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Inovație și Tehnologie în Medicina Ecvină – O Abordare Integrată a Diagnosticului, Tratamentului și Reabilitării prin Tehnologii Avansate, Chirurgie Personalizată și Terapie Regenerativă

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SUMMARY

This habilitation thesis brings together the most relevant scientific, clinical, and educational contributions of the author in the field of equine veterinary medicine, constituting a coherent synthesis deeply anchored in the current realities of specialized veterinary practice. The work provides an integrated and consistent overview of the activities carried out in recent years, highlighting the constant commitment to professional excellence, applied innovation, and continuous training in line with the ever-evolving demands of modern medicine.

Beyond the mere accumulation of theoretical knowledge, this thesis reflects a sustained effort to capitalize on applied research within clinical practice and to transform scientific data into concrete, feasible solutions for improving the health, comfort, and performance of sport horses. Thus, the author's own research results have provided essential contributions in various niche areas of equine medicine.

For example, in the field of locomotion biomechanics, the author coordinated and published an innovative study on the use of inertial measurement unit (IMU) sensors for the objective evaluation of lameness in horses, demonstrating for the first time in Romania the applicability of this non-invasive method in a clinical context. The paper "Quantitative lameness assessment in horses by using an accelerometer-based simple device: A preliminary study" (Open Veterinary Journal, 2024) showed that the data obtained via the sensors correlate significantly with the clinical scores assigned by specialists, thus providing an objective and reproducible tool for the early diagnosis of locomotor lesions.

Regarding metabolic and gastrointestinal pathology, the author documented and published one of the most extensive cases of ethylene glycol poisoning in sport horses, in which 39 animals were affected by the accidental ingestion of contaminated water. The study, conducted in a real clinical context, led to the implementation of an intensive therapeutic protocol and the identification of predictive biochemical markers, such as anion gap and creatinine levels, which can guide therapeutic decisions and prognosis. These findings are currently under publication and represent an important benchmark for equine emergency medicine in Romania.

In the realm of orthopedic surgery, the author performed a complex surgical correction of a severe congenital deformity in a Shetland foal, a case documented in the article "Surgical management of a severe congenital deformity of the hind limb in a Shetland pony foal – a case report" (ACTA VET. BRNO, 2021). By applying an individualized protocol involving arthrodesis, osteotomy, and prolonged immobilization, the restoration of locomotor functionality and the reintegration of the patient into active life were achieved, demonstrating the direct clinical impact of applied research.

At the same time, the thesis also reflects the educational dimension of the author's work, through active involvement in training young specialists, organizing workshops in equine sports medicine, and coordinating thesis and research projects. This educational activity has materialized in the publication of synthesis works, such as "Inertial Sensor Technologies—Their Role in Equine Gait Analysis, a Review" (Sensors, 2023), which provides a solid theoretical framework for understanding and applying these modern technologies in practical veterinary medicine.

Therefore, this habilitation thesis not only documents the professional and academic journey of the author, but also convincingly illustrates his ability to integrate research, practice, and education into a unified endeavor dedicated to advancing equine veterinary medicine. Each

research direction addressed has aimed not only at generating new knowledge but also at transferring this knowledge into clinical practice, thereby contributing to the development of a modern, evidence-based approach in equine medicine in Romania.

The structure of the work is thematically organized around four major research directions, each corresponding to an essential and current dimension of modern equine medicine: the biomechanical analysis of locomotion in sport horses, metabolic and gastrointestinal pathology in equines, orthopedic and oncologic surgery, and the development and implementation of modern technologies in the diagnosis and treatment of locomotor pathologies. This structuring is not arbitrary, but reflects both the coherence of the author's scientific and professional trajectory and a constant concern for adapting research to the real and stringent challenges of clinical practice. Each direction was strategically chosen in accordance with recent developments in the specialized literature and the real needs of the equine veterinary services market, offering concrete and scientifically validated solutions to high-impact clinical problems.

The first direction, dedicated to the biomechanical analysis of locomotion in sport horses, addresses an urgent need to objectify the diagnosis of lameness and optimize sporting performance. The author's research in this field, embodied through the use of inertial measurement unit (IMU) sensors and three-dimensional kinematic analysis, has provided innovative methods for quantitative gait evaluation, demonstrating the clinical applicability of these technologies and contributing to the foundation of evidence-based equine medicine.

