| REVIEW ARTICLE |

Surgical treatment of traumatic injuries of land turtles

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Abstract

Tortoises belong to the order Testudines, and their shell, composed of the carapace and plastron, protects internal organs and represents a unique evolutionary adaptation. The shell is a rigid structure of bony plates connected to the spine and ribs, requiring a specific approach to diagnosing and treating injuries. The most common injuries in terrestrial tortoises include traffic accidents, dog bites, and thermal injuries. Shell fractures can be simple or complex and are often accompanied by injuries to internal organs. Diagnostic procedures rely on imaging methods such as radiography, CT scans, and ultrasound, while laboratory analyses assess the general health status. Surgical treatment methods include wound management with thorough irrigation using sterile solutions, debridement of necrotic tissue, and application of antimicrobial agents. Shell fixation is performed using techniques such as screws, wires, epoxy, and bone plates, ensuring fracture stability and protection of internal structures. Vacuum therapy accelerates healing and reduces recovery time, especially for wounds with significant tissue loss. Limb fracture stabilisation involves external fixators, intramedullary pins, and special mini-plates, tailored to the specific fracture types. A combination of techniques is used to maximise stability in complex fractures and improve the healing process. Each phase of treatment, from initial stabilisation to final postoperative care, is crucial for the successful recovery and preservation of functionality in terrestrial tortoises. Special attention is given to adapting environmental conditions, including optimal temperature and humidity, to ensure tissue regeneration and overall health. This review aims to describe the specific anatomy of the land turtles, the most common injuries, methods of diagnosing injuries, and surgical treatment techniques depending on the type of injury.

Key words: *traumatic injuries; diagnostic; treatment; tortoise*

Introduction

Turtles (*Chelonia)* belong to the subclass *Anapsida* and represent a unique group of reptiles that can be recognised by their characteristic shell, which provides the necessary protection for their internal organs (Mader and Divers, 2013; Nejedli, 2019). This group is evolutionarily older than many other reptile species, and they have been present on Earth for more than 200 million years, even before the appearance of most large dinosaurs (Nejedli, 2019; Hernandez et al., 2020).

Turtle categorisation is based on their ability to retract their heads into their shell. They are therefore divided into the suborders *Cryptodira* and *Pleurodira* (Mader and Divers, 2013; Nejedli, 2019). Turtles pull their heads straight back into their

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shells. Land turtles (*Testudinidae*), which belong to the suborder Testudinidae, mostly inhabit dry land areas and can be recognised by their firm, domed shell and robust limbs adapted for walking on the ground (Nejedli, 2019).

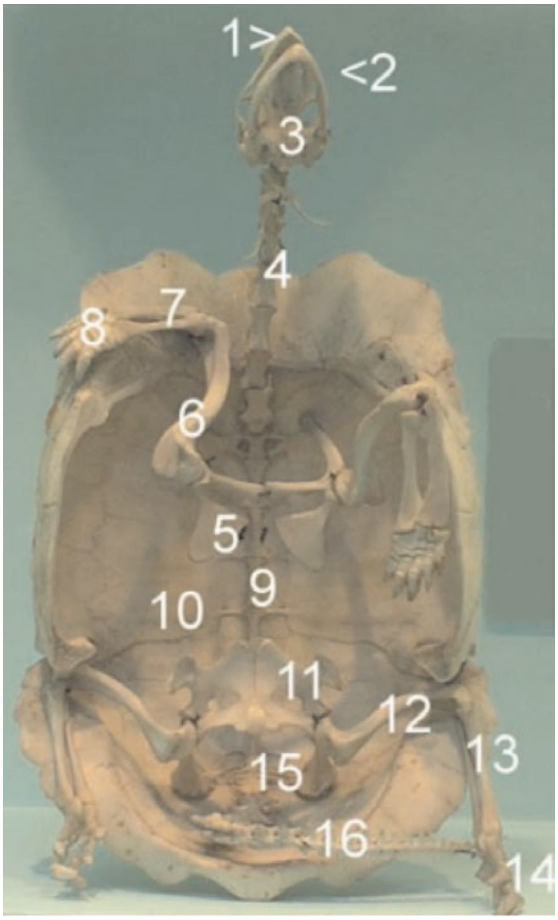
Despite their robust anatomy and natural adaptations that increase their resilience, land turtles are often exposed to traumatic injuries. The most common causes of injury include road traffic accidents, attacks by predators and falls from height (Mader and Divers 2013; Hernandez et al., 2020). Injuries that occur in this area usually include fractures of the shell, soft tissue damage and dislocations of the limbs. Such injuries require immediate veterinary intervention as turtles are susceptible to infection and injury-related stress (Hernandez et al., 2020).

