

Scaffold free cartilage by rotational culture

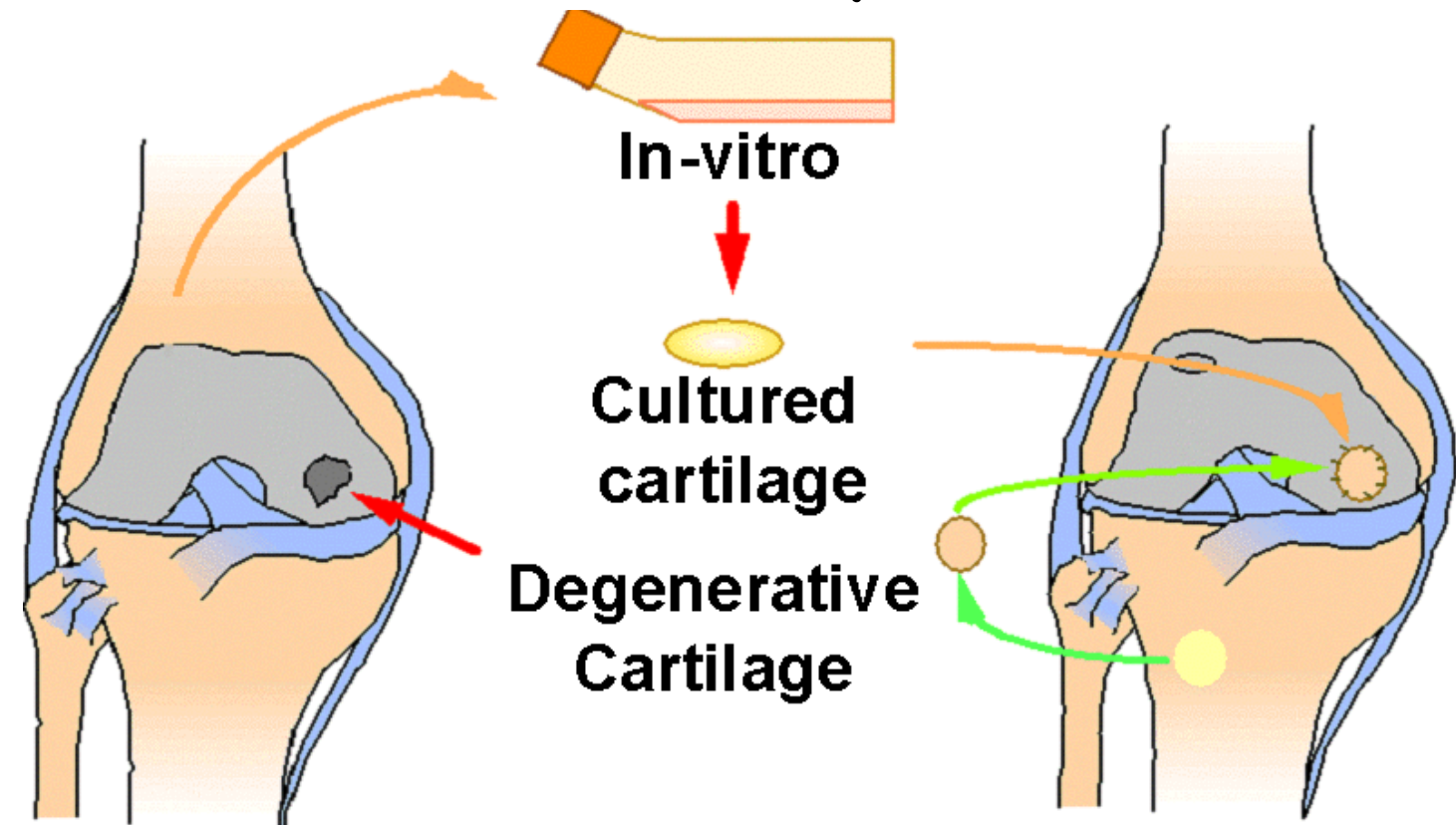
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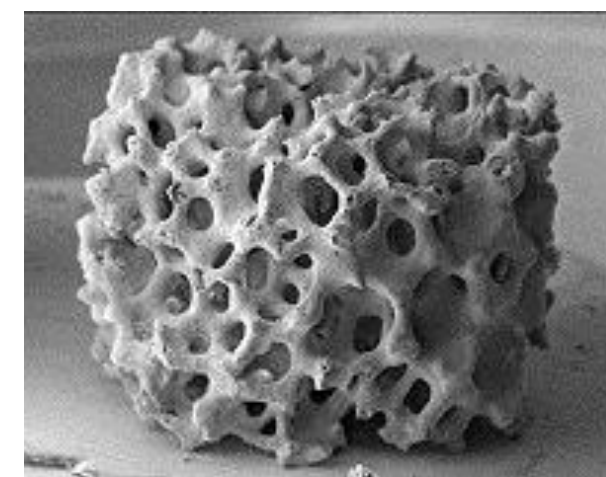
Regeneration of Cartilage using Tissue Engineering

