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Science Orthopedics

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Science Orthopedics: bridging the bench and the bedside

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Welcome to *Science Orthopedics*, a title deliberately chosen to reflect a conviction that has long animated our field yet has often remained underarticulated in the literature. The conjunction in our subtitle, "where 'Orthopedics' meets 'Science,'" is not merely rhetorical. It embodies a foundational belief: that the future of Orthopedics depends on the deliberate, rigorous, and sustained integration of mechanistic discovery with clinical insight. Orthopedics, for most of its history, has been a discipline defined by craftsmanship, anatomical mastery, and technical innovation. That tradition remains vital. But we now stand at a moment when the questions we ask about tissue regeneration, implant integration, pain mechanisms, and functional recovery demand a different kind of conversation. They demand the full intellectual apparatus of modern science.

For decades, orthopedic research has often followed a familiar arc: a clinical problem encountered in the operating room, a novel implant or surgical technique developed to address it, and a series of outcome studies documenting its performance. This model has produced extraordinary advances. Joint arthroplasty, spinal instrumentation, and arthroscopic surgery have transformed countless lives. Consider, for example, the challenge of osteoarthritis (OA). For decades, OA was viewed largely as a biomechanical disease of "wear and tear," managed by joint replacement when conservative measures failed. Today, we understand OA as a complex disorder involving mechanotransduction, low-grade inflammation, metabolic dysregulation, and neuroimmune crosstalk. The insights emerging from single-cell transcriptomics, spatial proteomics, and advanced imaging are revealing distinct molecular endotypes that may explain why some patients progress rapidly while others remain stable for years. These discoveries carry profound implications: they suggest that disease-modifying therapies may finally be within reach, that surgical timing could be personalized based on molecular biomarkers, and that rehabilitation strategies might be designed to modulate inflammatory pathways rather than simply strengthen muscles. But translating these insights requires a research ecosystem in which molecular biologists and arthroplasty surgeons collaborate on equal footing, and in which findings are disseminated to an audience fluent in both worlds. That is the ecosystem we aim to foster.

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The same imperative applies to spinal cord injury. Few conditions in orthopedics and neurosurgery carry such profound consequences for function, independence, and quality of life. For decades, the prevailing view held that the adult central nervous system possessed little capacity for repair, and management focused largely on stabilization, decompression, and chronic disability management. Today, we stand at the threshold of a different era. Advances in neuroimmunology have revealed that the spinal cord response to injury is governed by a complex interplay of inflammation, glial reactivity, and axon growth inhibition, all of which are increasingly targetable. Neural interface technologies, from epidural stimulation to brain–computer interfaces, are enabling volitional movement in patients once considered permanently paralyzed. Biomaterial scaffolds designed to bridge the lesion cavity, combined with cell-based strategies and rehabilitative training, are beginning to show promise in promoting circuit reorganization. Yet the gap between these laboratory breakthroughs and clinical translation remains formidable. Too often, promising neurorestorative strategies fail not because the underlying biology is unsound, but because they are developed without adequate consideration of the unique biomechanical demands of the injured spine, the inflammatory microenvironment created by trauma, the timing of intervention relative to secondary injury cascades, or the practical realities of surgical delivery and postoperative rehabilitation. Closing this gap requires not only translational research in the conventional sense, but a deeper integration: neurorestorative strategies must be conceived from the outset with surgical feasibility, biomechanical stability, and multimodal rehabilitation pathways in mind.

Our commitment to integration extends beyond biology and engineering. The central nervous system does not exist in isolation from the musculoskeletal apparatus. Spinal cord injury profoundly alters muscle biology, bone density, joint integrity, and metabolic function. Conversely, the mechanical environment imposed by orthopedic stabilization and rehabilitation shapes neural recovery. Understanding why some patients regain ambulation while others do not, and why some develop severe neurogenic heterotopic ossification or post-injury syringomyelia, requires insights that bridge neuroscience, immunology, biomechanics, and clinical orthopedics. We welcome contributions that cross these boundaries and place spinal cord injury - more broadly, the interface between neural and musculoskeletal systems - in its full physiological and therapeutic context.

To our readers, authors, and reviewers, we offer a vision of a journal that is both ambitious and inclusive. We will publish work that spans the full spectrum from fundamental discovery to clinical translation, with a particular interest in studies that connect these domains. We will prioritize methodological rigor, transparency, and reproducibility. We will embrace the diversity of approaches, from observational cohort studies to randomized trials, from mechanistic experiments to computational modeling, that characterizes a mature scientific field. And we will strive to be a forum where the orthopedic community can engage not only with the latest findings, but with the most important questions facing our discipline.

The name *Science Orthopedics* reflects a promise: that within these pages, the rich tradition of orthopedic surgery will meet the full power of modern scientific inquiry. The intersection of neural and musculoskeletal systems, in all its complexity, deserves nothing less. We invite you to join us in building this new platform, one where the bench and the bedside are not separated by a valley of death, but connected by a shared commitment to advancing the science of musculoskeletal and neural recovery.

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