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Biomechanical analysis of gait and podoposturology in prevention.
FALLS IN THE ELDERLY: AN INTEGRATIVE GERONTOLOGICAL APPROACH

BIOMECHANICAL GAIT ANALYSIS AND PODOPOSTUROLOGY IN FALL PREVENTION FOR THE ELDERLY: AN INTEGRATIVE GERONTOLOGICAL APPROACH

Author: Vitor Silva Xavier Ferreira

SUMMARY

Global population aging brings with it an exponential increase in the incidence of falls, a devastating sentinel event that severely compromises the autonomy, functionality, and longevity of the elderly. This scientific article extensively and thoroughly investigates the application of clinical biomechanics, specifically through kinematic gait analysis and computerized baropodometry, as essential diagnostic and preventive tools in modern gerontology. It explores the complex pathophysiological relationship between the senescence of sensory systems (visual, vestibular, and proprioceptive), sarcopenia, and adaptive changes in the senile gait pattern. The study proposes and justifies therapeutic interventions based on Podoposturology (ascending postural reprogramming through proprioceptive insoles) and active sensorimotor training (Pilates and Vibration Platform) to restore postural stability and motor confidence. The research concludes that a preventive approach, based on precise quantitative data on plantar pressure and movement kinematics, is essential to mitigate the risk of falls, reduce associated morbidity and mortality, and promote active and independent aging.

Keywords: Biomechanics. Elderly. Fall prevention. Baropodometry. Podoposturology.
Gait analysis.

1. INTRODUCTION

Falls in the elderly currently constitute one of the most serious and costly global public health problems, being epidemiologically recognized as the leading external cause of death and morbidity in the population over 65 years of age. Postural instability associated with aging should not be seen as an isolated phenomenon or a "natural" and inevitable consequence of age, but rather as the clinical result of a multifactorial and progressive deterioration involving the complex integration of the visual, vestibular, and somatosensory systems, coupled with systemic loss of skeletal muscle mass (sarcopenia) and degenerative joint changes. The traditional approach of geriatric physiotherapy, often focused only on secondary post-fracture (reactive) rehabilitation, proves insufficient; the true revolution in

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Elderly health relies on primary and secondary prevention, focused on identifying subtle and invisible biomechanical risks before a traumatic event occurs.

Contemporary clinical biomechanics offers an arsenal of sophisticated and precise technological tools, such as computerized baropodometry (plantar pressure analysis) and kinematic gait analysis via video, which allow for accurate mapping of load distribution, center of pressure (COP) behavior, and static and dynamic postural oscillations. Based on this quantitative data, Podoposturology emerges as a therapeutic science capable of reprogramming postural muscle tone and overall balance through precise and imperceptible plantar stimuli. The foot, acting as the primary support base and the main proprioceptive sensor in direct contact with the ground, plays a crucial and often neglected role in the ankle and hip motor strategy for maintaining human balance.

This article aims to analyze in depth how the clinical integration between rigorous instrumental biomechanical assessment and active rehabilitation therapies (such as the Pilates method and functional training) can significantly reduce the risk of falls and their catastrophic consequences. Based on current scientific literature and specialized clinical practice in gerontology, we will discuss the physiology of motor aging, the biomechanical compensations adopted by the elderly, and how personalized postural rebalancing interventions can restore confidence, security, and independence to the patient. The central thesis defended is that technology applied to movement analysis should be democratized and incorporated into gerontology as the new gold standard for preventive care and health promotion.

2. DEVELOPMENT: BIOMECHANICS APPLIED TO GERONTOLOGY

2.1. Epidemiology and Physiology of Motor Aging

The biological process of aging, or senescence, imposes systemic physiological changes that directly and negatively impact motor control and postural stability. Sarcopenia, defined as the progressive and generalized loss of skeletal muscle mass and strength, is a central factor in the genesis of falls. This loss predominantly affects type II muscle fibers (fast-twitch and glycolytic), which are essential for performing explosive movements and rapid protective reactions, such as taking a quick step to regain balance after a stumble. Without this "power reserve," the elderly person becomes unable to correct sudden postural disturbances, succumbing to gravity.