Redifferentiation of Dedifferentiated Chondrocyte



Problems for cartilage tissue engineering

- 1. Regulation of cell **differentiation**
- 2. **Homogeneous cell inoculation**

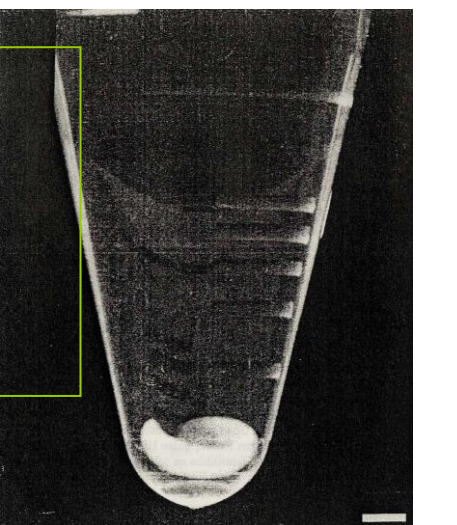


<http://www.bdj.co.jp/falcon/articles/31qe0k000005jsi.html>

Phenotypic modulation by Pellet culture system

- **Redifferentiation** from dedifferentiated chondrocytes is easy

- Only small one cell-aggregate formation each tube was capable
- Complicated manipulation



Ballock and Reddi, J Cell Biol, 1994

Question: How do we realize the formation of cartilage-like tissue?

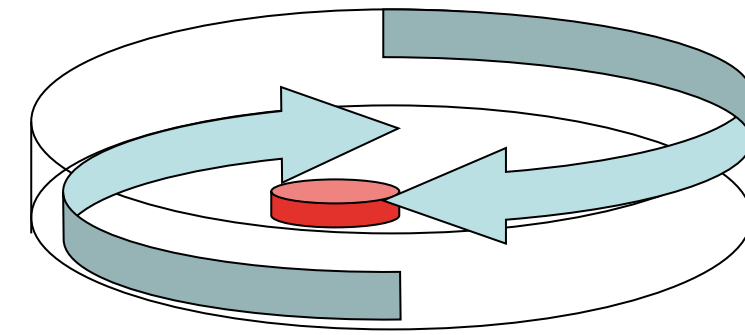
- Speculative idea
 - cell-cell interaction
 - diffusion of nutrition and oxygen by flow
 - mechanical stimulation (shear stress?)

