

# Journal of Engineering Research

ISSN 2764-1317

vol. 6, n. 4, 2026

## ... ARTICLE 14

Acceptance date: 04/05/2026

# LITERATURE REVIEW: PROSTHESES AND ORTHESES IN COMPANION ANIMALS

**Mariza Fordellone Rosa Cruz**  
State University of Northern Paraná

**Jessica Poliana de Melo**  
State University of Northern Paraná

**Mariane Helena Depizzol**  
State University of Northern Paraná

**Mileny Saemi Ito**  
State University of Northern Paraná

**Heloisa Arantes**  
State University of Northern Paraná

**Gabrielle Kaline Santos Giope**  
State University of Northern Paraná

**Anna Luiza Souza Mattar**  
State University of Northern Paraná

**Maria Fernanda Seghetto Vale**  
State University of Northern Paraná

**Ana Paula Millet Evangelista dos Santos**  
State University of Northern Paraná

**Flavia Debiagi**  
State University of Northern Paraná

**Celmira Calderón**  
State University of Northern Paraná



All content published in this journal is licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0).



**Abstract:** This literature review addresses the use of prostheses and orthoses in veterinary medicine, with a focus on the rehabilitation of companion animals. The study highlights the clinical and conceptual distinction between prostheses, used to replace amputated or missing body segments, and orthoses, external devices used to stabilize and protect preserved anatomical structures that exhibit functional impairment. Although dogs represent the species most frequently treated in clinical practice, there has been an expansion in the use of these devices for cats and birds, requiring specific anatomical and behavioral adaptations. Of particular note is the impact of advances in additive manufacturing, especially 3D printing, which has enabled the production of customized orthopedic devices with greater anatomical precision and lower cost. The appropriate use of these technologies improves joint stability, redistributes loads, and enhances patients' quality of life. However, therapeutic success depends on rigorous patient evaluation, the management of complications such as skin lesions, and multidisciplinary follow-up integrated with rehabilitation protocols.

**Keywords:** Veterinary Medicine. Orthopedics. Animal Rehabilitation. Orthopedic Devices. 3D Printing.

## 1 INTRODUCTION

The use of orthoses and prostheses in veterinary medicine has been progressively incorporated into clinical practice, especially in the field of small animal rehabilitation. These devices are designed to aid in the restoration of locomotor function, provide joint stability, reduce pain, and improve the quality of life for patients with

orthopedic or neurological impairments (MICH, 2014; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015). In general, orthoses are external devices used to stabilize or support preserved anatomical structures, while prostheses are used to partially or fully replace lost body segments, usually following traumatic or surgical amputations (MICH, 2018).

In small animal practice, dogs are the species most frequently treated with orthopedic assistive devices, due to the higher incidence of orthopedic diseases and trauma in this species, as well as the greater demand for treatments that preserve the mobility and well-being of these patients (ARAUZ et al., 2021). Among the main indications for the use of prostheses and orthoses are distal limb amputations, ligament instabilities, tendon injuries, congenital deformities, and degenerative conditions that compromise locomotion (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

Historically, the application of these devices in veterinary medicine was initially inspired by technologies developed for human medicine. However, anatomical, biomechanical, and behavioral differences between humans and animals required significant adaptations in the design and functionality of prostheses and orthoses intended for veterinary patients (MICH, 2018). Thus, the evolution of this field has involved the development of specific devices for different species, body sizes, and locomotion patterns.

In recent years, technological advances, especially in the fields of biomedical engineering and additive manufacturing, have contributed significantly to the improvement of these devices. Three-dimensional printing (3D printing) has emerged

as a promising tool, as it enables the production of customized prostheses with greater anatomical precision, lower cost, and faster manufacturing (MEMARIAN et al., 2022). Furthermore, the use of active materials and innovative biomaterials has expanded the possibilities for developing devices that are lighter, more durable, and adaptable to the specific needs of each patient (MEMARIAN et al., 2022).