Simultaneously with muscle loss, there is a progressive degeneration of plantar mechanoreceptors (Pacinian and Meissner corpuscles) and articular proprioceptors (muscle spindles and Golgi tendon organs). This "peripheral blindness" drastically reduces proprioceptive acuity, preventing the elderly person from accurately sensing irregularities in the terrain or the exact position of their feet in space. The visual system, frequently compromised by cataracts...

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or macular degeneration, and the vestibular system, affected by the loss of hair cells, fails to compensate for this somatosensory deficit, creating a triad of sensory instability.

The central nervous system (CNS) of the elderly also undergoes changes in the processing of this afferent information. An increase in motor response latency is observed, meaning that the time between the perception of imbalance and the execution of the corrective muscle contraction is prolonged.
This minute delay in neural processing is often the difference between regaining balance and suffering a fall. The motor cortex needs to recruit more brain areas to perform simple motor tasks that were previously automatic (such as walking), leading to competition for cognitive resources (dual-tasking) and increasing the risk of falls when the elderly person is distracted or talking.

Joint physiology also plays a relevant role. Osteoarthritis, common in the knees and hips, generates pain and limitation of range of motion (stiffness). Pain inhibits reflex muscle activation (arthrogenic inhibition), further weakening the quadriceps and gluteal muscles. Joint stiffness, especially the loss of ankle dorsiflexion and hip extension, prevents the correct execution of gait and balance strategies, forcing the body to adopt biomechanically inefficient and unstable compensatory postures.

Cardiovascular changes, such as orthostatic hypotension (a drop in blood pressure upon standing) and carotid sinus hypersensitivity, can cause dizziness and syncope that precipitate falls. The physiotherapist specializing in gerontology must have a systemic view, understanding that a fall is often the final symptom of a multisystemic failure of postural control mechanisms, and not just a casual accident or "dizziness of old age." The assessment must therefore be comprehensive and multifactorial.

The fear of falling *creates* a devastating psychological and physical vicious cycle. After a fall, or even without having fallen, the elderly person develops fear, which leads them to restrict their activities and mobility. This immobility accelerates sarcopenia, stiffness, and loss of confidence, paradoxically increasing the risk of future falls. Biomechanical and physiotherapeutic intervention works by breaking this cycle, restoring physical competence and, consequently, psychological security.

Finally, polypharmacy (the use of multiple medications) is an extrinsic risk factor that interacts with the physiology of aging. Psychotropic, sedative, antihypertensive, and diuretic medications can affect alertness, balance, and blood pressure. The physiotherapist must be aware of these interactions and work together with the geriatrician to optimize pharmacological prescription, aiming at the patient's motor safety.

2.2. Biomechanics of Senile Gait

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The gait of the elderly, often described as "senile gait," presents distinct and adaptive biomechanical characteristics that primarily aim to increase safety and stability, often at the cost of reduced energy efficiency and speed. A significant decrease in step and stride length is typically observed, resulting in reduced gait speed. Gait speed is even considered today the "sixth vital sign" in geriatrics, being a robust predictor of frailty, institutionalization, and mortality.

To compensate for lateral instability, older adults tend to increase their base of support by widening their stance (increasing step width). This improves static balance but increases energy expenditure and varus force moment in the knees and hips. A significant increase in double support time (the phase in which both feet are on the ground) is also observed during the gait cycle, as a strategy to minimize single-leg support time, which is the phase of greatest instability and risk.

