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The nanofiber-based biomimetic scaffolds for intervertebral disc tissue repair

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INTRODUCTION & AIM

The most common back and neck discomfort is closely linked to the dysfunction of the intervertebral disc (IVD) that undergoes degeneration. The IVD is composed of three distinct structures, namely the nucleus pulposus (NP), the annulus fibrosus (AF), and the vertebral end-plates (VEP). With advancing age, there is a decrease in the water content of the NP, resulting in the accumulation of mechanical loads on the annulus. Consequently, the NP experiences wear and cracking, leading to an ensuing inflammatory reaction and the occurrence of a prolapsed intervertebral disc. This process gives rise to a recurring cycle of accelerated degenerative disc disease.

METHOD

Current therapeutic approaches for degenerative disc disease provide pain relief or partially restore the native functions of the IVD. The application of biomimetic materials in tissue engineering represents a new strategy to restore the structure and function of IVD. Nanofiber scaffolds are widely utilized in the engineering of soft orthopedic tissues such as intervertebral discs due to their extensive surface area, structural similarities to components of the extracellular matrix, capacity to deliver bioactive signals, flexibility in polymer selection, and cost-effective fabrication methods. The fabricated IVD must simulate the structure of the native disc. Long-term implantation should show good shape maintenance, hydration, integration with surrounding tissues, and mechanical support and flexibility.

RESULTS & DISCUSSION

Biodegradable nano-fibers can carry anti-inflammatory drugs and cytokines for gradual release, aiding in healing and preventing inflammation. Synthetic scaffolds loaded with bioactive materials, stem cells, and growth factors can support IVD for long-term cure. The use of natural materials like silk with textile design features can imitate the IVD structure, providing cyto-compatibility, biodegradability, high strength, and stiffness, in tension and compression.

CONCLUSION

Nanofiber-based scaffolds, with their extraordinary properties, provide researchers with the opportunity to design scaffolds that can mimic the morphological and mechanical properties of the native IVD.

FUTURE WORK / REFERENCES

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