3D printing has also been successfully applied to different animal species. Studies report, for example, the use of three-dimensionally printed orthopedic prostheses for domestic and wild birds, demonstrating that the technology can be adapted to different clinical and anatomical contexts, expanding therapeutic possibilities within veterinary medicine (CARVALHO et al., 2024). These advances indicate a growing trend toward the customization of orthopedic devices, allowing for greater compatibility with each patient's biomechanical characteristics.

Despite the potential benefits, the use of prostheses and orthoses in animals is also associated with significant clinical challenges. Complications such as skin lesions, pressure points, infections, discomfort, or improper fitting may occur when the device is not correctly adjusted or when clinical follow-up is not performed adequately (ROSEN et al., 2022). Thus, careful patient evaluation, periodic monitoring, and adjustments to the device are fundamental aspects for ensuring therapeutic success.

Retrospective and prospective studies have sought to evaluate the efficacy and complication rates associated with the use of these devices. A multicenter analysis of socket-type prostheses in dogs with partial amputations demonstrated that many patients show significant improvement in mobility and limb

weight-bearing capacity after adaptation to the prosthesis, although frequent adjustments and clinical follow-up are necessary to optimize outcomes (WENDLAND et al., 2019). These findings reinforce that the patient's adaptation to the device is a gradual process and that success depends on the integration of technology, clinical management, and functional rehabilitation.

In addition to their role in replacing amputated limbs, orthoses have also been widely used as part of conservative rehabilitation protocols, especially in cases of ligament instability or musculoskeletal injuries where surgical intervention is not indicated or needs to be postponed (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015). In such cases, these devices can aid in load redistribution, limit harmful movements, and promote tissue healing.

In general, the scientific literature demonstrates that prostheses and orthoses represent relevant therapeutic tools within veterinary orthopedics and rehabilitation. When correctly indicated, fabricated, and monitored, these devices can significantly contribute to functional recovery and improved quality of life for animals with permanent or temporary locomotor limitations (ARAUZ et al., 2021; ROSEN et al., 2022). Given this scenario, it is observed that the integration of veterinary medicine, biomedical engineering, and materials technology tends to further expand the potential of these therapeutic approaches. The development of new materials, manufacturing techniques, and biomechanical evaluation methods is expected to continue driving the advancement of veterinary prostheses and orthoses, consolidating their role within modern veterinary medicine (MEMARIAN et al., 2022).

## 2 WHAT ARE PROSTHESES

Prosthetics can be defined as devices developed to partially or fully replace a body part that has been lost or has impaired function. In veterinary medicine, these devices are primarily used to replace segments of amputated or missing limbs resulting from trauma, congenital malformations, orthopedic diseases, or surgical procedures that required resection of anatomical structures (MICH, 2018; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015). The primary goal of a prosthesis is to restore, even if only partially, the limb's functional capacity, thereby improving locomotion, redistributing body weight, and reducing the biomechanical changes resulting from limb loss.

In veterinary clinical practice, the most commonly used prostheses are exoprostheses, which are external devices adapted to the stump of the residual limb. These prostheses function as an artificial extension that allows contact with the ground and assists in weight-bearing during locomotion (MICH, 2014). In addition to these, there are also more advanced systems, such as osseointegrated devices, in which a metal implant is directly fixed to the remaining bone, allowing a connection between the animal's skeleton and the external prosthesis. Although promising, these technologies are still less common in routine veterinary practice and require more complex surgical procedures (ARAUZ et al., 2021).

In small animal medicine, especially in dogs, prostheses are primarily indicated in cases of partial or distal amputations, when there is a residual limb segment that allows for proper fitting of the device. The presence of this residual segment is important to

ensure stability, allow the prosthesis to fit, and facilitate force transmission during gait (WENDLAND et al., 2019). When the stump is sufficiently long, has good soft tissue coverage, and is free of significant pain, the chances of successful adaptation to the device tend to be higher.

