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Advancements in Biomechanical Systems: Harnessing Cultured Muscles with Integrated Tendon Structures

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Introduction

The development of cultured muscles with tendon structures for modular bio-actuators represents a significant advancement in the field of bioengineering and robotics. This innovative approach combines tissue engineering techniques with robotics to create functional muscle-tendon units that can mimic the complex movements and capabilities of natural muscle. By utilizing cultured muscles with tendon structures, researchers aim to enhance the performance and versatility of bio-actuators, opening up new possibilities for applications in healthcare, prosthetics, and robotic systems. Bio-robots are crossover frameworks that coordinate natural parts with counterfeit parts [1]. The next generation of robots is expected to be bio-robots, which have the adaptability of living things, high energy efficiency thanks to the direct conversion of chemical energy into kinetic energy, self-healing, high controllability, and high accuracy. Soft robotics and nano-scale mechatronics are expected to be influenced by bio robots. Bio-actuators have been effectively applied to activate bio-robots as of late. An actuator that makes use of biological muscles is known as a bio-actuator. A counterfeit body and bio-actuators can be incorporated into a bio-robot. A large number of the bio-robots grew up until this point utilized dainty film shapes to culture and impel muscle cells on the film surface [2].

Description

The development of cultured muscles with tendon structures involves the integration of various disciplines, including tissue engineering, biomaterials science, and robotics. The process begins with the cultivation of muscle cells in a controlled laboratory environment. These cells are carefully nurtured and provided with the necessary nutrients and growth factors to promote their proliferation and maturation. Through a combination of precise biochemical cues and mechanical stimulation, the cells organize themselves into functional muscle tissue, resembling the architecture found in the human body. To create tendon-like structures, researchers employ various techniques such as electrospinning, 3D printing, or tissue engineering approaches. These methods allow for the precise arrangement of collagen fibers or other biomaterials that mimic the hierarchical structure and mechanical properties of natural tendons [3,4].

The cultured muscle tissues and tendon-like structures are then carefully assembled to form muscle-tendon units, which can be integrated into bio-actuators. The resulting bio-actuators offer several advantages over traditional actuators. One of the key advantages of these cultured muscles with tendon structures is their modularity. The bio-actuators can be designed and assembled in a modular fashion, allowing for scalability and customization based on the desired application. Multiple bio-actuator units can be interconnected to form larger robotic systems, capable of producing coordinated movements and generating significant forces. This modularity also facilitates easy repair and replacement of individual components, leading to enhanced durability and longevity [5].

Conclusion

The development of cultured muscles with tendon structures for modular bio-actuators represents a significant step forward in the field of bioengineering and robotics. By combining tissue engineering techniques with robotics, researchers have created functional muscle-tendon units that can replicate the capabilities of natural muscle. These bio-actuators offer enhanced performance, versatility, and scalability, making them suitable for a wide range of applications in healthcare, prosthetics, and robotics. Moving forward, further advancements in this field will focus on improving the efficiency and reliability of muscle tissue culturing techniques, optimizing the mechanical properties and functionality of the tendon-like structures, and refining the integration of muscle-tendon units into bio-actuators. With continued research and development, cultured muscles with tendon structures have the potential to revolutionize the field of robotics, enabling the creation of highly realistic and adaptable bio-actuators that can augment human capabilities and improve the quality of life for many individuals.

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Conflict of Interest

There are no conflicts of interest by author.

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