health and allows for more natural feeding behaviours (Dierenfald et al., 1994). Imbalances, such as a calcium deficit or a high phosphorus level, limit calcium absorption, resulting in tooth demineralisation; the optimal calcium:phosphorus ratio is 2:1 (Neel et al., 2016). In this scenario, the puma was fed a red meat and bone diet twice a day. However, the provided bone diet is unlikely to be sufficient to reach the optimal calcium-phosphorus ratio. Furthermore, the cage limits the quantity of sunlight it receives, resulting in vitamin D insufficiency.

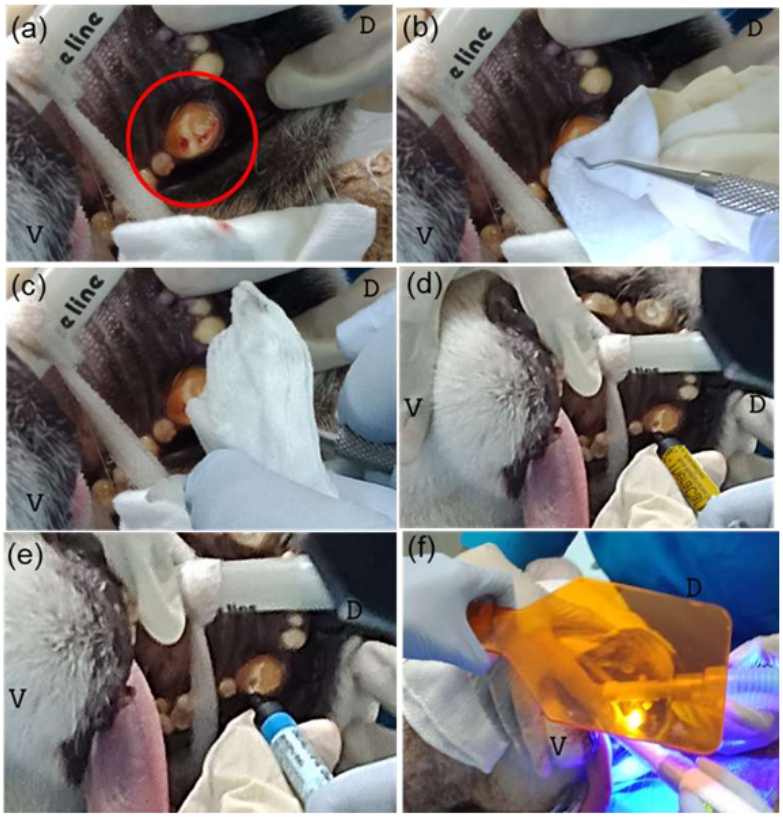

Figure 2 (a) Left upper canine tooth fracture exposing the pulp chamber. (b) Caries excavation using dentin excavator with gauze. (c) Pinpoint bleeding arrested (haemostasis achieved by pressure). (d) TheraCal LC (calcium silicate) placed as pulp capping. (e) Composite resin filling used as main filling for canine tooth fracture. (f) UV light used to harden the composite fillings. (Positioning: D, Dorsal; V, Ventral).

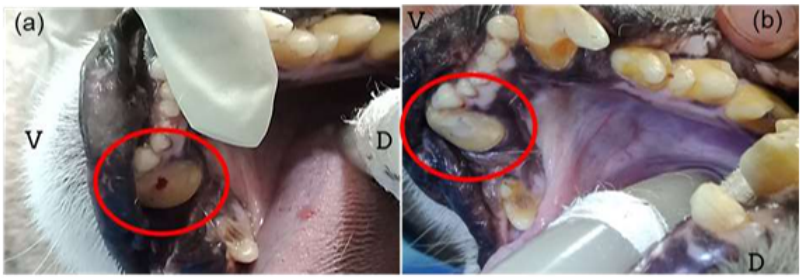

Figure 3 (a) Lower left canine fracture exposing pulp cavity. (b) Dental cavity filled with composite filling.

In this case, nutritional secondary hyperparathyroidism was suspected based on diet, clinical signs, and hypocalcemia but was not definitively diagnosed. All three causes, namely low calcium intake, high phosphorus consumption, and vitamin D deficiency, will diminish serum calcium concentration or hypocalcaemia. This mechanism causes the release of parathyroid hormone, which raises the calcium level in the blood by boosting calcium absorption from the intestine and intensifying calcium reabsorption from the kidney by preventing it from being expelled through urine. Aside from that, it will also increase the absorption of calcium from the bone by multiplying osteoclast activity within the bones and, in the really long term, progressive demineralisation of tooth or bone, resulting in weak

tooth or bone (Cooper and Gittoes, 2008; Neel et al., 2016). When the animal eats the bone, it fractures its dentals, exposing the pulp chamber, a soft tissue with blood vessels and nerves that attract bacteria. In the presence of food debris, bacteria produce acid, which causes greater tooth resorption. This will result in the formation of dental cavities. Both acid production and tooth caries formation produce pulp swelling and irritation, which presses on the nerve and causes pain (Neel et al., 2016), making the animal unwilling to feed and eventually leading to weight loss.