The second direction, which focuses on metabolic and gastrointestinal pathology, reflects a growing interest in critical conditions with potentially lethal outcomes among sport and pleasure horses, such as ethylene glycol poisoning or internal hernias. The studies conducted by the author in this field have not only documented rare cases but also formulated therapeutic protocols applicable in equine clinical emergencies, with a direct impact on morbidity and mortality in these pathologies.

The third direction, represented by orthopedic and oncologic surgery, addresses both traumatic injuries and congenital deformities in young horses, as well as the management of complex tumor formations. The surgical interventions performed and documented by the author, such as the correction of severe deformities or the excision of sinonasal formations using minimally invasive techniques, have been described in international specialized literature and have contributed to advancing equine surgical practices in Romania.

The fourth direction integrates the technological dimension of medical progress, aiming at the development and implementation of modern diagnostic and treatment methods, such as laparoscopic surgery, the use of IMU technologies in orthopedics, and the application of advanced imaging in therapeutic planning. These initiatives have been coupled with a constant concern for training an interdisciplinary team capable of managing the complexity of equine locomotor pathologies with state-of-the-art tools and approaches.

Overall, the thematic structure of the work reflects not only the academic and clinical interests of the author but also a strategic orientation towards those areas in which research produces results with immediate applicability, thus providing a real response to the needs of contemporary veterinary medicine. This thematic approach supports the central idea of the thesis: modern equine medicine must be integrative, technology-based, grounded in reality, and oriented towards performance and measurable results.

Each field addressed in this thesis represents the result of a complex and coherent process of integrating classical methods with emerging ones—a continuous endeavor to combine direct clinical experience with evidence-based research and a solid bridge between national and

international collaborations and the educational activities carried out within higher veterinary education. This integrative vision is essential for contemporary equine medicine, where clinical challenges are increasingly complex and expectations regarding animal performance are ever higher And the precision of the medical act continues to increase. In this context, the author built his research and clinical intervention directions based on real field needs, but with a solid theoretical and technological foundation, leveraging available resources and creating innovative opportunities for intervention, learning, and research.

The integration of inertial measurement unit (IMU) sensors in the evaluation of equine locomotion is a striking example of how modern technology can be translated into veterinary practice with multiple benefits. This methodology, used by the author in several studies published in internationally indexed journals, has demonstrated the ability to detect subtle lameness early, to objectively quantify post-therapeutic progress, and to contribute to the personalization of rehabilitation programs for sport horses. In parallel, the development of minimally invasive techniques in orthopedic surgery—from arthroscopy to experimental laparoscopic explorations—has allowed for less traumatic interventions, faster recoveries, and a reduced impact on the animal's quality of life. These procedures, supported by the author's participation in international courses and the publication of the results in specialized journals, represent a strategic direction for modernizing veterinary surgical practice in Romania.

Moreover, the effort to integrate these innovations was not limited solely to the realm of research and clinical practice; it was also translated into educational activities, through the adaptation of the university curriculum, the development of new optional modules, the introduction of simulation-based learning, and the active involvement of students and residents in the clinical and scientific process. Thus, the author contributed not only to the transmission of knowledge, but also to cultivating a modern mindset centered on innovation, scientific rigor, and interdisciplinary collaboration. These cumulative efforts demonstrate the author's firm commitment to optimizing the veterinary medical act, enhancing animal quality of life and performance, and reinforcing the position of equine medicine as a leading field within the veterinary medical profession in Romania and Central and Eastern Europe.

This thesis not only documents a solid professional journey, but also builds a coherent and articulated vision of the future of equine veterinary medicine, based on four essential dimensions: applied research with direct clinical impact, continuous training and specialization of young veterinarians, strengthening of national and international institutional partnerships, and the adoption and implementation of new technologies in diagnosis and therapy. All these components are interconnected within a system that fosters sustainable progress and constant adaptation to the current and future challenges of the profession.

Applied research, carried out in a real clinical setting, has enabled the validation of modern methods for the evaluation of locomotion and for surgical intervention, emphasizing quantifiable, replicable, and patient-oriented results. In parallel, the training of young specialists was seen not only as an academic responsibility, but as an essential mission for ensuring the future of the profession, by transmitting the values of excellence, ethics, and innovation. Through active involvement in clinical education, mentorship, and the development of postgraduate specialty programs, the author contributed to shaping a new generation of veterinarians capable of meeting the demands of modern equine medicine.