Scaffold-free

High-density culture + gyrational culture

Rotational culture

- Diffusion Nutrition and Oxygen
- Loading of Mechanical Stress Centrifugal forces Drag force

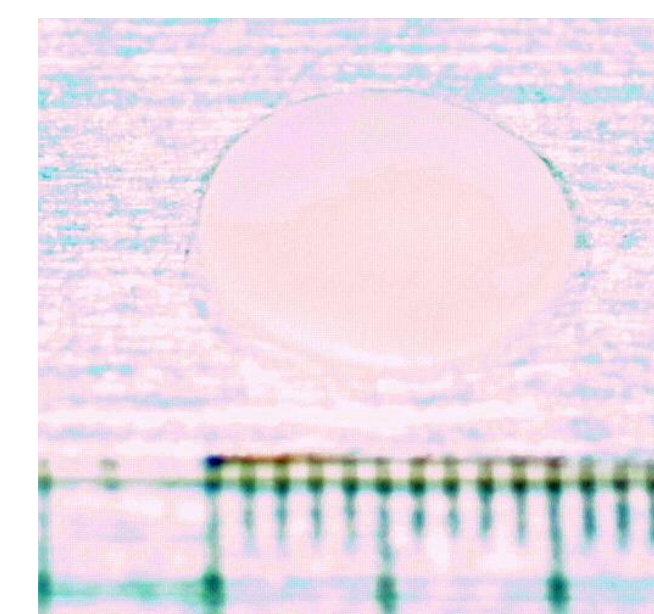


Appearance