Fractured teeth were reported in 2.3% of captive wild cats at the Zoo of Brasilia City and 22.0% of wild cats in Namibia (Roux et al., 2009; Roza et al., 2009). Tooth fractures were also common in tigers and lions in Australian zoos, which were caused by feeding on huge, hard bits of bone that eventually became wedged between canine teeth (Whitten et al., 2019). There are three different approaches to managing difficult crown fractures in wildlife. The first option is tooth extraction and implantation. This procedure has been used in advanced countries with the latest technology, especially in manufacturing dentures expressly designed for wild animals. A recent report of tooth implantation was performed on *Panthera tigris*, which had a right upper canine issue (Muhoro, 2019). The dentures used were made of gold, which is one of the strongest metals. It may be the best solution in this circumstance after two complicated operations have been completed, but it is not relevant in most situations due to a lack of knowledge, technology, and facilities. Vital pulp therapy may be the preferred treatment for complex crown fractures (Wiggs and Lobprise, 1997). The treatment comprises removing roughly 5 millimetres of the exposed pulp, also known as coronal pulpectomy, to allow ample room for direct pulp capping and restoration, as well as medicating the remaining pulp to assist new dentin formation and to successfully restore the viable tooth (Niemiec, 2001).

Root canal therapy is an option for retaining periodontally sound strategic teeth compromised by pulp damage (Girard et al., 2006). The pulp is removed and replaced with a material that allows the tooth to operate normally without the risk of infection or pain. This method is a suitable choice to be employed because wild felids can use the tooth immediately afterwards, as there is no surgical site to worry about. However, there are currently insufficient facilities, and the treatment is a difficult procedure that requires prior training. The prognosis for this patient was favourable to fair. It's good since the exposed pulp chamber was coated in composite to lessen the danger of pain, inflammation, and infection while also allowing animals to feed comfortably. However, it might be fair if the composite that covered the pulp chamber cracked and revealed the pulp chamber again.

A standardized pain scoring system was not used for this case, and we acknowledge this as a limitation and recommend future cases should include objective pain assessment methods. However in general the animal was suspected to have chronic dental pain based on the clinical assessment such as low body condition (2.5/5), and the reduction body weight in 5 months from 34 to 27 kg, indicating animal had less eating and/or compromise the body function for digestion process due to pain and the evidence of stress leukogram could be suggestive of animal in pain. A proper dental examination such as dental radiograph is important for a suitable management plan and to follow-up the progression post-operatively because this could affect ability to fully assess root fractures, pulp status, or periapical pathology.

CONCLUSION

The case was diagnosed with a complicated crown fracture of bilateral upper and lower canine teeth. Weakness of tooth structure leading to fracture could be due to secondary hyperparathyroidism that caused by imbalance diet and husbandry. Future studies should recommend parathyroid hormone testing as part

of routine health assessments for captive carnivores. Captive animals should get sufficient sunlight and calcium supplements for the prevention of nutritional secondary hyperparathyroidism (NSH). Dental restoration by dental filling using a composite resin and silver was opted to reduce the risk of pain, inflammation and infection as well as to improve the quality of life. This case has a limitation such as lack of pain scoring, absence of radiographic examination and follow-up, and speculative NSH diagnosis. For future exercise should include objective pain assessment, routine dental radiography, and improved diet formulation as standard procedures for captive carnivores.

ACKNOWLEDGEMENTS

The author would like to express utmost gratitude to the private medical dentist, management and staff of Zoo Veterinary Hospital and Carnivore Section (Zoo Negara), and Avian and Exotic Animal Unit (AvEx), University Veterinary Hospital, Faculty of Veterinary Medicine (UPM) for the collaboration and support throughout the succession of the case.

AUTHOR CONTRIBUTIONS

The case of this puma was first attended by K.J. and M.N.R. After thorough dental inspection, it was decided the puma need invasive dental repair. The dental filling procedure were guided by medical dentist, assisted by K.J., M.N.R. and A.C.A. Consequently, A.C.A and R.R. conceived the idea of reporting the procedure and findings for this case. A.C.A, R.R. and M.F.R equally contributed on this case report–research; manuscript drafting; K.J. and M.N.R equally contributed on patient care and monitoring. All authors have checked the final draft.

CONFLICT OF INTEREST

All authors declare no conflict of interest.

REFERENCES

American Veterinary Dental College (AVDC). Available online: https://avdc.org/avdc-nomenclature/

Bellows, J., Berg, M.L., Dennis, S., Harvey, R., Lobprise, H.B., Snyder, C.J., Stone, A.E.S., Van de Wetering, A.G., 2019. 2019 AAHA Dental care guidelines for dogs and cats. J. Am. Anim. Hosp. Assoc. 55(2), 49-69.