At the same time, the work underscores the importance of institutional partnerships—whether through collaborations with other European universities, international professional associations, specialist colleagues, or academic networks. These relationships have enabled not

only access to high-level educational and scientific resources, but also an openness towards the internationalization of the Romanian academic endeavor in the equine field. Last but not least, the adoption and integration of new technologies—from inertial sensors and advanced imaging to minimally invasive surgical techniques and analysis.

Biomechanics – reflects the author's commitment to high-performance veterinary medicine, based on objective data and adapted to international standards.

Thus, this thesis represents not only a synthesis of the work carried out, but also a strategic manifesto for the future directions of equine veterinary medicine in Romania: an innovative field, grounded in rigorous scientific research, patient-centered, and open to international collaboration.

I. Equine Locomotion Biomechanics through the Use of Inertial Measurement Unit (IMU) Sensors

The use of inertial measurement unit (IMU) sensors in the analysis of equine locomotion represents one of the most innovative research directions with major practical impact in contemporary equine veterinary medicine. This research line was systematically pursued by the author with the aim of overcoming the limitations of subjective clinical assessment of lameness and providing objective, quantitative tools to support the diagnosis, treatment, and monitoring of locomotor disorders in sport horses.

IMU sensors are advanced electronic devices that integrate accelerometers, gyroscopes, and magnetometers to measure acceleration, angular velocity, and spatial orientation of body segments. In the conducted studies, these sensors were used to record in real time the parameters of movement in horses, under field conditions and in different phases of the gait cycle. Thus, it became possible to objectively analyze the symmetry and regularity of the stride, the amplitude of joint movements, postural variations, and the degree of fatigue induced by physical effort.

In the study "Quantitative lameness assessment in horses by using an accelerometer-based simple device: A preliminary study" (Crecan et al., 2024), the author validated the use of a portable, affordable, and user-friendly device capable of identifying locomotor asymmetries in horses with a precision comparable to that of clinical assessments performed by experts. The results of this preliminary study demonstrated that IMU analysis provides relevant data for detecting lameness in both the pelvic and thoracic limbs, being sensitive to subtle changes in gait patterns that might go unnoticed during a conventional visual examination.

Continuing along this direction, the work "Development of a Novel Approach for Detection of Equine Lameness Based on Inertial Sensors: A Preliminary Study" (Crecan et al., 2022) proposed an advanced methodology based on specific algorithms for processing the raw data provided by IMUs. This study laid the foundation for a semi-automated system for lameness detection, which can be applied in real clinical settings without requiring complex infrastructure. An essential aspect of this research is the evaluation of the impact of training and fatigue on gait quality, demonstrating the utility of IMU sensors not only in diagnosis but also in equine sports medicine for performance optimization.

The synthesis work "Inertial Sensor Technologies—Their Role in Equine Gait Analysis, a Review" (Crecan and Peștean, 2023) provides an overview of the applicability of inertial sensors in equine orthopedics, reviewing the advantages, limitations, and future research directions. In this work, the author emphasizes the potential of these technologies in implementing standardized gait evaluation protocols, both in clinical contexts and in pre-purchase evaluations or postoperative rehabilitation programs. IMU sensors are also valuable in assessing the impact of various types of equipment (saddles, protective gear, horseshoes) on locomotor biomechanics, allowing for their individualized adaptation to each horse's needs.

This research direction demonstrates the author's ability to integrate technological innovations into veterinary clinical practice, thereby contributing to the development of an evidence-based approach in the diagnosis and treatment of locomotor disorders in equines. By promoting the use of inertial sensors, the author not only proposes modern and effective solutions but also creates a solid educational framework for training future specialists in equine sports medicine.

By publishing these works in prestigious international journals, the contributions made to the field are scientifically validated and recognized by the international academic community. Furthermore, the obtained results provide a solid foundation for extending the research towards the development of integrated systems for biomechanical analysis, which may include other emerging technologies such as artificial intelligence, 3D kinematic modeling, or augmented reality.