The veterinary approach to treating injuries in tortoises is based on an understanding of their specific anatomy and physiology (Mader and Divers, 2013; Hernandez et al., 2020). For example, the carapace is criss-crossed by blood vessels and nerve fibres, which require special care when treating fractures. In addition, the slow metabolism can impair wound healing and recovery (Mader and Divers, 2013). In some cases, injuries require surgical intervention to ensure the stability of the shell and prevent further complications.

Correct thermoregulation is crucial for metabolic stability. Tortoises should be housed in an environment with an air temperature between 25 and 30°C, while night-time air temperatures should be maintained at a minimum of 20°C (Highfeld, 1996; McArthur et al., 2004).

This review describes the anatomy, most common injuries in land turtles, methods of injury diagnosis, and surgical treatment techniques.

Figure 1. Ventral skeletal anatomy: *Geochelone pardalis*, the plastron removed.



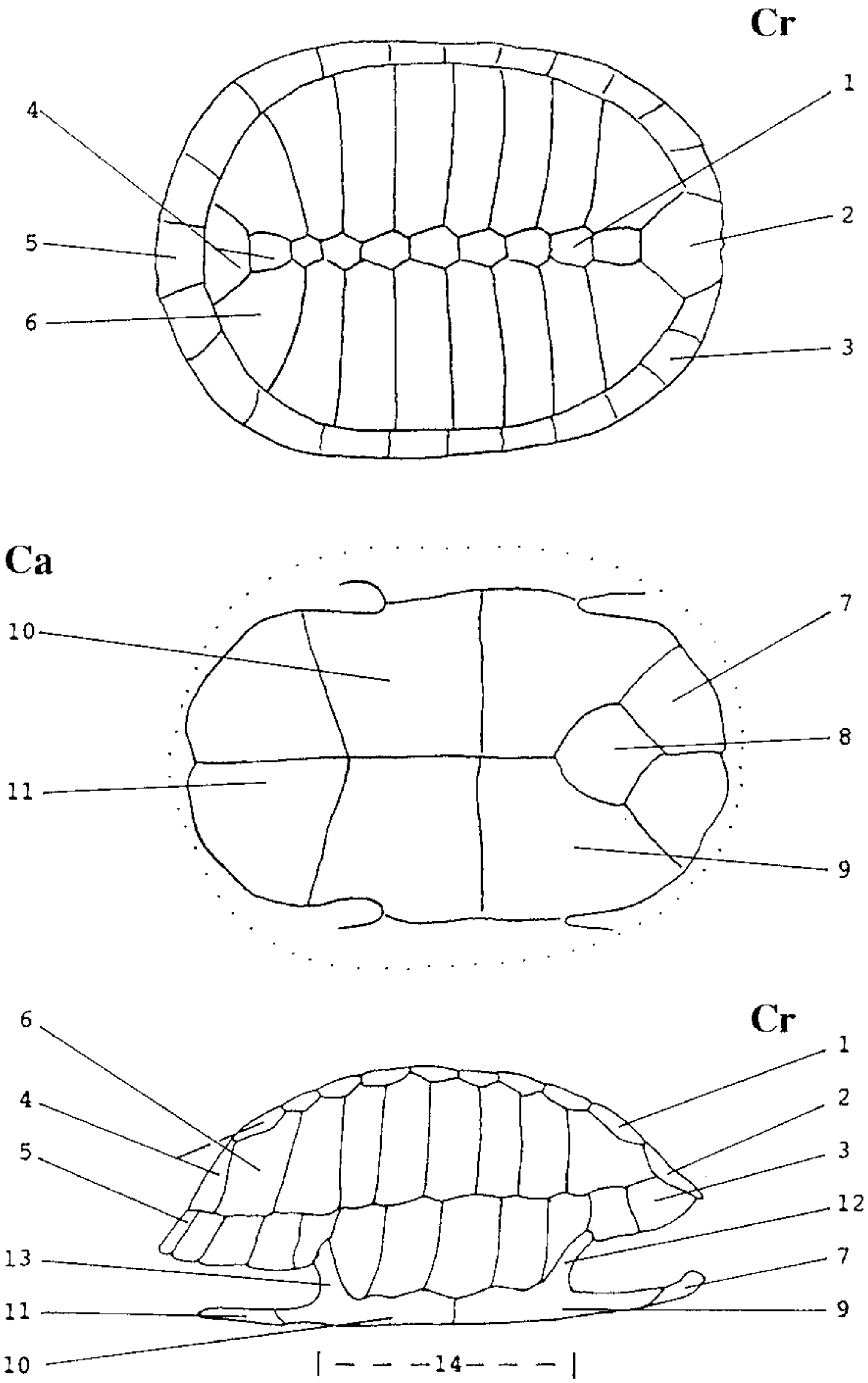
1. Rhamphotheca (jaw cover); 2. Mandibula; 3. Cranium; 4. Cervical vertebrae; 5. Scapula; 6. Humerus; 7. Radius and ulna; 8. Carpal bones; 9. Lumbar vertebrae; 10. Carapace; 11. Pubic bone; 12. Femur; 13. Tibia and fibula; 14. Tarsal bones; 15. Sacral vertebrae; 16. Caudal vertebrae (McArthur et al., 2004).