D'Alessandro, C., Piccoli, G.B., Cupisti, A., 2015. The "phosphorus pyramid": a visual tool for dietary phosphate management in dialysis and CKD patients. BMC Nephrol. 16, 9.

Cooper, M.S., Gittoes, N.J.L., 2008. Diagnosis and management of hypocalcaemia. BMJ. 336, 1298-1302.

Dierenfield, E.S., Bush, M., Phillips, L., Montali, R., 1994. Nutrition, food preparation and feeding. In: Tilson, R., Brady. G., Traylor-Holzer, K., Armstrong, D. (Eds.), Management and conservation of captive tigers, Panthera tigris. Minnesota Zoo, Apple Valley, Minnesota.

DuPont, G.G., 2010. Problems with the dental hard tissues. In: Niemiec, B.A. (Ed.), Small animal dental, oral and maxillofacial disease: a colour handbook. Manson, London, pp. 127-156.

Girard, N., 2021. Fillings, crowns, and implants (issue 22.3-dental). Vet Focus, Royal Canin®. Available online:

https://vetfocus.royalcanin.com/en/scientific/fillings-crowns-and-implants. (Assessed on April 16, 2023).
Girard, N., Southerden, P., Hennet, P., 2006. Root canal treatment in dogs and cats. J. Vet. Dent. 23(3), 148–160.
Kitchener, A., 1991. The natural history of the wild cats. Comstock Publishing Associates, New York, pp. 280.
Kressin, D., Honzelka, S., 2023. Tooth cavities in dogs. Animal dentistry and oral surgery specialists LLC. eVetSites®. Available online: https://www.mypetsdentist.com/ tooth-cavities-in-dogs.pml. (Assessed on April 16, 2023).
Muhoro, N., 2019. Bengal tiger gets gold tooth and becomes coolest feline in the world. Available online: https://www.ibtimes.com/bengal-tiger-gets-gold-tooth-becomes-coolest-feline-world-2856872.
Neel, E.A.A, Aljabo, A., Strange, A., Ibrahim, S., Coathup, M., Young, A.M., Bozec, L., Mudera, V., 2016. Demineralization–remineralization dynamics in teeth and bone. Int. J. Nanomedicine. 11, 4743-4763.
Niemiec, B.A., 2001. Assessment of vital pulp therapy for nine complicated crown fractures and fifty-four crown reductions in dogs and cats. J. Vet. Dent. 18(3), 122-125.

Nielsen, C., Thompson, D., Kelly, M., Lopez-Gonzalez, C.A., 2015. Puma concolor. The IUCN Red List of Threatened Species. Available online: http://dx.doi.org/10.2305/IUC N.UK.2015-4.RLTS.T18868A50663436.en.
Roux, P., Berger, M., Stich, H., Schawalder, P., 2009. Oral examination and radiographic evaluation of the dentition in wild cats from Namibia. J. Vet. Dent. 26(1), 16-22.
Roza, M.R., Andrade, M.J., Almeida, D.C., Silva, L.A.F., Borges, T.R.J., Prieto, L.A., Souza, L.A.C., 2009. Prevalence of dental disorders in wild cats maintained at captivity in the Zoo of Brasilia City. Available online: https://www.vin.com/apputil/ content/defaultadv1.aspx?pId=11290&id=4252896&print=1
Sunquist, M., Sunquist, F., 2002. Wild cats of the world. University of Chicago Press, Chicago, Illinois, pp. 462.
Thrall, D.E., 2017. Textbook of veterinary diagnostic radiology, (7th edition). Elsevier, Missouri.
Vosburgh, K.M., Barbiers, R.B., Sikarskie, J.G., Ullrey, D.E., 1982. A soft versus hard diet and oral health in captive Timber wolves (Canis lupus). J. Zoo Anim. Med. 13(3), 104-107.
Whitten, C., Vogelnest, L., D'Arcy, R., Thomson, P., Phalen, D., 2019. A retrospective study of reported disorders of the oral cavity in large felids in Australian zoos. J. Zoo. Wildl. Med. 50(1), 16-22.
Wiggs, R.B., Lobprise, H.B., 1997. Advanced endodontic therapies. In: Wiggs, R.B., Lobprise H.B. (Eds), Veterinary dentistry: principles & practice. Lippincott-Raven, Philadelphia, pp. 337-339.

How to cite this article;
Kavitha Jayaseelan, Mat Naim Ramli, Rozanaliza Radzi, Mira Farhana Razlan, and Azlan Che-Amat. Composite resin and silver cavity filling for the canine teeth fracture in Puma *(Puma concolor)*. Veterinary Integrative Sciences. 2026; 24(1): e2026012-1-8.