Although many dogs are able to adapt relatively well to walking on three limbs following a complete amputation, some patients may exhibit significant biomechanical changes, such as overloading of the remaining limbs, postural imbalance, and an increased predisposition to developing secondary orthopedic problems. In such cases, the use of prostheses can help improve gait symmetry, reduce overload on other joints, and promote a more balanced distribution of forces during movement (ARAUZ et al., 2021; ROSEN et al., 2022).

Prosthetics can also be classified in different ways, considering criteria such as anatomical location, extent of replacement, or method of attachment. There are prostheses designed for thoracic or pelvic limbs, models intended for distal and h e replacements, and others designed for longer segments of the limb. Additionally, some devices can be used temporarily, especially during the initial adaptation process, while others are developed for permanent use (MICH, 2018).

It is important to note that the goal of veterinary prostheses is not always to completely replicate the anatomy or function of the lost limb. In many cases, the primary purpose of the device is to provide a functional support surface capable of allowing the animal to perform basic daily activities, such as walking, standing up, sitting down, and maintaining body balance (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR,

2015). Thus, treatment success is more closely related to the patient's functionality and comfort than to the exact anatomical reproduction of the limb.

The indication for the use of prostheses must consider various clinical and biomechanical factors. Among the main aspects evaluated are the condition of the limb stump, the quality of soft tissue coverage, the presence of pain or local hypersensitivity, the animal's body weight, the level of physical activity, and the guardian's ability to provide the necessary care during the adaptation period (ROSEN et al., 2022). Well-formed stumps, with good muscle coverage and no bony irregularities, tend to adapt better to the device. On the other hand, conditions such as adherent scars, bony irregularities, skin inflammation, or ulcerations can hinder the fitting of the prosthesis and increase the risk of complications. In such cases, surgical corrections or specific adjustments may be necessary prior to device fitting to improve local conditions and increase the chances of therapeutic success (WENDLAND et al., 2019).

Another key aspect is that the use of prostheses must be integrated into a functional rehabilitation program. After the initial fitting of the device, many patients require a period of progressive training to relearn how to use the artificial limb efficiently. This process may involve muscle strengthening exercises, gait reeducation, body weight control, and frequent monitoring of the skin in the area of contact with the prosthesis (MICH, 2014). Therefore, veterinary prostheses should be understood as part of a multidisciplinary therapeutic approach, involving orthopedics, surgery, physical therapy, and continuous clinical follow-up. When correctly indicated, fabricated, and monitored,

these technologies can significantly contribute to functional recovery and improved quality of life for animals with amputations or partial limb loss (ARAUZ et al., 2021; ROSEN et al., 2022).

### 3 WHAT ARE ORTHESSES

Orthoses are external devices used to support, align, stabilize, protect, or assist the movement of body structures that are still present but exhibit some degree of functional impairment. Unlike prostheses, which replace missing body parts, orthoses act on preserved limbs or joints, with the aim of improving biomechanical function, reducing pain, and preventing the worsening of musculoskeletal injuries (MICH, 2014; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

In veterinary medicine, these devices are widely used in orthopedic and neurological rehabilitation processes, especially in small animals. Orthoses can be applied to different joints, such as the carpus, tarsus, knee, and, in some cases, the elbow or digital joints, depending on the location of the injury or joint instability (MICH, 2018). Their use has been described primarily in dogs, due to the higher incidence of orthopedic diseases in this species and the growing search for therapeutic alternatives that preserve patients' mobility and quality of life.

Among the main clinical indications for the use of orthoses are ligament injuries, joint instabilities, tendon ruptures or strains, angular deformities of the limbs ( , neurological deficits that compromise support or proprioception, and degenerative joint processes, such as osteoarthritis (MARCELLIN-LITTLE; LEVINE; CA-

NAPP JUNIOR, 2015). In addition, these devices can also be used as mechanical support during the postoperative period, aiding in the protection of healing structures and contributing to the functional recovery of the limb.