Anatomy of the locomotor system of turtles

The locomotor system of tortoises is a fascinating example of evolutionary adaptations that enable movement, stability and protection in their specific habitats (Bellairs, 1969; Hernandez et al., 2020). The skeletal system consists of an inner and an outer part. The inner part consists of the axial skeleton, which includes the skull, spine and ribs, and the suspensory skeleton, which contains the thoracic and pelvic limbs. The outer part consists of skin plates that form the carapace and plastron. Together, they form a characteristic carapace that protects the internal organs and ensures biomechanical stability (Hernandez et al., 2020). The vertebral column of turtles consists of a total of 40 to 50 vertebrae, which are divided into cervical, dorsal, sacral and caudal vertebrae. The special feature of this structure is that the dorsal vertebrae are fused to the inside of the carapace, further increasing the stability of the skeleton (Bellairs, 1969). The ribs, which are fused to the bony structure of the carapace, also contribute to the strength of the entire system (Pough et al., 2002). The anatomy of the skeleton is shown in Figure 1.

The dorsal convex part of the carapace consists of 38 paired and 12 or 13 unpaired dermal bones. The neural plates in the centre of the carapace are fused to the vertebrae, and on both sides laterally, bone plates are fused with the ribs (Nejedli, 2019). Eleven pairs of marginal bones and two unequal bones in the midline form the edge of the carapace. The plastron consists of one odd and four paired bones. The paired interclavicular bones are embedded in the unpaired cranial bones (entoplastron). Lateral to the entoplastron, we find the paired epiplastron bone, in which paired clavicles are incorporated. Caudally, we find paired hypoplastron

Figure 2. Anatomical structure of the shell.



1. Neural plates; 2. Cervical panel; 3. Peripheral panels; 4. Suprapigal plates; 5. Pigal plates; 6. Bone plates; 7. Epiplastron; 8. Endoplastron; 9. Hyoplastron; 10. Hypoplastron; 11. Xifiplastron; 12. Cranial Bridge; 13. Caudal bridge; 14. Bridge; Cr= cranial; Ca= caudal (McArthur et al., 2004).

Figure 3. Severe dog bite trauma in a Russian tortoise (*Testudo horsfieldii*) (McArthur, 2006).

and hyoplastron, and xifiplastron is the most caudal paired bone (Nejedli, 2019). The described anatomical structure of the shell is shown in Figure 2.

The pelvic and thoracic girdles are connected to the muscles inside the shell and help reinforce it. Turtles move using a pair of thoracic and a pair of pelvic limbs, and most terrestrial species have five claws on each limb (Nejedli, 2019). The claws are used for digging, making nests, and burying during hibernation. Land turtles are characterised by having short, stocky toes adapted to walking, and their movement is often accompanied by muscle sluggishness due to the way their limbs rotate to the side. The limbs are covered with plates or scales, contributing to their protection and adaptation to different habitat conditions (Nejedli, 2019).

Traumatic injuries

Traumatic injuries in land turtles represent a significant clinical problem in veterinary medicine. These injuries can affect the shell, soft tissues, and internal organs. They are usually caused by predator attacks, road traffic accidents, falls from height, thermal injuries or unsuitable housing conditions (McArthur et al., 2004; Hedley, 2017; Hollwarth, 2023). Each of these injuries has specific clinical signs, and their complexity requires detailed evaluation.

Attacks by predators, such as dogs (Figure 3), birds of prey or mammals, are the main causes of shell damage in land turtles. Turtles received after a predator attack often have deep wounds on the carapace and plastron, which can reach soft tissues and even internal organs. If the predator is large, the biting force can cause depressive fractures, penetrating injuries affecting the body cavity, as well as fractures of the carapace or plastron. Similar injuries can occur in tortoises that hibernate improperly outdoors, where they are often attacked by rats. In these cases, rats usually target the soft tissues in the leg area (Hollwarth, 2023).

