Current Developments in Cell-Based Cartilage Repair Systems

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An review of the literature provides no evidence so far for normal regeneration of hyaline cartilage in animal cartilage repair models and still today's treatments for cartilage resurfacing are less than satisfactory, and rarely restore full function or return the tissue to its native normal state. However, cell biologists, bioengineers and surgeons work closely together developing biomedical orthopaedics with a combined knowledge of using biocompatible, biomimetic, biomechanic suitable scaffolds seeded with chondrogeneic cells and loaded with bioactive molecules that promote time relapsed cellular differentiation and/or maturation.

Subsequently, we will see more and more of different cell-containing resorbable scaffolds to be used for arthroscopic implantation. Some scaffolds with cells cultured for several weeks (mature grafts) while other just seeded with cells 1-2 days prior to surgery (immature grafts) or even just at implantation time. The cartilage repair technology with in vitro expanded autologous chondrocytes needs to be further improved. The maintenance of the original phenotype by isolated chondrocytes grown in vitro is an important requisite for their use and handling in a future transarthroscopic technique in articular cartilage resurfacing. The future research in cartilage repair will be directed more and more between biology and materials science working with matrices containing growth factors guiding the implanted chondrogeneic cells to produce a restoration of the injured cartilage, as near as possible a full regeneration.

Research in regenerative biology involves the cell and molecular biology, developmental cell biology, immunology, and polymer chemistry. This new direction in medicine will use three strategies: transplantation of cells to form new tissue in the transplant site, implantation of bio artificial tissues constructed in vitro, and induction of regeneration in vivo from healthy tissues next to an injury [41].

However, regarding the future for cartilage repair in the new century, the idea is to transplant stem/progenitor cells, or their differentiated products, into a cartilage lesion site where they may form new tissue, or the cells could be used to construct a bio artificial tissue in vitro to replace the original tissue or organ. Bio artificial tissues are made by seeding stem or differentiated cells into a natural or artificial biomaterial scaffold shaped in the appropriate form, then implanting or pasting the construct into the defects of the damaged cartilage. Theoretically, the use of stem cells is preferable to the use of differentiated cells harvested directly from a donor because stem cells have the potential for unlimited growth and a rich supply. Such so-called uncommitted cells are capable of a broad range of chondrogeneic expression and could provide a regenerative tissue that recreates the embryonic lineage transitions originally involved in joint tissue formation. However, the recent research described in this talk shows that the use of true committed chondrocytes is still reasonable but more research is needed to know how to make use of them in a more efficient way.

The presentation will include a discussion on the actural state of cartilage repair and speculations for the future cartilage tissue engineering with cells in scaffolds, biocomposites and/or hybrid-semi-biological approaches.