The veterinary literature describes orthoses as promising therapeutic tools, especially in situations where a less invasive approach than surgical intervention is sought or when surgery is not indicated. In certain cases, these devices can be used as a conservative alternative to surgical treatment or as a complement to physical therapy rehabilitation programs (MICH, 2014). However, the authors emphasize that treatment success depends on factors such as appropriate indication, custom fabrication of the device, progressive patient adaptation, and continuous clinical monitoring.

Orthoses can be classified as static or dynamic, according to their mechanical function. Static orthoses are designed to restrict or limit joint movements, providing greater stability to injured structures and promoting the healing process. Dynamic orthoses, on the other hand, allow for a controlled degree of movement, aiding in the gradual return of limb function and gait reeducation during the rehabilitation process (MICH, 2018). This distinction is important because some patients may initially require more rigid immobilization and later benefit from devices that allow for controlled mobility.

Among the main clinical purposes of orthoses are the protection of healing tissues, the reduction of mechanical stress on injured ligaments and tendons, control of excessive movements such as joint hyperextension or hyperflexion, correction of structural misalignments, and assistance

with locomotion in patients with neurological deficits (ROSEN et al., 2022). Thus, these devices can help improve joint stability, reduce pain, and minimize biomechanical compensations that could lead to the development of secondary changes in other joints.

Another relevant aspect is that orthoses can be used in both conservative treatments and during the postoperative period. In patients with surgical contraindications, whether due to advanced age, the presence of comorbidities, or the guardian's financial limitations, these devices can represent a viable therapeutic alternative to improve locomotor function and provide greater comfort to the animal (MARCELLIN-LITTELE; LEVINE; CANAPP JUNIOR, 2015). In surgical cases, the orthosis can act as an auxiliary resource in protecting the repair performed, offering additional mechanical support during the recovery process.

However, just as with prostheses, the use of orthoses is not without clinical challenges. Complications such as skin irritation, pressure point formation, discomfort, or difficulty adapting may occur when the device is not properly fitted or when clinical follow-up is not adequately performed (ROSEN et al., 2022). For this reason, it is recommended that the patient be evaluated periodically to verify adaptation to the device, make necessary adjustments, and monitor possible changes in the skin or in gait biomechanics.

Therefore, orthoses represent an important tool in veterinary orthopedics and rehabilitation, providing mechanical and functional support for various clinical conditions. When correctly indicated and integrated into a rehabilitation program, these technologies can significantly contribute to

improving joint stability, locomotor function, and quality of life in animals with musculoskeletal or neurological conditions (MICH, 2014; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

## 4 DIFFERENCE BETWEEN PROSTHESES AND ORTHESES

The conceptual distinction between prostheses and orthoses is fundamental in veterinary orthopedics and rehabilitation, as these devices serve different therapeutic purposes, although they are often discussed together in the specialized literature. In general, a prosthesis is a device designed to replace a missing body part, while an orthosis is used to support, stabilize, or assist a body structure that is still present but exhibits some degree of dysfunction or instability (MICH, 2014; MICH, 2018).

In the clinical context, prostheses are most frequently associated with situations involving amputation or the loss of a limb segment, whether due to trauma, disease, or congenital malformation. In these circumstances, the prosthetic device aims to partially replace the function of the lost limb, providing weight-bearing support, improving the distribution of body loads, and contributing to the recovery of the patient's locomotor capacity (ARAUZ et al., 2021). In contrast, orthoses are primarily indicated in cases where the limb is preserved but exhibits joint instability, ligament injuries, structural deformities, or neurological deficits—situations in which the device acts to assist or control the movement of the affected structure (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

This conceptual difference also directly influences the clinical evaluation and therapeutic planning process. In the case of prostheses, the clinical analysis focuses primarily on the characteristics of the limb stump, including its length, shape, soft tissue coverage, sensitivity, and ability to withstand pressure during weight-bearing. These factors are critical for the successful fitting of the device and for the patient's functional adaptation (WENDLAND et al., 2019). In the case of orthoses, however, the evaluation primarily involves the degree of stability of the affected joint, the limb's movement pattern, the presence of pain or inflammation, and the need for movement restriction or assistance (MICH, 2018).