Severe shell fractures are caused by car accidents, especially in urban and rural areas where turtles are exposed to vehicles. Turtles received after such injuries show signs of shock, intense pain and bleeding. Radiograph examinations often reveal multiple fractures of the carapace and plastron, while injuries to internal organs, such as the bladder and intestines, are present in more serious trauma (Highfield, 1996). Falls from heights, especially in home conditions, are another common cause of injury in land turtles. Such incidents often cause closed or open fractures of the shell, and in some cases, there is a luxation of the joints and other damage to the limbs. Turtles in such cases show lethargy, avoidance of movement, and loss of appetite (McArthur et al., 2004).

Fires are another serious cause of traumatic injuries in land turtles. According to Giraudo et al.

(2006), fires in France destroyed entire populations of the tortoise (*Testudo hermanni*). Turtles that survive fires often show severe thermal injuries on their shells and soft tissues. The shell can be carbonised, with deep burns penetrating the underlying tissue. Clinical signs include loss of appetite, dehydration, secondary infections, and tissue necrosis (Chitty and Raftery, 2013; Cousquer, 2020).

Injuries caused by lawnmowers and trimmers are less common but can occur if turtles hide in tall grass. Lawnmowers often cause plate separation and fractures of the carapace, and in severe cases, can lead to detachment of the upper part of the carapace along with the spine (Hollwarth, 2023).

Biaggini and Corti (2020) stated that proximity to human activities, especially agriculture, is one of the best predictors for the occurrence of shell injuries, including deep scratches, dents and deformations, with individuals with shell damage being reported 24% more often in such locations.

Traumatic injuries in land turtles can take many forms, from superficial fissures to penetrating wounds (McArthur et al., 2004; Chitty and Raftery, 2013). Turtles received after car accidents often show signs of hypovolemic shock, such as pale mucous membranes, lethargy, and tachycardia. Clinical examination reveals extensive deformation of the shell and exposed bone (Hedley, 2017). Tortoises that have suffered falls from a height or mechanical stress commonly show clinical signs, including haematomas, oedema, and abrasions (McArthur et al., 2004). Radiological images are necessary to confirm fractures or displacements of bone structures (Chitty and Raftery, 2013). In thermal injuries, the signs may develop slowly but ultimately lead to infection and tissue loss if not treated promptly (McArthur et al., 2004; Divers, 2020).

Diagnostic procedures

The diagnosis of a traumatic injury begins with taking a detailed history data that includes information about the circumstances of the injury, medical history, posture and eating habits, which is crucial for understanding the cause and severity of the injury (Chitty and Raftery, 2013). Appropriate hospitalisation conditions are essential for the reception of turtles as patients. Many need to be hospitalised so that they can be sedated for detailed examinations or diagnostic samples (McArthur et al., 2004). Critically ill patients require immediate care, while surgical patients are hospitalised before and after the procedure (McArthur et al., 2004; Chitty and Raftery, 2013).

The assessment of weight and body dimensions is only one aspect of the physical examination, including detailed tortoise observation, collection of medical history and a complete physical evaluation. Nevertheless, recording body weight and measurements is important for health status assessment. Length is most accurately measured as the length of the carapace midline in the United States or the straight length of the carapace in the United Kingdom. When measuring, shell curvature should not be accounted for (McArthur et al., 2004). Individual weight measurement has limited value, while monitoring changes over time may indicate dehydration, food intake, gestation period, urolithiasis, or disease. Weight loss can signal anorexia, cachexia, or fluid elimination (McArthur et al., 2004). Some authors have developed formulas for assessing health:

- Jackson (1980): Comparison of carapace weight and straight length for *Testudo hermanni* and *Testudo graeca* during hibernation.
- Donoghue (1996): Weight formulas:
  - weight (g) = 0.15 × MCL (mm^3) for healthy individuals.
  - weight (g) = 0.59 × (length × width × height) (cm^3) + 388 for *Geochelone agassizii,* where weight less than 10% of the predicted requires intervention.
- Jacobson et al. (1999) stated that an 8% weight loss during hibernation indicates disease.