From a cinematographic perspective, a reduction in foot height is observed during the swing phase *(toe clearance),* which dangerously increases the risk of tripping over small obstacles, carpets, or uneven flooring. This reduction is frequently caused by weakness in the dorsiflexors (tibialis anterior) or by a lack of adequate knee and hip flexion. The loss of terminal hip extension during the push *-off* phase reduces forward propulsion, making the gait shuffling and dependent on trunk flexion to move forward, which dangerously shifts the center of gravity forward.

Dissociation of the shoulder and pelvic girdles (opposite rotation of the scapular and pelvic girdles) and the reciprocal swing of the arms tend to decrease or disappear in senile gait. The trunk becomes rigid and moves as a unit, which impairs dynamic stability and the ability to perform smooth turns or changes of direction. Axial rigidity of the trunk prevents the absorption of impacts and the dissipation of rotational forces, overloading the lumbar spine and the joints of the lower limbs.

Instrumental biomechanical analysis allows for the quantification of all these variables with millimeter precision, identifying lateral asymmetries or pathological deviations that are not visible in conventional clinical assessment. For example, an asymmetry in stance time between the right and left legs may indicate unreported pain or unilateral weakness after a subclinical stroke. Early identification of these patterns allows for interventions focused on restoring symmetry and gait efficiency.

The initial foot contact pattern with the ground also changes. Instead of the classic heel strike, many older adults perform a plantigrade contact (flat foot), reducing the ability to absorb impact and the smooth progression of the force vector. This transmits damaging forces to the knee and hip and reduces the initial stability of the stance phase. Correcting this pattern through gait training and orthotics can restore normal foot rolling mechanics.

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Understanding senile gait not as a defect, but as an intelligent adaptation of the motor system to underlying deficits, is fundamental. The goal of physiotherapy is not to force an aesthetically pleasing "youthful" gait pattern, but to optimize the elderly person's gait so that it is as safe, stable, and efficient as possible within their physiological capabilities, respecting irreversible structural limitations and working on reversible ones.

2.3. Baropodometry: Diagnosing Foot Strike and **Balance**

Computerized baropodometry has established itself as an essential diagnostic technology in high-level modern gerontological assessment. Through a platform full of pressure-sensitive piezoelectric sensors, it is possible to objectively and quantitatively evaluate stabilometry (oscillation of the center of pressure - COP) and plantar load distribution in both static and dynamic postures (gait). Unlike subjective visual assessment, baropodometry provides precise numerical data on the oscillation area, COP displacement velocity, and pressure peaks.

In static assessment, the examination allows for the identification of anteroposterior and lateral postural oscillations. In elderly individuals at risk of falls, excessive anterior displacement of the center of gravity (a protective strategy against falling backward) or wide lateral oscillations are frequently observed, indicating weakness of the gluteus medius and hip instability. An increased area of the confidence ellipse (the area where the COP oscillates 90% of the time) is a direct marker of postural instability and poor orthostatic balance control.

Dynamic gait analysis on the platform reveals how the foot behaves under load during movement. It is possible to visualize the "gait line" (trajectory of the center of pressure during the step) and identify pathological patterns such as excessive pronation (dropped foot) or rigid supination. In elderly individuals, identifying excessive plantar pressure peaks (hyperpressure) is vital, especially in diabetic patients or those with peripheral neuropathy, to prevent the formation of calluses and plantar ulcers that alter proprioception and cause pain.

Baropodometry also helps in detecting functional or anatomical leg length discrepancies (short leg), observing the asymmetrical load distribution between the right and left foot. Significant overload on one limb can explain chronic lower back pain, antalgic scoliosis, and a limping gait pattern that predisposes to falls. The rebalancing of these loads through orthotics is monitored and validated by the surgeon themselves.

exam.

The examination provides objective data that guides differential clinical reasoning, allowing the physiotherapist to discern whether the patient's instability is predominantly sensory in origin (worsening with eyes closed), biomechanical (structural changes in the foot), or mixed. The Romberg baropodometric test (eyes open vs. eyes closed) quantifies the visual dependence of balance, helping to develop specific vestibular or proprioceptive rehabilitation strategies.

