INNOVATIVE APPROACHES TO THE DEVELOPMENT OF NEXT-GENERATION ORTHOPEDIC DEVICES

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Orthopedic braces are commonly used orthopedic technical devices intended to support joint stabilization, alleviate pain, and assist rehabilitation following injuries, surgical interventions, or chronic conditions. The demand for these devices is steadily increasing as a result of the rising prevalence of musculoskeletal disorders, population aging, sports-related injuries, and the growing emphasis on preventive healthcare. Driven by the demand for non-invasive treatment solutions, the European orthopedic braces market is expanding at an estimated annual rate of 5–7%. Individuals over the age of 65 are particularly affected by conditions such as osteoarthritis, osteoporosis, and spinal disorders, which contributes to an increased need for braces designed for the back, foot, knee, and hip. At the same time, the growing popularity of recreational sports activities, including running and football, has led to a higher incidence of ligament injuries and post-surgical rehabilitation cases, further increasing the use of orthopedic braces and splints. Advancements in technology create new possibilities for the development of lightweight and "smart" braces incorporating sensor-based systems and manufactured using 3D printing technologies. In addition, the expansion of e-commerce and over-the-counter availability has improved the accessibility of orthopedic braces. Overall, the demand for these devices remains stable and continues to grow, particularly for preventive and rehabilitative applications. The aim of this study was to perform patient testing using next-generation equipment and to implement advanced manufacturing approaches for orthopedic braces. Biomechanical movement analysis was carried out using portable Digitsole Pro equipment. The biomechanical data obtained were subsequently applied in a targeted manner to the design and production of lower-limb orthopedic technical devices. Furthermore, the study highlights the potential and future prospects of 3D printing technologies in the manufacturing of orthopedic technical solutions.