Turtles with shell injuries require a thorough examination because injuries can damage deeper structures such as the spine, lungs, or body cavity, depending on their location (McArthur et al., 2004; Eatwell, 2015). It is necessary to assess the animal's mobility and examine the limbs, cloaca and head for possible signs of trauma or neurological problems (Chitty and Raferty, 2013; Eatwell, 2015). Puncture wounds that penetrate the body cavity or pulmonary fields should be specifically recorded as they may require additional evaluation (Eatwell, 2015). With damage to the lung fields, foamy, bloody or serous discharge caused by air escaping through the wound often occurs (Chitty and Raferty, 2013). Rinsing such wounds is not recommended (McArthur et al., 2004). Since turtles do not have a diaphragm, respiration is based on contractions of the smooth muscles of the lungs and skeletal muscles of the limbs, which allows respiration to continue even with injuries like this (Eatwell, 2015).

Imaging

Radiography is an essential tool for assessing bone structures in traumatic injuries. Standard ventrodorsal and lateral projections enable the visualisation of carapace and plastron fractures and the assessment of the position of bone fragments (Mader and Divers 2013). The advantage of X-rays is their speed and availability, while limitations include a lower resolution for soft tissue imaging (McArthur et al., 2004). Computed tomography (CT) provides superior resolution and three-dimensional analysis

Figure 4. Wet-dry bandage over the entire shell, with gauze soaked in sterile saline and then wrapped with a self-adhesive flexible bandage (Hollwarth, 2023).

of complex injuries. CT is used to detect carapace microfractures and to assess damage to lung fields or internal organs such as the liver and bladder (Chitty and Raferty, 2013). Although CT is more accurate than X-ray, its availability and cost can be limiting factors. Magnetic resonance imaging (MRI) is used less frequently in turtles, but it is useful for the detailed evaluation of soft tissues, including damage to muscles, ligaments, and internal organs. MRI provides information on tissue oedema and haematomas, in traumas where internal bleeding or soft tissue damage is suspected (Mader and Divers, 2013). Although not the first choice, MRI can be used for complex cases. Ultrasound is a non-invasive method used to evaluate soft tissues and internal organs. It is useful for detecting fluid in the abdominal cavity, retained eggs or haematomas (Chitty and Raferty, 2013). The advantages of ultrasound include accessibility and safety, while its limitations include lower resolution than CT and dependence on the operator's experience.

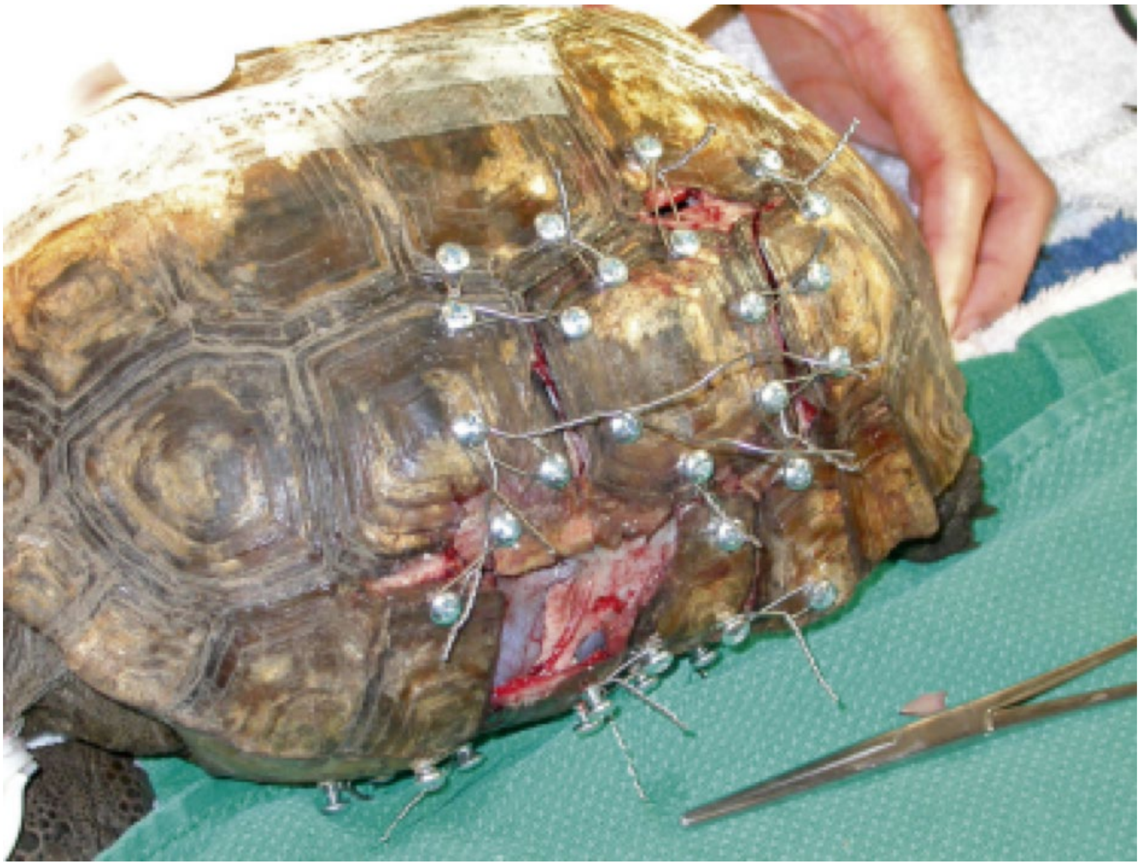
Surgical treatment of injuries in turtles