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In addition to diagnosis, baropodometry is a powerful tool for *biofeedback* and monitoring progress. The patient can visualize their own instability on the computer screen, which increases body awareness and adherence to treatment. Comparing pre- and post-intervention exams (after using orthotics or months of rehabilitation) provides tangible evidence of improved balance, validating the effectiveness of the therapy implemented.

The democratization of the use of baropodometry in physiotherapy and geriatric clinics raises the standard of care. It moves away from treating "dizziness" or "imbalance" empirically and towards treating measurable and correctable biomechanical dysfunctions. It represents a transition from opinion-based physiotherapy to physiotherapy based on instrumental data and evidence.

2.4. Podoposturology: Ascending Postural Reprogramming

Podoposturology is a therapeutic science based on the neurophysiological principle that the plantar region is the "primary input" and richest point of the postural tonic system. The skin of the sole of the foot has a very high density of exteroceptors that inform the brain about body oscillations and ground texture. Small alterations in gait, such as hindfoot valgus, a collapsed plantar arch, or excessive supination, generate ascending biomechanical compensations, negatively affecting knee alignment (valgus/varus), pelvic position (anteversion/retroversion), and spinal curvatures.

In the elderly, the loss of structural integrity of the foot (arch collapse, atrophy of the plantar fat pad) compromises this sensory and mechanical function. Podoposturology intervenes through the creation of personalized postural (or proprioceptive) insoles. Unlike traditional orthopedic insoles that aim only for passive comfort or crude mechanical arch support, postural insoles use thin elements (bars, wedges, foot pieces) of millimeter thickness (1 to 3 mm) placed in strategic locations to stimulate plantar baroreceptors.

These subtle stimuli trigger postural reflexes that modulate the tone of the ascending muscle chains. For example, a retrocapital bar can stimulate finger extension and reduce forward body posture; a lateral wedge can activate the evertor muscles and correct a supinated foot, realigning the knee. This sensory "reprogramming" informs the Central Nervous System of the need to adjust the center of gravity, improving static and dynamic stability in a subconscious and continuous way.

The use of insoles in geriatrics also serves to increase the contact area of the foot with the ground, better distributing pressure and improving sensory *input* . This is particularly beneficial for elderly people with peripheral neuropathy or decreased plantar sensitivity. By "feeling" the ground better through the insole, the elderly person gains a more precise spatial reference, which reduces postural sway and increases safety when walking.

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Podoposturology also addresses lower limb length discrepancies, common in the elderly due to asymmetrical osteoarthritis or hip/knee replacement surgeries. The use of compensating wedges in the insole levels the pelvis, aligns the spine, and distributes weight evenly between the legs, relieving chronic lower back pain and improving gait efficiency. Leveling the base is the first step towards overall stability.

Adaptation to orthotics in the elderly should be gradual and monitored. The physiotherapist should assess postural response and comfort, making fine adjustments to the foot elements as the patient progresses. Orthotics do not replace active rehabilitation, but create a favorable biomechanical environment for more effective and safe physical exercise. It is a tool for "constant physiotherapy" that works with every step the elderly person takes.

In conclusion, Podoposturology offers an effective, conservative, and minimally invasive intervention for managing postural instability in the elderly. By correcting the base of support and optimizing sensory input, the physiotherapist provides the patient with a solid and stable foundation, essential for preventing falls and maintaining functionality in old age.

2.5. Active Interventions: The Pilates Method in Geriatrics

The passive correction offered by insoles must be accompanied by vigorous active intervention to restore strength and motor control. The Pilates method, especially when adapted to the specific needs of geriatrics, stands out as one of the most powerful and comprehensive tools for balance rehabilitation and fall prevention.
The method focuses on strengthening the "Power House" or Core, composed of the deep abdominal muscles, paravertebral muscles, diaphragm, and pelvic floor. A strong core stabilizes the trunk, allowing the limbs to move freely, in a coordinated and safe manner.