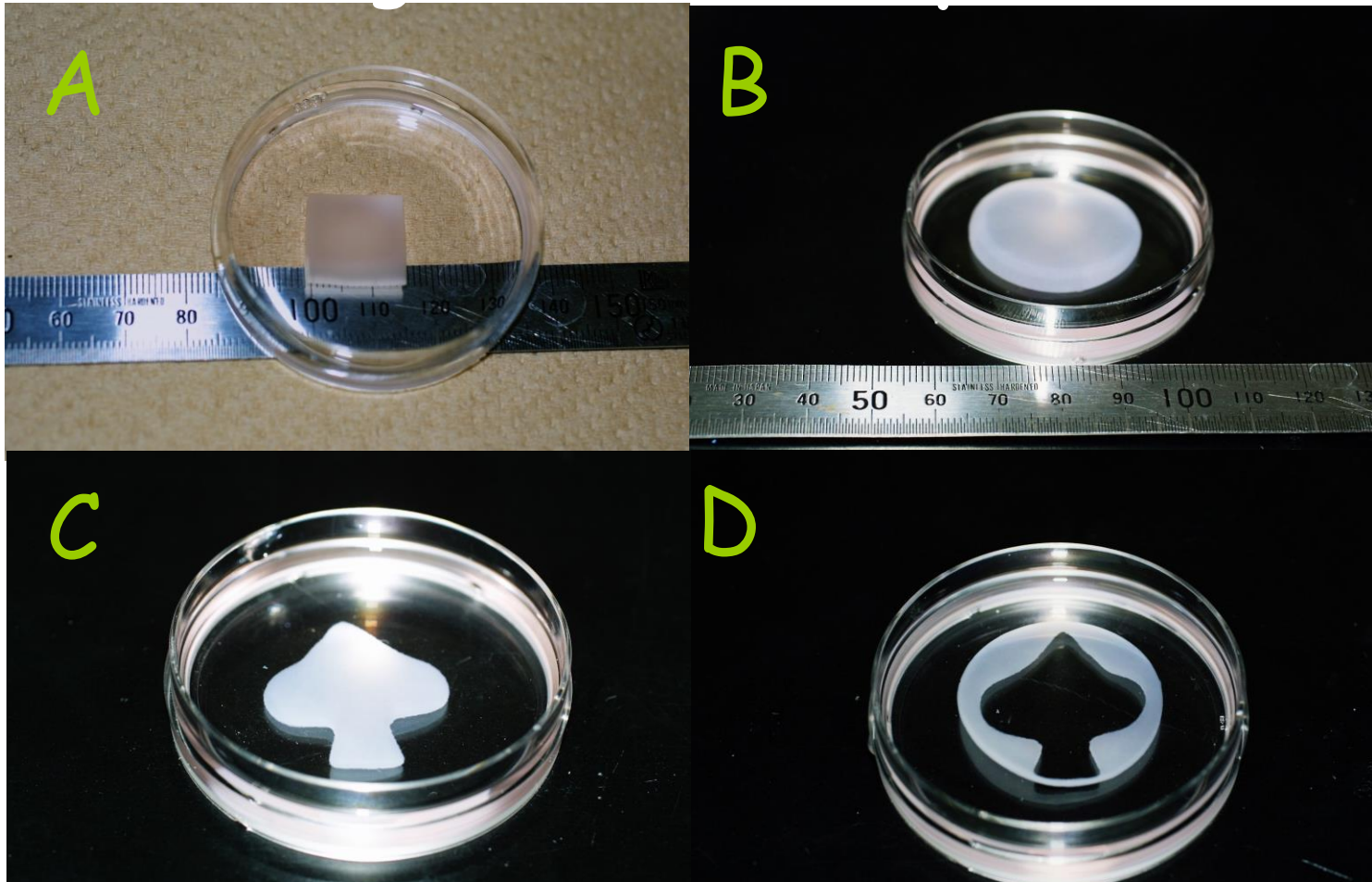
• Rotational



• Static

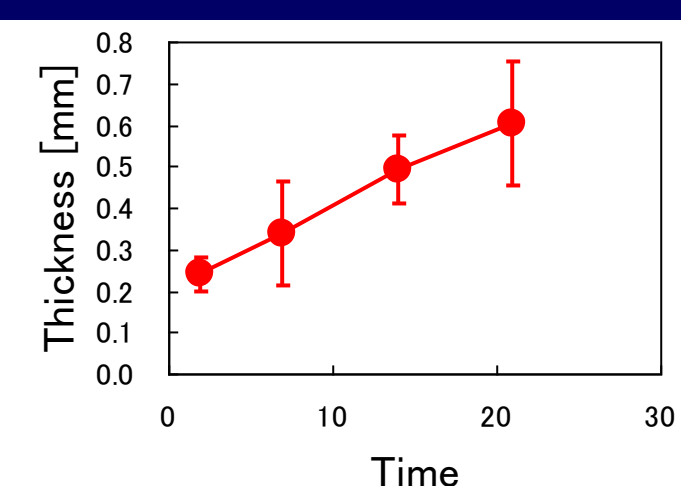


Shapes of Tissue Engineered Cartilages without any Scaffolds

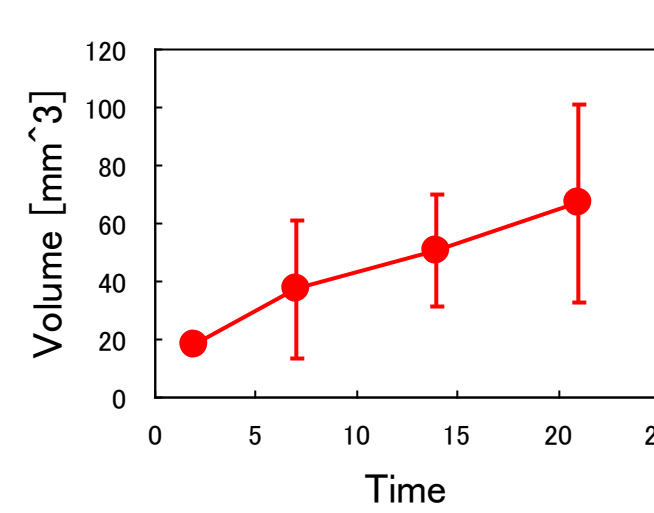
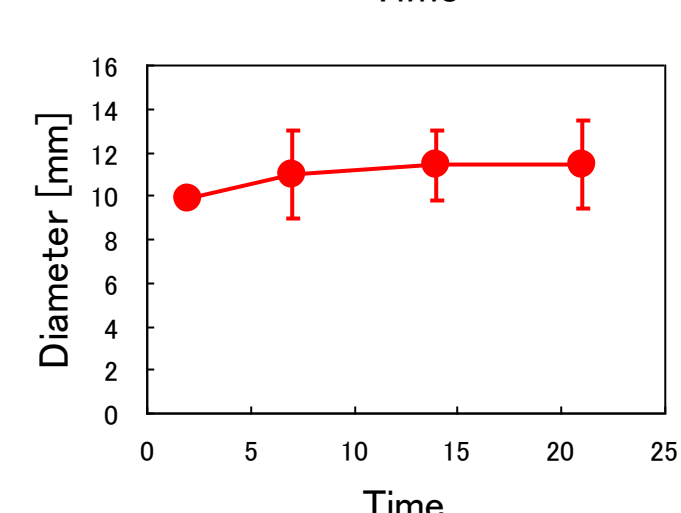