Wound treatment in turtles requires a specific approach due to their unique anatomy and physiology. The basic principles of wound treatment, such as cleaning, debridement and the application of topical agents, are similar to those of humans and other animals, but adapted to meet the needs of this group of reptiles (Mader and Divers, 2013; Hernandez et al., 2020).

It is necessary to rinse the wound thoroughly with sterile saline or Ringer's lactate to remove contaminants and reduce the risk of infection. When rinsing wounds with greater contamination, a diluted solution of chlorhexidine (0.05%) or povidone-iodine can be used, but after initial disinfection, it is recommended to switch to a sterile saline solution to avoid cytotoxicity (Cousquer, 2008; Hernandez et al., 2020). For wounds with impaired integrity of the coelomic cavity, the tortoise should be positioned so that gravity facilitates drainage of fluid and exudates ventrally (Mader and Divers, 2013). Removal of necrotic tissue and foreign bodies is essential to prevent infection and create a favourable base for healing. Regular removal of dead tissue promotes the healing process and reduces the possibility of complications (Hernandez et al., 2020).

The choice of topical agents depends on the condition and the stage of wound healing. Silver-based products, such as silver sulphadiazine and pH-balanced ionic silver solutions, have shown anti-

Figure 5. *Gopherus polyphemus* with a complex fracture. Multiple wires are tightened evenly to ensure a good fit of the shell fragments. On the lateral part of the carapace, one area is visible where part of the shell is missing (Mader and Divers, 2013).



microbial properties and accelerated wound healing (Cousquer, 2008; Hernandez et al., 2020). Honey is a natural antimicrobial agent with good results, but requires waterproof bandages to stay in place, especially in aquatic turtles. However, honey attracts insects, therefore, it is not suitable for outdoor conditions (Mader and Divers, 2013). Biological glass borate preparations, which promote angiogenesis, are applied to deep wounds with exposed bone and can be covered with antibiotic-impregnated bone cement for additional stabilisation (Hernandez et al., 2020). For deep wounds, doxycycline gel is often used, which remains stable even in water conditions, and can be additionally protected with a layer of superglue for water resistance (Cousquer, 2008).

For large wounds, the bandage can be secured with stitches or staples that hold the bandage in place. Waterproof bandages for aquatic species consist of gauze impregnated with petroleum jelly, the edges of which are closed with superglue and covered with waterproof tape. For larger wounds, the bandage can be fixed with umbilical tape threaded through sutures or staples (Cousquer, 2004). An example of a bandage can be seen in Figure 4.

Regular dressing changes and assessment of the condition of the wound are key to successful

Figure 6. Typical positions for orthopaedic plate placement include the central plastron or the area closer to the more mobile femoral or pectoral flaps. The plate provides firm longitudinal fixation, which other methods cannot provide, especially in cases of complete loss of the bone joint in the distal fragment (Eatwell, 2015).

Figure 7. Wound closure by vacuum method with the use of suction systems (Mader and Divers, 2013).

healing. In the initial stages of treatment, bandages should be changed daily to reduce contamination and promote healing. As the wound progresses, the change interval may be extended to weekly shifts until the wound is covered with healthy granulation tissue (Hernandez et al., 2020). The prognosis of recovery depends on the severity of the injury, the timeliness of the intervention and the general condition of the turtle. Minor injuries heal faster with proper care, while more complex wounds require a longer healing period and more intensive care. Timely and adequate wound treatment significantly increases the chances of a turtle's full recovery and return to the natural environment or the continuation of quality life in captivity (Cousquer, 2008; Mader and Divers, 2013).