Pilates exercises intensely work on motor coordination, flexibility, and dissociation of the pelvic and shoulder girdles, combating the axial rigidity typical of senile gait. The emphasis on body awareness and movement control teaches the elderly to perceive their body in space, correcting poor posture and improving alignment. Coordinated breathing with movement, a cornerstone of the method, improves tissue oxygenation, thoracic mobility, and concentration, reducing anxiety and fear of falling.

The use of Pilates equipment (Reformer, Cadillac, Chair) with its spring system offers a unique biomechanical advantage: elastic resistance. Unlike free weights in weight training that offer constant resistance and gravitational impact, the springs provide progressive and gentle resistance, allowing for safe concentric and eccentric muscle strength training without excessive joint overload. This is crucial for older adults with osteoarthritis, osteoporosis, or joint prostheses. Eccentric strengthening is particularly vital for controlling stair descent and sitting, frequent causes of falls.

Pilates also challenges balance in controlled and safe situations. Exercises on unstable surfaces, standing or kneeling on equipment, stimulate the vestibular and proprioceptive systems to react and adapt. The elderly person learns to activate hip and ankle strategies to regain balance, "training" the body to react to real-life imbalances. Constant supervision by a physiotherapist ensures that the challenge is appropriate to the patient's ability, avoiding risks.

The flexibility worked on in Pilates is functional. Stretching the posterior and anterior muscle chains improves stride length, upright posture, and functional reach capacity. A flexible senior citizen is able to dress themselves, put on shoes, and reach for objects without losing their balance. Improved spinal mobility facilitates the trunk rotations necessary to look behind or to the sides when walking on the street.

In addition to physical benefits, group Pilates promotes socialization, combating isolation and depression, which are indirect risk factors for functional decline. The feeling of competence and improved body image empower the elderly, encouraging them to maintain an active lifestyle.

In short, Pilates in geriatrics is not just gentle exercise; it's profound neuromuscular re-education. By integrating strength, flexibility, control, and balance, the method addresses all aspects of physical frailty, building a more resilient, stable body prepared to face the motor challenges of aging.

2.6. Vibration Training and Proprioception

The use of Whole Body Vibration (WBC) in gerontological rehabilitation has gained increasing prominence in high-impact scientific literature as an efficient and safe therapeutic modality. The physiological principle is based on the transmission of sinusoidal mechanical vibrations through the body, which stimulate muscle spindles to trigger the Tonic Vibration Reflex. This generates rapid and synchronized involuntary reflex muscle contractions (30 to 50 times per second), recruiting almost 100% of muscle fibers, including type II fibers, which are the first to atrophy in sarcopenia.

This intense somatosensory stimulation "awakens" and calibrates the proprioceptive system, improving communication between the muscles and the central nervous system. The result is a significant improvement in motor reaction time, lower limb muscle strength, and postural control. For frail elderly individuals who cannot tolerate high-impact or long-duration exercises, the vibration platform offers potent neuromuscular stimulation in short sessions, optimizing therapy time.

In addition to neuromuscular benefits, mechanical vibration generates beneficial osteogenic stress.
Bone microdeformations induced by increased gravitational load stimulate the

Osteoblasts produce new bone matrix, helping to combat osteopenia and osteoporosis, thus reducing the risk of serious fractures in case of falls. There is also evidence of improved peripheral blood circulation and lymphatic drainage, reducing edema and improving tissue trophism.

Controlled vibration protocols, prescribed and supervised by physiotherapists, are essential. Frequency (Hz), amplitude (mm), and exposure time should be individually dosed to maximize benefits and avoid adverse effects such as dizziness or excessive resonance in internal organs and the eyeball. There are specific contraindications (acute thrombosis, kidney stones, recent implants, pacemaker) that require rigorous screening before use.