A: Square, B: Big circle, C: Spade, D: B-C (3 weeks culture)

Growth Curve of Tissue Engineered Cartilage by Rotational Culture



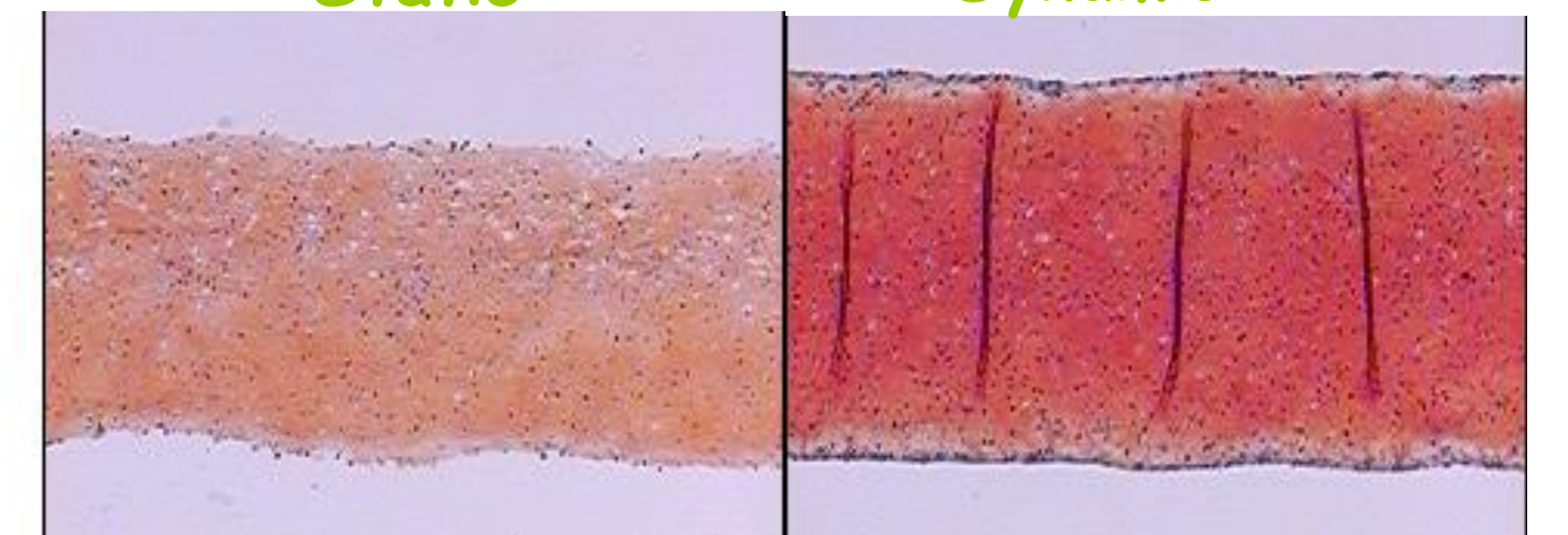
- P2
- Dynamic culture
- 1.5×10^7 cells
- 2 days ~ 21 days
- n=4 mean \pm S.E.