Fixation of the shell

Shell injuries are divided into closed fractures, where internal structures are not exposed and which usually have a more favourable prognosis, open fractures involving exposure of internal tissues or organs and require immediate intervention due to the risk of infection, and complex fractures with multiple fractures or tissue loss, where the prognosis depends on the extent of the injury and the success of fixation (Mader and Divers, 2013; Hernandez et al., 2020). Thorough assessment of all fractures is crucial, stabilising the animal and cleaning the injured area.

Stainless steel screws and orthopaedic wires are most commonly used to stabilise fractures. The screws are placed in the healthy part of the shell at least 0.5 cm from the edge of the fracture to prevent breakage, and the wires are formed into eights to allow stabilisation and even pressure (Hernandez et al., 2020) (Figure 5). Plastic clamps in combination with epoxy are often used for simple fractures without major bone displacements. For treatment of more complex injuries, orthopaedic plates can be applied (Figure 6) that are glued with epoxy or special adhesives for additional stabilisation (Divers, 1998). For fractures with tissue loss, the use of porous bioactive glass and bone cement impregnated with antibiotics is recommended to fill the gaps and promote regeneration (Cousquer, 2008; Hernandez et al., 2020). With aquatic turtles, it is crucial to ensure the water resistance of fixation devices and wounds. Materials such as superglues and waterproof coatings are used for additional protection to prevent contamination in the water (Hollwarth, 2023).

The prognosis depends on the type of injury. Simple closed fractures usually recover within 4–6 weeks with proper stabilisation, while open fractures with tissue exposure require more time, usually 6–12 weeks, with infection control. Complex fractures with tissue loss have a cautious prognosis, while fractures involving the spine carry a poor prognosis due to possible neurological damage (McArthur et al., 2004; Mader and Divers, 2013).

Post-operative care includes regular monitoring of fixation devices, changing dressings and rinsing wounds with sterile saline solution to prevent complications such as infection or screw loosening. X-ray examinations are used to monitor the progress of healing, while the fixators are removed once complete stabilisation of the fracture has been confirmed (Eatwell, 2015; Hernandez et al., 2020).

Limb fractures

Stabilisation of limb fractures in land turtles is a challenging aspect of veterinary medicine, requiring adapted techniques and equipment. Turtles have a robust bone structure of limbs, but their anatomical uniqueness makes it difficult to apply conventional stabilisation methods.

One of the most commonly used techniques to stabilise the limbs is external fixators. This method involves Kirschner wires (K-wire) placed through the fractured bone and connected with metal rods or frames. K-wires are precisely inserted to avoid damage to soft tissue or joints, and their outer part is connected using annular or linear frames. The advantage of this technique is that it allows free access to the wound, which is especially useful in open fractures where regular care and rinsing are required. Properly installed external fixators ensure stability while providing minimal mobility required for physiological healing (Mader and Divers, 2013; Hernandez et al., 2020).

Intramedullary pins are applied in fractures on the proximal parts of the limbs, such as the femur or humerus. This technique involves inserting a metal rod inside the bone canal to achieve stability. Intramedullary pins are useful for closed fractures where soft tissue treatment is not required. This method allows firm stabilisation and reduces the risk of complications such as displacement of bone fragments during healing (Mader and Divers, 2013).

In specific fractures of the distal parts of the limbs or when smaller bones are present, a combination of techniques may be necessary, such as the use of mini-plates and screws. Stainless steel mini plates are placed directly on the surface of the bone and fixed with screws to ensure complete and rigid stabilisation. This technique is often combined with external fixators for stability in complex fractures (Eatwell, 2023).

Limb stabilisation techniques must be adapted to each case, taking into account the location and type of fracture and the tortoise's health status. Innovative combinations of methods and precise planning of surgical procedures significantly increase the success of treatment, confirmed by practical examples (Hollwarth, 2023).

Vacuum therapy

Mader and Divers (2013) describe vacuum therapy for wound closure (*Vacuum-Assisted Closure,* VAC). This method uses negative pressure to accelerate the healing of complex wounds. This method has proven effective in mammals and reptiles, and turtles are ideal candidates due to their calm nature and the anatomical shape of the shell, which makes bandaging easy. Although it requires more equipment than conventional methods, VAC therapy significantly shortens treatment time, which outweighs the cost of an extended hospital stay. VAC therapy in turtles is most often applied in complex shell injuries (carapace and plastron) that expose soft tissues. Such injuries usually occur due to trauma, rather than burns or infections. The use of therapy in the early phase of treatment allows for better results, while later it is possible to switch to traditional methods. The duration of therapy varies: in land turtles, it lasts from a few days to four weeks, while in sea turtles, the treatment can last more than a year, depending on the severity of the injury (Mader and Divers, 2013).