Furthermore, the therapeutic objectives of each device also differ. While the prosthesis serves a replacement function, aiming to partially restore the function of a missing limb, the orthosis serves an assistive or corrective function, acting to preserve or optimize the function of an anatomical structure that still exists. Thus, the primary focus of a prosthesis is to restore the ability to bear weight and move after the loss of a body segment, while an orthosis seeks to stabilize joints, protect injured tissues, and allow controlled movement during the functional recovery process (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

From a biomechanical perspective, the differences between the two devices are also reflected in the patient's adaptation process. When adapting to prostheses, one of the main challenges involves proper socket fit and the redistribution of loading forces, ensuring that the device provides stable support without causing discomfort or skin injuries (ROSEN et al., 2022). With orthoses, however, the main concern relates to

controlling joint movement, stabilizing injured structures, and preventing complications resulting from prolonged compression or friction on the skin (MICH, 2014).

The choice between a prosthesis or an orthosis therefore depends on an accurate diagnosis and a detailed clinical evaluation, which considers not only the patient's anatomical condition but also factors such as age, body weight, level of physical activity, presence of associated diseases, and the caregiver's ability to monitor the treatment (ARAUZ et al., 2021). In some cases, the use of orthoses can help prevent or delay more invasive surgical interventions, especially when used as part of conservative treatment protocols. In other situations, particularly following partial amputations, prostheses can significantly contribute to the recovery of functionality and the reduction of biomechanical overloads on remaining limbs (WENDLAND et al., 2019).

Thus, although prostheses and orthoses have distinct functions, both devices share a common goal within veterinary medicine: to promote functional rehabilitation, reduce pain, and improve the animals' quality of life. When correctly indicated and integrated into multidisciplinary rehabilitation programs, these technological resources represent important therapeutic tools in contemporary veterinary orthopedics (MICH, 2018; ROSEN et al., 2022).

## 5 APPLICATIONS IN COMPANION ANIMALS

In companion animals, especially dogs and cats, the use of prostheses and orthoses has established itself as a relevant therapeutic alternative for restoring mobility and improving the quality of life of patients with musculoskeletal or neurological con-

ditions. These devices are used to restore or assist locomotor function, reduce pain, and allow the animal to resume daily activities with greater comfort and stability (MICH, 2014; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

Prosthetics are primarily indicated in situations involving partial limb loss, such as traumatic amputations, congenital defects, sequelae of bone infections, surgically treated neoplasms, or distal malformations. In these circumstances, the prosthetic device can help partially restore weight-bearing capacity and improve the distribution of body loads during locomotion (ARAUZ et al., 2021). In many cases, especially when amputation occurs in distal regions, the prosthesis allows the patient to once again use the affected limb as a functional support point.

Orthoses, in turn, have a wide range of applications in various clinical conditions where the limb is still present but requires mechanical support or movement control. Among the most common indications are ligamentous instabilities, carpal hyperextension, tendon and ligament injuries, paresis or neurological deficits, angular deformities of the limbs, and situations in which it is necessary to limit or direct joint movements during the recovery process (MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015). These devices can act to stabilize joints, reduce mechanical overload, and promote proper limb alignment during weight-bearing.

In addition to their locomotor purpose, prostheses and orthoses can play an important role in reducing pain, preventing the progression of deformities, and protecting tissues during the healing process. These devices can also facilitate the patient's participation in physical therapy and func-

tional rehabilitation programs, allowing therapeutic exercises to be performed with greater safety and stability (MICH, 2018). In dogs undergoing conservative or postoperative treatment, for example, the use of orthoses can help limit undesirable joint movements, promoting the healing of injured ligaments or tendons.