In conclusion, the research dedicated to the use of inertial sensors in the analysis of equine locomotion biomechanics not only provides a highly valuable clinical tool but also opens important perspectives in sports medicine, orthopedic rehabilitation, and applied veterinary education, positioning this topic as a central pillar in the development of modern equine medicine.

II. Orthopedic Pathology and the Surgical Treatment of Osteochondritis Dissecans (OCD)

A second major pillar of the author's research is the approach to orthopedic pathology in sport horses, with a particular focus on the diagnosis, treatment, and postoperative monitoring of osteochondritis dissecans (OCD) at the hock joint. This condition represents one of the most common causes of lameness in both young and adult sport horses, and its impact on the athletic career is considerable. Osteochondritis dissecans affects joint surfaces through the appearance of osteochondral fragments, which induce inflammation, pain, and, in the absence of intervention, progressive joint degeneration.

In the study "Lameness Diagnostic, Treatment, and Follow-up in Adult Sport-Horses with Hock Osteochondritis Dissecans (OCD)" (Crecan et al., 2022), the author developed a comprehensive clinical protocol for managing these cases. The work included a complex diagnostic phase, based on detailed clinical evaluation (flexion tests, digital palpation, gait observation), followed by imaging confirmation through multiplanar radiography and joint ultrasound. These methods allowed for the precise localization of osteochondral fragments and the evaluation of the degree of effusion and cartilage alteration. The proposed therapeutic protocol consisted of minimally invasive arthroscopic intervention to remove free fragments and degenerated tissue, followed by joint lavage and stabilization of the remaining joint structure.

The importance of this study lies not only in the clinical validation of the arthroscopic method as the treatment of choice for OCD, but also in the establishment of a postoperative recovery plan that includes intra-articular injectable therapies (hyaluronic acid, corticosteroids, PRP) and gradual rehabilitation programs. The monitoring of locomotor progress was carried out both through repeated clinical evaluations and by using inertial sensors, which illustrates the multidisciplinary and integrative character of this research direction.

In addition to the surgical dimension of the treatment, the author also addressed the regenerative aspect of therapy for the affected joints. The paper "Equestrian Synovial Fluid Mesenchymal Stem Cells, a Potential Experimental Model for Osteoarticular Therapies" (Crecan et al., 2019) provides a valuable contribution to the field of regenerative therapies by demonstrating the potential of mesenchymal stem cells isolated from equine synovial fluid. The study highlighted the viability of these cells, their chondrogenic capacity, and their usefulness as

an experimental model for articular cartilage regeneration. This research opens an important avenue for the therapeutic use of autologous products in equine orthopedic pathology, with applicative perspectives in the treatment of cartilage lesions post-OCD.

Through these two studies, the author not only proposes scientifically validated solutions for the treatment of OCD but also actively contributes to the modernization of equine orthopedic practice, integrating minimally invasive interventions with advanced regenerative therapies. These directions reflect a sustained effort to align equine veterinary medicine with the standards of human medicine in terms of a personalized, multidimensional, and evidence-based approach.

Moreover, the implementation of these therapeutic protocols has enabled the training and education of young veterinarians within the teaching activity, providing them with direct access to relevant case studies, modern surgical techniques, and advanced monitoring methods. This complementarity between clinical practice, research, and university education constitutes one of the essential objectives of the author's vision for the development of university-level equine medicine in Romania.

In conclusion, the research dedicated to osteochondritic pathology in equines outlines an integrated intervention model in which early diagnosis, minimally invasive treatment, regenerative therapy, and guided rehabilitation converge into a comprehensive therapeutic protocol, with direct benefits on the health, longevity, and performance of sport horses. This model serves as a reference both for current veterinary practice and for the development of future research lines in comparative orthopedics and sports medicine.

III. Advanced Orthopedic and Oncologic Surgery in Equine Pathology

A distinct research direction in the author's work is represented by the development and application of innovative surgical solutions in equine orthopedic and oncologic pathology, with an emphasis on minimally invasive, personalized interventions adapted to the specific needs of the patient. This component of the research reflects a modern approach focused on reducing perioperative risk, optimizing functional prognosis, and shortening postoperative recovery time without compromising the quality of the intervention.

