## **Intervertebral Disc Repair**

Intervertebral disc degeneration and herniation often necessitate surgical interventions including a discectomy with or without a nucleotomy, which results in a loss of the normal nucleus pulposus (NP) and a defect in the annulus fibrosus (AF). Due to the limited regenerative capacity of the Intervertebral disc tissue, the annular tear may remain a persistent defect and result in recurrent herniation post-surgery. Bioadhesives are promising alternatives but show limited adhesion performance, low regenerative capacity, and inability to prevent re-herniation.

i et al. report hybrid bioadhesives that combine an injectable glue and a tough sealant to simultaneously repair and regenerate IVD post-nucleotomy. The glue fills the NP cavity while the sealant seals the AF defect. Strong adhesion occurs with the IVD tissues and survives extreme disc loading. Furthermore, the glue can match native NP mechanically, and support the viability and matrix deposition of encapsulated cells, serving as a suitable cell delivery vehicle to promote NP regeneration. Besides, biomechanical tests with bovine IVD motion segments demonstrate the capacity of the hybrid bioadhesives to restore the biomechanics of bovine discs under cyclic loading and to prevent permanent herniation under extreme loading. This work highlights the synergy of bioadhesive and tissue-engineering approaches. Future works are expected to further improve the tissue specificity of bioadhesives and prove their efficacy for tissue repair and regeneration <sup>1)</sup>

## Spinal intervertebral disc regeneration versus repair <sup>2)</sup>.

Multiple regenerative strategies for intervertebral disc regeneration are being employed to reduce pain and improve quality of life. Current promising strategies include molecular therapy, gene therapy, cell therapy, and augmentation with biomaterials. Multiple clinical trials studying biologic, cell-based, and scaffold-based injectable therapies are currently being investigated.

Low back pain due to intervertebral disc disease represents a significant health and societal burden. Current promising strategies include molecular therapy, gene therapy, cell-based therapy, and augmentation with biomaterials. To date, there are no Food and Drug Administration-approved intradiscal therapies for discogenic pain, and there are no large randomized trials that have shown clinically significant improvement with any investigational regenerative treatment. Multiple clinical trials studying biologic, cell-based, or scaffold-based injectable therapies are being currently investigated <sup>3)</sup>.

## Systematic reviews

To identify the most frequently cited articles relating to the repair of intervertebral disc (IVD) and to summarize the key points and findings of these highly cited works, to quantify their impact on the developments of the disc disease treatment. IVD repair is an ever-growing and multi-disciplinary innovating treatment method for disc diseases. There are numerous literatures and related studies about it, promoting the development of the field. A comprehensive review and analysis of the most influential articles can help clarify the most effective strategy of IVD repair, and discover the

promising directions for future research.

Methods: The Thomson Reuters Web of Knowledge was searched for citations of all literatures relevant to IVD repair. The number of citations, key points, categories, authorships, years, journals, countries, and institutions of publications were analyzed.

Results: The most highly cited articles in IVD Repair were published over 30 years, between 1991 and 2017. Most works (No. 41) were published between 2005 and 2009. The most-cited article was Sakai's 2003 article which described the possibility of combining MSC and gel to repair IVD. The three most popular categories involved were Orthopedics [44], Clinical Neurology [34], Engineering, and Biomedical [24]. The three most common topics were regenerative medicine and the progenitor cells [33], biomaterials and cellular scaffolds [29], application of growth factors [25]. Author Masuda and the partners have 4 articles in the top 100 list. The Rush University has 12 articles in the top 100 list.

Conclusion: This report identifies the top 100 articles in IVD repair and acknowledges those individuals who have contributed the most to the study of the IVD repair and the body of knowledge used to the repair strategy making. It allows insight into the trends of this innovative and interdisciplinary subspecialty of spine surgery  $^{4)}$ .

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