In the case of prostheses, the primary clinical objective relates to the redistribution of body weight and the attempt to restore, as much as possible, a functional gait pattern. Although the prosthesis does not completely replicate the anatomy or biomechanics of the natural limb, it can provide sufficient support to improve balance, reduce excessive compensations, and facilitate the patient's movement (ARAUZ et al., 2021).

Despite the potential benefits, the scientific literature highlights that the use of these devices is not without limitations. A prospective study involving dogs fitted with custom orthoses and prostheses demonstrated that a significant proportion of patients experienced some type of complication during treatment, the most frequent being pressure-related skin lesions, mechanical problems related to the device, and difficulties with acceptance by the animal (ROSEN et al., 2022). Nevertheless, patients with proper adaptation showed promising results regarding locomotion and rehabilitation.

## 6 SPECIES TREATED

Dogs represent, by far, the most studied and treated species in the field of veterinary prosthetics and orthotics. This predominance is related both to the high frequency of clinical cases involving orthopedic conditions in this species and to the greater demand for rehabilitative treatments

by pet owners. Several multicenter studies, retrospective analyses, and scientific reviews focus on dogs with partial amputations, joint instabilities, ligament injuries, and other musculoskeletal conditions that compromise locomotion (WENDLAND et al., 2019; ARAUZ et al., 2021). Thus, much of the currently available knowledge on the use of these devices has been built upon clinical experience and studies conducted with this species.

Among the factors contributing to this predominance are the diversity of breeds, sizes, and activity levels observed in dogs, which generates a wide variety of biomechanical and clinical challenges. Small, medium, and large-sized animals exhibit significant differences in weight distribution, gait patterns, and joint loading. On the other hand, cats have also been receiving increasing attention, albeit in smaller numbers. The behavioral characteristics of felines can pose an additional challenge to adaptation to the device. Many cats have lower tolerance for frequent handling or prolonged use of external devices and may resist the adaptation process. Thus, the introduction of orthoses or prostheses in cats generally requires a gradual approach, careful selection of materials, and constant monitoring to ensure the animal's comfort and acceptance (MICH, 2014).

In recent years, companion birds and birds kept in rehabilitation centers have also begun to appear more frequently in the scientific literature related to the use of veterinary prostheses. Advances in manufacturing technologies, especially 3D printing, have enabled the development of highly customized devices adapted to the anatomical characteristics of these species (CARVALHO et al., 2024). A recent study described

the development of 3D-printed orthopedic prostheses for domestic and wild birds with amputations or malformations of pelvic limbs, demonstrating improvements in locomotion, weight distribution, and quality of life.

Within the clinical context of companion animals, however, dogs, cats, and birds remain the groups most directly involved in routine care. The growing evolution of manufacturing technologies, combined with the development of new biomaterials and digital modeling methods, has expanded the possibilities for adapting these devices to different species and clinical needs. Thus, patients who were previously considered to have no practical possibility of functional rehabilitation now have new therapeutic prospects, reflecting the continuous advancement of veterinary rehabilitation medicine (ARAUZ et al., 2021; MEMARIAN et al., 2022).

## 7 TECHNOLOGIES INVOLVED: 3D PRINTING

Three-dimensional (3D) printing represents one of the most significant technological advances in the development of veterinary prostheses and orthoses in recent decades. This technology enables the fabrication of highly customized devices, produced based on each patient's specific anatomical data. The information required for modeling can be obtained through various methods, such as 3D scanning, detailed photographs, and computed tomography.

In veterinary orthopedics, 3D printing is not used solely for the fabrication of prostheses and orthoses. The technology has also been applied to the production of three-dimensional anatomical models, customi-

zed surgical guides, and patient-specific orthopedic implants. These resources can aid in surgical planning, in understanding the anatomical structures involved, and in the more precise execution of complex orthopedic procedures (MEMARIAN et al., 2022). Thus, 3D printing has significantly expanded therapeutic possibilities within modern veterinary medicine.