Negative pressure promotes healing by reducing oedema, removing exudate, increasing tissue perfusion and stimulating the formation of granulation tissue. VAC therapy exerts a mechanical force on the wound, acting macroscopically by pulling on the wound edges and microscopically by stretching the cells, which accelerates tissue regeneration and strengthens the immune response. In severe shell injuries, therapy can help to restore the lung tissue to the correct anatomical position and preserve the space of the coelomic cavity (Mader and Divers, 2013).

In VAC therapy, an open-cell foam is inserted into the wound, covered with an airtight dressing and connected to a suction device (Figure 7). Aids such as adhesive tape and silicone sealant are used to ensure a tight seal. The dressing must cover the shell a few centimetres beyond the wound to reinforce it. A suction device, such as the VAC Freedom system, allows precise pressure regulation and can work continuously or intermittently. Regular dressing changes and hygiene are key to avoiding complications (Mader and Divers, 2013).

VAC therapy is not suitable for injuries with exposed organs or blood vessels without adequate protection, or for patients with blood clotting disorders or neoplastic lesions. In addition, inadequately cleansed wounds can slow healing due to the formation of granulation tissue over necrotic tissue. VAC therapy in turtles offers a fast and effective solution for complex injuries, reducing treatment and hospitalisation times. The technique is easy to apply, and its success makes it a valuable method for treating shell injuries in turtles (Mader and Divers, 2013).

Conclusion

Turtles have a unique anatomical and physiological structure that requires specific approaches in the diagnosis and treatment of injuries. The most common injuries in tortoises include fractures of the shell and limbs caused by car accidents, dog bites and falls. Stabilisation of fractures is an important part of treatment and includes the use of external fixators, intramedullary rods and orthopaedic plates, depending on the type of fracture. Wound treatment includes irrigation, debridement and the administration of antimicrobial agents to prevent infection and accelerate healing. Fixation of the shell is done with screws, wires, epoxy and other materials that allow the fractures to be stabilised and the internal structures to be protected. The success of the treatment depends on timely intervention, the quality of post-operative care, and the adaptation of environmental conditions to ensure adequate recovery.

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> Kirurško liječenje traumatskih ozljeda u kopnenih kornjača

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Kopnene kornjače pripadaju redu Testudines, a njihov oklop, sastavljen od karapaksa i plastrona, pruža zaštitu unutarnjim organima te predstavlja jedinstvenu evolucijsku prilagodbu. Oklop je kruta konstrukcija izrađena od koštanih ploča povezanih s kralježnicom i rebrima, što zahtijeva specifičan pristup dijagnostici i liječenju ozljeda. Najčešće ozljede kopnenih kornjača uključuju prometne nesreće, ugrize pasa i toplinske ozljede. Prijelomi oklopa mogu biti jednostavni ili složeni te su često popraćeni ozljedama unutarnjih organa. Dijagnostički postupci oslanjaju se na slikovne metode kao što su radiografija,

CT i ultrazvuk, dok se laboratorijske pretrage koriste za procjenu općeg zdravstvenog stanja. Kirurške metode liječenja uključuju liječenje rana temeljitim ispiranjem sterilnim otopinama, debridman nekrotičnog tkiva i primjenu antimikrobnih sredstava. Fiksacija oklopa izvodi se tehnikama kao što su vijci, žice, epoksidne i koštane ploče, osiguravajući stabilnost prijeloma i zaštitu unutarnjih struktura. Vakuumska terapija ubrzava zacjeljivanje i smanjuje vrijeme oporavka, osobito kod rana sa značajnim gubitkom tkiva. Stabilizacija prijeloma ekstremiteta uključuje vanjske fiksatore, intramedularne igle i mini pločice, prilagođene vrsti prijeloma. U složenim slučajevima koristi se kombinacija tehnika da bi se postigla maksimalna stabilnost i omogućio proces ozdravljenja. Svaka faza liječenja, od početne stabilizacije do završne postoperativne njege, ključna je za uspješan oporavak i očuvanje funkcionalnosti kopnenih kornjača. Posebna se pažnja posvećuje prilagodbi uvjeta okoline, uključujući optimalnu temperaturu i vlažnost, kako bi se osigurala regeneracija tkiva i cjelokupno zdravlje. Cilj je ovog sustavnog pregleda opisati anatomiju, najčešće ozljede kopnenih kornjača, metode dijagnosticiranja ozljeda te opisati tehniku kirurškog liječenja ovisno o vrsti ozljede.

Ključne riječi: *traumatske ozljede, dijagnostika, liječenje, kopnena kornjača*