關節修復與再生的細胞外間質改變

Extracellular Matrix Changes in Joint Repair and Regeneration

中文摘要

從老鼠尾韌帶萃取的第一型膠原蛋白，研發出一種有生物降解性的重組膠原蛋白模板，使用在顳顎關節關節板的修復與再生。本實驗目的是研究關節關節板組織細胞外間質的變化以及再生的機制。

本實驗使用 32 隻紐西蘭白兔，4 隻做假手術，4 隻為控制組而其餘動物則做部分顳顎關節關節板切除手術。在關節板被切除的動物，以重組膠原蛋白植體來再生關節板。假手術及對照組的動物，並沒有使用任何植體。之後，手數植入後一個月、兩個月、三個月將關節製成組織切片，使用第一型膠原蛋白與第二型膠原蛋白抗體做免疫組織染色以及 H&E 染色來觀察組織變化。

除了比較植體治療再生的關節板與自然狀態關節板的相異性，以確立再生關節板的修復與功能。並觀察再生時細胞外間質的改變與細胞的變化，進一步探討再生的機制。

結果顯示。在部分切除關節板且沒有使用植體的關節，隨著時間進展，關節的病變愈嚴重。三個月後關節軟骨完全破壞，骨頭裸露。纖維化區域會有大量第一型膠原蛋白。而第二型膠原蛋白則表現在增生的軟骨區域。相對的，使用重組膠原蛋白模板植體的關節，關節板會展現再生作用。隨著時間關節板再生愈多，對關節軟骨的保護愈多。關節板再生組織的細胞外間質會先從細胞分泌，再形成不規則排列纖維，之後經由重塑而成纖維排列規則緊密的關節板。膠原蛋白的表現也會跟著增加。再生組織的細胞會漸漸分化成軟骨母細胞，細胞周圍的纖維呈現緻密排列而看起來較小。最後，可以觀察到再生組織的細胞外型、細胞外間質組成與膠原蛋白表現都會近似於正常組織。

結論：重組膠原蛋白模板植體能有效促使手術引發缺損的關節板再生。關節板組織再生機制與細胞外間質有密切的關聯，特別是第一型及第二型膠原蛋白。

英文摘要

Reconstituted type I collagen matrix extracted from the rat tail tendon was utilized to regenerate the temporomandibular joint disc in the rabbit. The aim of this study was to examine extracellular matrix changes and mechanisms of regeneration in the temporomandibular joint disc.

Thirty-two New Zealand rabbits underwent either sham surgical procedures or partial temporomandibular joint discectomy. In animals that underwent partial discectomy, the discs were replaced by reconstituted collagen templates. Some of the surgerized animals did not receive any implant. Tissue sections of the surgerized temporomandibular joint were obtained at 1-, 2-, and 3-month interval after surgery. Tissue morphology was evaluated either by gross and histology. Collagen changes of the disc were determined using immunohistochemistry.

To confirm the structure and function of regenerative disc, this study compared the

differences of regenerative and native disc. Additionally the changes of extracellular matrix and cell morphology were taken to understanding the mechanism of disc regeneration.

Histology showed that the joint appeared more severe degeneration in the partially discectomized joint without implantation when time passed. After 3 months, the cartilage was fully destroyed and the bone was entirely exposed. In untreated joints, the condyle exhibited type I collagen in the fibrous regions and type II collagen in areas of proliferative cartilage. In contrast, discs that recievied reconstituted collagen template regenerated and the extracellular matrix of regenerative disc could return normal to protect joint. Cells in the regenerative tissue expressed extracellular matrix first, and then the tissue formed fibers randomly. Gradually, fibers became regular and compact by tissue remodeling and collagen expression increased. The reparative cells differentiated into chondroblasts, and the peri-cellular fibers showed a heavy density. Cell morphology appeared smaller compared to the early stage of repair. Finally, the morphology, extracellular matrix composition and the collagen expression of the disc and condyle was similar to that of normal tissue.

In conclusion, the reconstituted collagen template effectively facilitated a regeneration for the surgically discectomized discs. The regeneration of articular discs had correlate closely with extracellular matrix, especially type I and type II collagen.