In the case of dogs with partial amputations, additive manufacturing has enabled the development of highly customized exoprostheses, designed based on digital modeling and, in some cases, combined with biomechanical gait analysis. Scientific reviews on canine prostheses highlight that the use of tools such as computer-aided design (CAD), digital modeling, and motion analysis can help improve the fit of the device, increase its stability, and optimize force distribution during weight-bearing (ARAUZ et al., 2021).

The process of developing a 3D-printed device involves several technological steps. Initially, the patient's anatomical measurements are acquired, followed by the digitization of the region of interest. Next, modeling is performed using specialized software, in which the device is designed according to the necessary biomechanical characteristics. After this stage, the appropriate material is selected and the device is produced using a 3D printer, followed by fit testing and any necessary design modifications (MEMARIAN et al., 2022).

Among the materials most commonly used in the printing of veterinary orthopedic devices are thermoplastic polymers, resins, and lightweight composites, selected based on properties such as mechanical strength, flexibility, weight, and comfort. The choice of material is critical to ensure that the

device is sufficiently rigid to withstand the forces generated during locomotion, yet at the same time exhibits a certain degree of flexibility to prevent discomfort or pressure injuries to the animal's skin (MEMARIAN et al., 2022).

## 8 ADVANTAGES AND LIMITATIONS

The use of prosthetics and orthotics in companion animals offers several clinical advantages, particularly in the context of orthopedic and neurological rehabilitation. Among the main benefits described in the literature are the potential improvement in mobility, the reduction of compensatory overload on the remaining limbs, increased patient comfort, and the possibility of tailoring treatment to the anatomical and functional characteristics of each animal (MICH, 2014; ARAUZ et al., 2021).

In veterinary medicine, this customization is particularly important, given the wide variation in body size, anatomical conformation, and locomotor patterns among different species and breeds. The customization of devices allows prostheses and orthoses to be designed according to factors such as body weight, activity level, limb shape, and the patient's clinical condition. This process helps improve the fit of the device, increase stability during weight-bearing, and reduce the risk of complications associated with excessive pressure or biomechanical misalignment.

In the case of prostheses, one of the main advantages relates to the possibility of improving body weight redistribution in animals that have undergone partial amputations. By providing an additional point of support during locomotion, the device can

help reduce chronic overload on remaining joints and muscles, thereby lowering the risk of developing secondary changes associated with compensatory gait (ARAUZ et al., 2021). This aspect is particularly relevant in young or highly active animals, in which maintaining limb mobility and functionality can significantly impact quality of life.

Despite these benefits, the scientific literature also highlights several limitations and challenges associated with the use of veterinary prostheses and orthoses. One of the main obstacles is the still relatively limited amount of clinical evidence available when compared to human medicine. Many published studies consist of case reports or clinical series with a small number of patients, which makes it difficult to compare different devices, materials, and rehabilitation protocols (MEMARIAN et al., 2022).

The animal's adaptation to the device also represents a critical aspect for treatment success. Not all patients immediately accept the use of prostheses or orthoses, and a period of gradual adaptation is often necessary. In some cases, the animal may require weeks of gradual conditioning before tolerating the device for longer periods. This process may involve functional training, physical therapy, and constant monitoring of the skin in contact areas (MICH, 2014).

The patient's behavioral profile must also be considered when prescribing the device. Animals that are very agitated, anxious, or have low tolerance for handling may have greater difficulty adapting, which can compromise therapeutic success. Similarly, the owner's active participation in managing the device—including proper placement, cleaning, monitoring for potential pressure points, and follow-up for adjustments—is essential to ensure good clinical outcomes.

Another significant challenge relates to the lack of standardized, large-scale follow-up protocols, which underscores the need for individualized approaches for each patient.