One of the significant achievements in this direction is documented in the article "Surgical management of a severe congenital deformity of the hind limb in a Shetland pony foal – a case report" (Crecan et al., 2021), published in Acta Veterinaria Brno. The study details the surgical approach to a severe congenital malformation of the hind limb in a Shetland foal—a rare pathology with a severe functional impact. The intervention involved a combination of corrective osteotomy, arthrodesis, and internal fixation with a plate and screws, and was successfully performed through rigorous preoperative planning and execution tailored to the anatomical particularities of the pediatric patient.

This work makes an important contribution to the specialized literature by highlighting the feasibility of complex interventions in very young patients, while also providing a therapeutic model applicable to other forms of congenital deformities. Postoperative management included a protocol of immobilization with a bivalve cast and progressive physiotherapy, and the complete recovery of locomotor function demonstrated the success of the surgical intervention and the validity of the applied protocols. The study also emphasizes the need for early diagnosis and prompt intervention to prevent the worsening of deformities during the rapid growth period.

In the realm of oncologic surgery, the author documented an innovative technique for a sinonasal approach in the article "Removal of an Extensive Nasal Polyp in a Standing Horse, Using a Direct Approach to the Nasal Cavity Through a Bone Flap" (Crecan et al., 2021), also published in Acta Veterinaria Brno. The presented case involves the removal of an extensive tumor formation

from the nasal cavity of an adult mare, using a minimally invasive technique performed on a standing horse, thus avoiding general anesthesia—a crucial aspect in equine medicine, where anesthesia presents increased risks.

The intervention consisted of creating a controlled bony flap to provide direct access to the lesion, with optimal hemorrhage control and superior visualization of the surgical field. The proposed technique allowed for complete excision, with a reduced risk of recurrence, and a rapid postoperative recovery without significant complications. This work represents a valuable contribution to equine sinonasal surgery, offering a viable alternative to classical trepanation approaches or more aggressive procedures. At the same time, it demonstrates that interventions performed on a standing horse, with deep sedation and careful monitoring, can be both safe and effective.

Regional blocks can become the therapeutic standard in certain pathological contexts, significantly reducing operator stress and anesthetic complications.
Through these studies, the author provides solid evidence regarding the efficiency of personalized surgical approaches, guided by the principles of minimally invasive medicine and adapted to the clinical realities of equine veterinary medicine. Moreover, these interventions contribute to expanding the portfolio of advanced procedures available at the Equine Clinic, positioning it as a center of excellence for orthopedic and oncologic surgery.
Complementarily, these cases have also had a strong educational impact, being integrated into clinical teaching activities, demonstrating the practical applicability of theoretical knowledge, and familiarizing students with modern, safe, and effective techniques. The presented approaches can be considered methodological benchmarks for the development of standardized treatment protocols in equine surgery, including for rare or complex pathologies, and they provide a solid foundation for future research on the use of image-guided technologies and biocompatible materials in tissue reconstruction.
Thus, the author's contributions in advanced orthopedic and oncologic surgery demonstrate not only technical competence and innovative capacity but also a strategic vision aimed at continuously improving clinical services, with a direct impact on the well-being of equine patients and the quality of veterinary care.

IV. Metabolic and Gastrointestinal Pathology in Mares

Another essential direction of the author's scientific and clinical activity is represented by the investigation and management of rare metabolic and gastrointestinal pathologies with potentially severe progression in equine medicine. In particular, the research has focused on two nosological entities with low incidence but major impact on patient morbidity and mortality: ethylene glycol toxicosis and small intestinal herniation through the broad ligament.

The first relevant work in this direction is the collective case report titled "Ethylene glycol toxicosis in 39 sport horses following ingestion of contaminated water: A case report," currently in press, which documents one of the largest known events of accidental ethylene glycol poisoning in equine veterinary medicine in Romania. The study was triggered by a severe epidemiological incident in which 39 sport horses exhibited acute clinical signs of acute renal failure, later correlated with the accidental ingestion of water contaminated with ethylene glycol—a toxic compound commonly found in cooling systems.

The research included a detailed clinical evaluation, correlated with biochemical analyses that revealed significant increases in serum creatinine, urea, lactate, and the anion gap—parameters suggestive of the diagnosis. Early diagnosis was made possible through the use of rapid tests and the confirmation of toxicity through specialized laboratory analyses. The emergency therapeutic

intervention included the intravenous administration of isotonic fluids, nephroprotective agents (including mannitol and sodium bicarbonate), as well as fomepizole, a competitive inhibitor of alcohol dehydrogenase, which prevents the metabolism of ethylene glycol into toxic metabolites.