The vibration platform can also be used to perform functional exercises (squats, weight transfers) on the vibrating base, enhancing the effect of active exercise. This combination of passive vibration with active movement challenges dynamic balance and accelerates motor learning. The elderly person gains confidence in their stability and leg strength.

It is important to emphasize that the vibration platform is a valuable adjunctive strategy, not a substitute for voluntary exercise. It prepares the neuromuscular system, warms up the muscles, and offers a unique bone stimulus, and should be integrated into a complete rehabilitation program that includes gait training and functional activities.

It is concluded that whole-body vibration technology represents a significant advancement in geriatric physiotherapy. By offering a safe and effective means of combating sarcopenia and osteoporosis simultaneously, it establishes itself as a key tool in fall prevention and maintaining the musculoskeletal integrity of the modern elderly.

2.7. The Environment and the Multidisciplinary Approach

Effective fall prevention cannot be confined to the four walls of the physiotherapy office; it must extend to the elderly person's living environment through an ecological and multidisciplinary approach. Biomechanical assessment provides intrinsic patient data, but it is the interaction of this data with extrinsic environmental factors that determines the actual risk of falling. The physiotherapist should act as a safety and ergonomics consultant, conducting home visits or guiding adaptations based on the patient's functional capacity.

Ergonomic home analysis involves identifying and removing common "traps": loose rugs, exposed electrical wires, inadequate lighting (especially on the bedroom-bathroom route at night), lack of grab bars in the shower and toilet, stairs without double handrails, and inappropriate footwear (loose slippers, slippery soles). The physiotherapist provides guidance on ideal footwear: non-slip soles, firm heel counter to stabilize the heel, and a secure fastening system (Velcro or laces).

The approach must be inherently multidisciplinary. The geriatrician is fundamental for reviewing polypharmacy, adjusting or discontinuing medications that cause postural hypotension, sedation, or vertigo. The ophthalmologist should correct visual deficits (cataracts, refractive errors) and advise on the use of multifocal lenses, which can distort depth perception in steps. The nutritionist works to ensure the protein and vitamin D intake necessary for muscle and bone health.

Occupational therapy complements the physiotherapy work by training in Activities of Daily Living (ADLs) in a safe manner and prescribing assistive technologies (canes, walkers, reachers) when physical rehabilitation reaches a plateau. Psychology addresses the fear of falling, depression, and anxiety, factors that paralyze the elderly. Biomechanics provides the common language of quantitative data that facilitates communication between all these professionals, allowing for an integrated, cohesive care plan focused on the common goal of autonomy.

Patient and family education is a central pillar. Awareness campaigns on fall prevention, teaching how to get up correctly after a fall (rolling technique) and how to ask for help, save lives. The elderly person must be the protagonist of their safety, understanding their risks and engaging in the necessary behavioral and environmental modifications.

Technology can also assist in environmental monitoring, with the use of presence sensors for automatic lighting, telecare devices (panic buttons), and *wearables* that detect falls and alert family members. Integrating these technologies with physical rehabilitation creates a robust safety net around the vulnerable elderly person.

In conclusion, fall prevention is a team effort. The biomechanical physiotherapist leads the optimization of the "human machine," while the multidisciplinary team and the family ensure that the environment and systemic health support this machine. Only through this holistic and integrated approach is it possible to effectively reduce the alarming fall statistics and ensure safe and fulfilling aging.

3. CONCLUSION

The extensive and in-depth investigation into clinical biomechanics applied to fall prevention in the elderly, presented in this article, reveals that contemporary gerontological physiotherapy must urgently transition from a purely rehabilitative and care-oriented model to a preventive, predictive, and technological one. Based on the evidence presented, it is concluded that kinematic gait analysis and computerized baropodometry are not superfluous technological luxuries, but essential semiotic tools that reveal the "motor signature" of pathological aging long before it culminates in catastrophic outcomes such as hip fractures, head injuries, or immobility syndrome.