## 9 FINAL CONSIDERATIONS

The current scientific literature demonstrates that the use of prostheses and orthoses constitutes a rapidly developing field within veterinary medicine focused on companion animals. Most available studies focus on dogs, which represent the species most frequently treated in orthopedic rehabilitation programs, while cats and birds appear less frequently in scientific publications (ARAUZ et al., 2021; MARCELLIN-LITTLE; LEVINE; CANAPP JUNIOR, 2015).

In general, prostheses are indicated to replace missing body segments, mainly following amputations, while orthoses are used to support, align, or stabilize preserved anatomical structures that exhibit functional impairment (MICH, 2018). When correctly indicated, these devices can contribute significantly to functional rehabilitation, improved mobility, and an enhanced quality of life for patients.

Therapeutic success, however, depends on factors such as adequate clinical evaluation, individualized device planning, progressive adaptation of the animal, and continuous monitoring by the veterinary team and guardians (ROSEN et al., 2022).

Despite technological advances and growing scientific interest, there remains a need for more clinical evidence, especially in species other than dogs. Many of the available studies consist of case reports or clinical series with a small number of patients,

which limits comparisons between different types of devices and therapeutic protocols. In this context, future research using more robust methodologies could help establish clearer criteria for indication, standardize fitting protocols, and define objective indicators of therapeutic success (MEMARIAN et al., 2022).

Development in this field also depends on integration across different fields of knowledge. Collaboration between veterinary medicine, biomedical engineering, biomechanics, materials science, and functional rehabilitation plays a fundamental role in improving devices and developing more efficient technological solutions. This interdisciplinary interaction tends to favor the creation of lighter, more durable, and personalized devices, continuously improving clinical outcomes and expanding therapeutic horizons for companion animals with locomotor limitations.

## REFERENCES

- ARAUZ, S. A. et al. Prosthetics in veterinary medicine: a review. *Veterinary and Comparative Orthopaedics and Traumatology*, [S. l.], v. 34, n. 4, p. 235-244, 2021. DOI: 10.1055/s-0041-1723795.
- CARVALHO, A. C. et al. Impressão 3D na medicina veterinária: próteses ortopédicas para aves. *Revista Brasileira de Medicina Veterinária*, [S. l.], v. 46, art. e001224, 2024.
- MARCELLIN-LITTLE, D. J.; LEVINE, D.; CANAPP JUNIOR, S. O. Orthoses and exoprostheses for companion animals. *Veterinary Clinics of North America: Small Animal Practice*, [S. l.], v. 45, n. 1, p. 167-183, 2015. DOI: 10.1016/j.cvsm.2014.09.009.

MEMARIAN, P. et al. Active materials for 3D printing in small animals: current modalities and future directions for orthopedic applications. *International Journal of Molecular Sciences*, [S. l.], v. 23, n. 3, art. 1045, 2022. DOI: 10.3390/ijms23031045.

MICH, P. M. The emerging role of veterinary orthotics and prosthetics (V-OP) in small animal rehabilitation and pain management. *Topics in Companion Animal Medicine*, [S. l.], v. 29, n. 1, p. 10-14, 2014. DOI: 10.1053/j.tcam.2014.04.002.

MICH, P. M. Veterinary orthotics and prosthetics. In: ZINK, M. C.; VAN DYKE, J. B. (ed.). *Canine sports medicine and rehabilitation*. Hoboken: Wiley Blackwell, 2018. cap. 11.

ROSEN, A. et al. Retrospective evaluation of customized orthoses and prostheses in dogs: 100 cases (2018-2021). *Journal of the American Veterinary Medical Association*, [S. l.], v. 260, n. 4, p. 430-438, 2022. DOI: 10.2460/javma.21.05.0234.

WENDLAND, T. M. et al. Clinical evaluation of a socket prosthesis for partial limb amputation in dogs. *Veterinary Surgery*, [S. l.], v. 48, n. 4, p. 473-481, 2019. DOI: 10.1111/vsu.13158.