Clinical results showed that in horses receiving treatment within the first 6–8 hours after ingestion, the survival rate was significantly higher, emphasizing the importance of rapid intervention and standardized protocols. Thus, the study made a significant contribution to outlining an action guide for cases of toxicosis in equines, while also identifying the need to develop advanced methods of extracorporeal detoxification (hemoperfusion, plasmapheresis) in intensive equine medicine.

The second work, published under the title "Small intestinal herniation through the broad ligament in a mare outside of the gestation period – a case report" (Crecan et al., 2018, Acta Veterinaria Brno), discusses a rare case of internal herniation of the small intestine through the broad ligament in a mare outside the gestation period. This pathology, with an extremely low frequency, is even more difficult to diagnose in the absence of an obstetrical context, often being confused with other forms of severe colic.

Early diagnosis was achieved through careful rectal examination, supplemented with transabdominal and transrectal ultrasound, which revealed the presence of a non-vascularized intestinal segment, abnormally positioned in the pelvic cavity. The emergency surgical intervention consisted of an exploratory laparotomy, manual reduction of the herniated segment, and resection of the ischemic portion, followed by end-to-end anastomosis. Postoperatively, the patient received intensive care, including antimicrobial therapy and circulatory support.

This work made an important contribution to the specialized literature by providing a detailed documentation of a case of non-gestational internal herniation, highlighting the importance of systematic postpartum examinations and extensive abdominal ultrasound in cases of recurrent or unexplained colic. Additionally, the article provided a framework for developing differential diagnostic algorithms in equine abdominal surgical pathology, proposing an interdisciplinary approach that integrates surgery, obstetrics, and imaging.

Through these two contributions, the author demonstrates an exceptional capacity to address complex and rare clinical situations, propose effective therapeutic solutions, and contribute to the development of a body of knowledge useful in emergency equine medicine. In both the cases of metabolic toxicosis and internal herniation, the undertaken research offers not only valuable data for current practice but also a starting point for prospective studies aimed at improving the prevention, diagnosis, and treatment of these major pathologies.

Integrating these case studies into the university educational process—through lectures, practical work, and simulations—contributes to training a generation of veterinarians better prepared for managing complex emergencies and for applying theoretical knowledge in real clinical contexts, thus reinforcing the role of applied clinical education in modern veterinary medicine.

Conclusions

The conclusions of this habilitation thesis reflect a complex, coherent, and strategic professional endeavor in which scientific research, clinical activity, and teaching interweave to support and strengthen the development of equine veterinary medicine in Romania, within an increasingly demanding and competitive international context. Each investigated direction—from the biomechanical analysis of locomotion to the approach to rare metabolic pathologies or the application of advanced surgery—demonstrates not only a genuine concern for innovation but also

the author's ability to functionally integrate the most recent technological and scientific advances into everyday veterinary practice.

For example, the integration of inertial sensors (IMU) in equine orthopedics is not just a demonstration of the ability to use modern tools but also reflects a profound vision regarding the transformation of the veterinary medical act into one based on objective, reproducible data with high diagnostic and prognostic value. The studies dedicated to this direction do not merely represent a simple technological test; they provide concrete solutions for early lameness detection, personalization of recovery plans, and the improvement of athletic performance, contributing to a paradigm shift in equine sports medicine.

Similarly, the research on osteochondritis dissecans (OCD) demonstrates that equine medicine can directly benefit from advances in cellular and regenerative biology. Arthroscopy and synovial stem cell therapy are not only modern therapeutic options but also mark an essential step towards personalized equine medicine—a direction in which treatments are no longer applied generically but are tailored to each individual according to their morphological and pathological characteristics. In the field of advanced equine surgery and oncology, the author proposes innovative minimally invasive techniques—such as standing procedures for the removal of sinonasal formations—that significantly reduce operative risks and accelerate postoperative recovery. These contributions deliver direct benefits to both the patient and the veterinary team, increasing the efficiency of interventions and demonstrating that modern equine medicine in Romania can be aligned with the best international practices.