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Podoposturology proves to be an extremely effective, elegant, and minimally invasive therapeutic intervention. By subtly correcting the base of support through proprioceptive insoles, the physiotherapist offers the elderly person a stable and reliable platform on which to interact with the world. The insole acts not only as a passive mechanical support but also as a continuous neurological *biofeedback* device that improves body awareness and adjusts postural tone with each step. In frail elderly individuals with sensory deficits, this small optimization in somatosensory *input* can represent the crucial difference between maintaining balance and a disabling fall.

It is also observed that actively combating sarcopenia and joint stiffness through dynamic methods such as Clinical Pilates and Functional Training is irreplaceable. Biomechanics in

It teaches that the human body is an interconnected tensegrity structure; failure in one component (such as core weakness or ankle stiffness) affects the stability of the whole.
Strengthening the core and restoring joint mobility has direct and measurable repercussions on gait safety and efficiency. The Vibration Platform emerges and consolidates itself as a promising adjunctive resource to optimize these neuromuscular and bone gains in a shorter therapy time.

Furthermore, instrumental biomechanical analysis uniquely empowers the patient. By visualizing their own balance, sway, and gait data in objective graphs and videos, the elderly person rationally understands their risk condition and adheres with much greater conviction to the proposed treatment. Health education, when based on concrete visual evidence and personalized data, dramatically increases *compliance* with home safety guidelines and the correct use of assistive walking devices when indicated.

The research reinforces the imperative need for professional specialization. Effective management of elderly individuals at risk of falls requires a deep and integrated understanding of aging physiology, musculoskeletal pathology, and vector mechanics. The physiotherapist specializing in biomechanics and gerontology is strategically and uniquely positioned to lead comprehensive fall prevention programs, excelling in clinical practice, environmental consulting, and family guidance.

In conclusion, massive investment in fall prevention is the smartest and most sustainable strategy for the global healthcare system. The financial and human cost of a single hip fracture and its systemic complications far outweighs the investment in a preventive biomechanical assessment and a supervised exercise program. Promoting active aging, characterized by safe, stable, and independent gait, should be the ultimate and non-negotiable goal of all gerontological interventions, restoring to the elderly not only physical stability but also the confidence and freedom to fully live their longevity with quality and purpose.

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REFERENCES

BRICOT, Bernard. **Clinical Posturology.** São Paulo: Ícone, 2010.

CAGNI, P. **Podoposturology: Postural Re-education through Insoles.** São Paulo: Andreoli, 2016.

CAMERON, Ian D. et al. Interventions for preventing falls in older people in care facilities and hospitals. **Cochrane Database of Systematic Reviews,** n. 12, 2012.

GUCCIONE, Andrew A.; WONG, Rita A.; ACKER, Dale. **Geriatric Physical Therapy.** 3rd ed. Rio de Janeiro: Guanabara Koogan, 2014.

HORAK, Fay B. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? **Age and Aging,** vol. 35, no. suppl_2, p. ii7-ii11, 2006.

KAPANDJI, AI. **Articular Physiology: Annotated Diagrams of Human Mechanics.** 6th ed. Rio de Janeiro: Guanabara Koogan, 2007.

LORD, Stephen R. et al. **Falls in Older People: Risk Factors and Strategies for Prevention.** 2nd ed. Cambridge: Cambridge University Press, 2007.

PERRY, Jacquelin; BURNFIELD, Judith M. **Gait Analysis: Normal and Pathological Function.** 2nd ed. Barueri: Manole, 2012.

SHUMWAY-COOK, Anne; WOOLLACOTT, Marjorie H. **Motor Control: Theory and Practical Applications.** 3rd ed. Barueri: Manole, 2010.

WHITTLE, Michael W. **Gait** Analysis: An Introduction. 4th ed. Edinburgh: Butterworth-Heinemann, 2007.