On the other hand, the approach to rare conditions, such as ethylene glycol toxicosis or small intestinal herniation through the broad ligament, reveals a profound investigative spirit and a desire to expand medical knowledge in less explored areas. This research not only describes isolated cases but also provides a basis for the development of standardized therapeutic protocols, educational models, and preventive strategies for potentially lethal medical emergencies.

The fact that all these research directions have been accompanied by the dissemination of results in recognized international journals—such as Sensors, Open Veterinary Journal, Acta Veterinaria Brno, Farmacia, or Revista Română de Medicină Veterinară—validates the scientific quality of the endeavor and contributes to increasing the visibility of Romanian veterinary medicine on the international stage. Moreover, the publication of these studies constitutes a valuable resource for the continuous education of young specialists, offering models of best practice and concrete benchmarks for their future activities.

In essence, this thesis is not limited to a mere inventory of scientific and professional activity; it proposes an articulated and pragmatic vision of the role that modern equine medicine must assume in society: a field of clinical excellence, experience-based education, and research with immediate practical impact. Built on a rigorous foundation, supported by tangible results, and guided by solid professional values, the work reflects the author's commitment to actively contributing to the transformation of the Romanian veterinary system into one characterized by performance, innovation, and international openness.

Recommendations

A first recommendation arises from the results obtained in the field of equine locomotion biomechanical analysis through the use of inertial measurement unit (IMU) sensors. Given the demonstrated clinical value of these technologies in early lameness diagnosis, treatment monitoring, and performance optimization, the expansion of IMU usage in current veterinary practice is imperative. Thus, their integration as a standard method in routine orthopedic evaluations, pre-purchase examinations, and post-traumatic or postoperative rehabilitation

protocols is recommended. The systematic implementation of these devices will lead to a significant increase in diagnostic accuracy, a reduction in clinical subjectivity, and the optimization of individualized therapeutic strategies for each patient.

Regarding equine orthopedic pathology, the presented research has highlighted the efficiency of arthroscopic treatment in cases of osteochondritis dissecans (OCD), supported by well-structured rehabilitation protocols and, in some cases, regenerative therapies (e.g., synovial stem cells). In this context, it is recommended to develop and promote a standardized national protocol for the diagnosis, treatment, and postoperative monitoring of horses with OCD. Such a guideline, developed in collaboration with leading university centers and private clinics, would contribute to the uniformity of veterinary practice, increase therapeutic efficiency, and shorten the recovery period for patients, with a direct positive impact on the athletic careers of the horses.

In the field of advanced equine surgery, the results obtained in interventions addressing congenital deformities and sinonasal tumor formations have demonstrated the feasibility and efficiency of personalized, minimally invasive techniques, adapted to the specifics of each case. In this regard, the development of a national training program in cutting-edge equine surgery is recommended, including standing procedures, the use of bone flaps, image-guided surgery, and modern internal fixation methods. This program could be supported through thematic workshops, postgraduate courses, and integration into international training networks (e.g., ECVS, AO-VET), thereby contributing to the professionalization and modernization of equine surgical interventions in Romania.

Research related to rare metabolic and gastrointestinal pathologies, such as ethylene glycol toxicosis and small intestinal herniation through the broad ligament, highlights the need for clinical vigilance and prompt surgical intervention. It is recommended to establish a national registry of rare equine cases, which should include standardized diagnostic protocols, surgical intervention algorithms, and follow-up guidelines. Such an instrument would represent an important resource for both practitioners and researchers, contributing to the increased preparedness for rare but severe emergencies and the consolidation of an evidence-based culture in equine medicine.

Last but not least, considering the positive impact of this research on the training of young specialists, it is recommended to continue and expand the author's involvement in educating a new generation of veterinarians dedicated to equine medicine. This can be achieved through the development of a thematic doctoral program, the integration of students and residents into applied research projects, and by supporting their participation in international congresses. Simultaneously, the internationalization of the clinic and the creation of a center of excellence in equine orthopedics and sports medicine will consolidate the academic visibility of the university and facilitate the attraction of educational and scientific partnerships.

These recommendations, formulated in a realistic manner and based on concrete results, reflect not only the author's potential but also the strategic development directions for equine veterinary medicine in Romania, with an openness toward the international community.