The tissue engineered cartilage cultured under dynamic conditions was strongly stained with Safranin-O. (3 weeks culture)

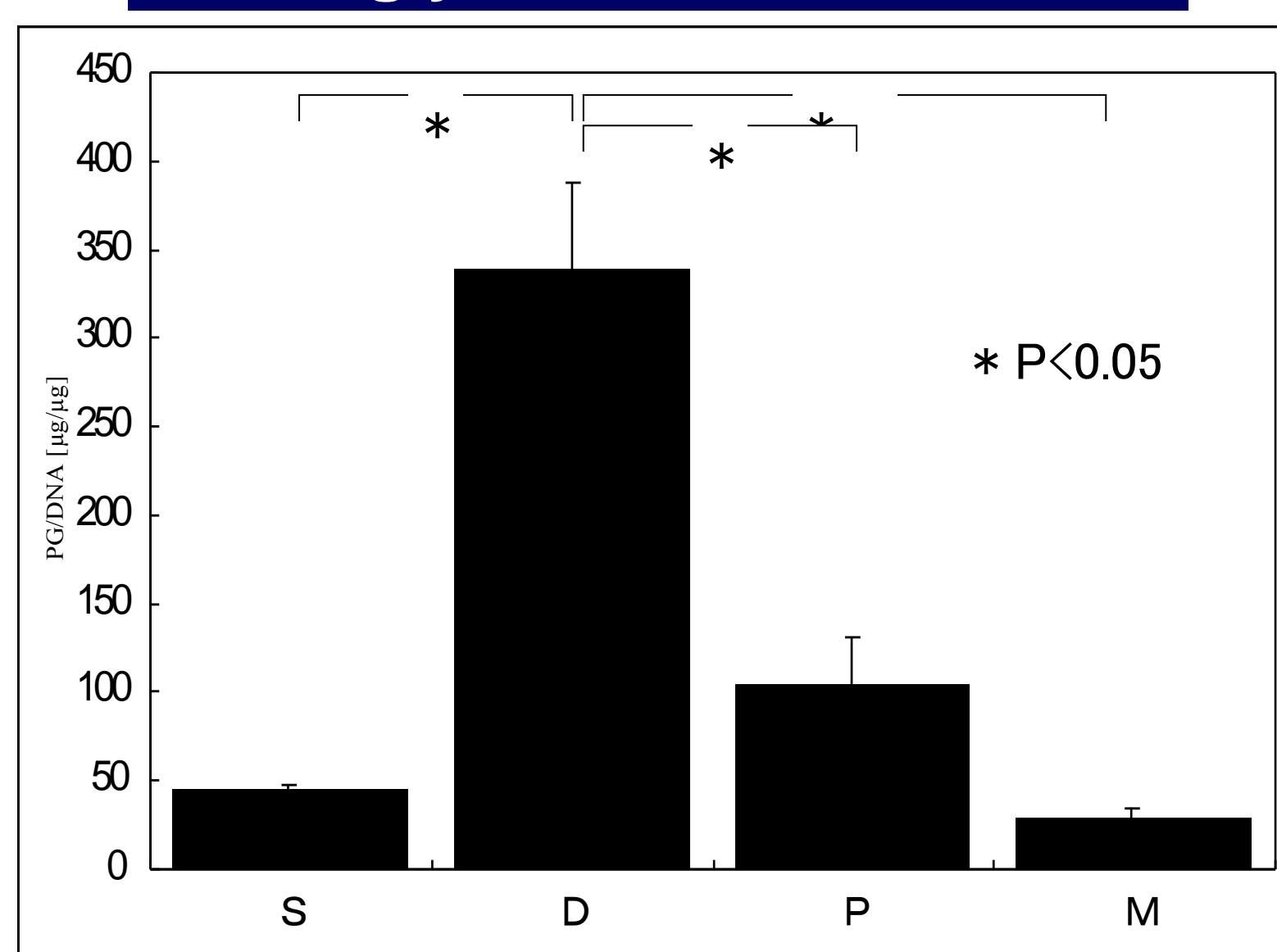
Static

Dynamic



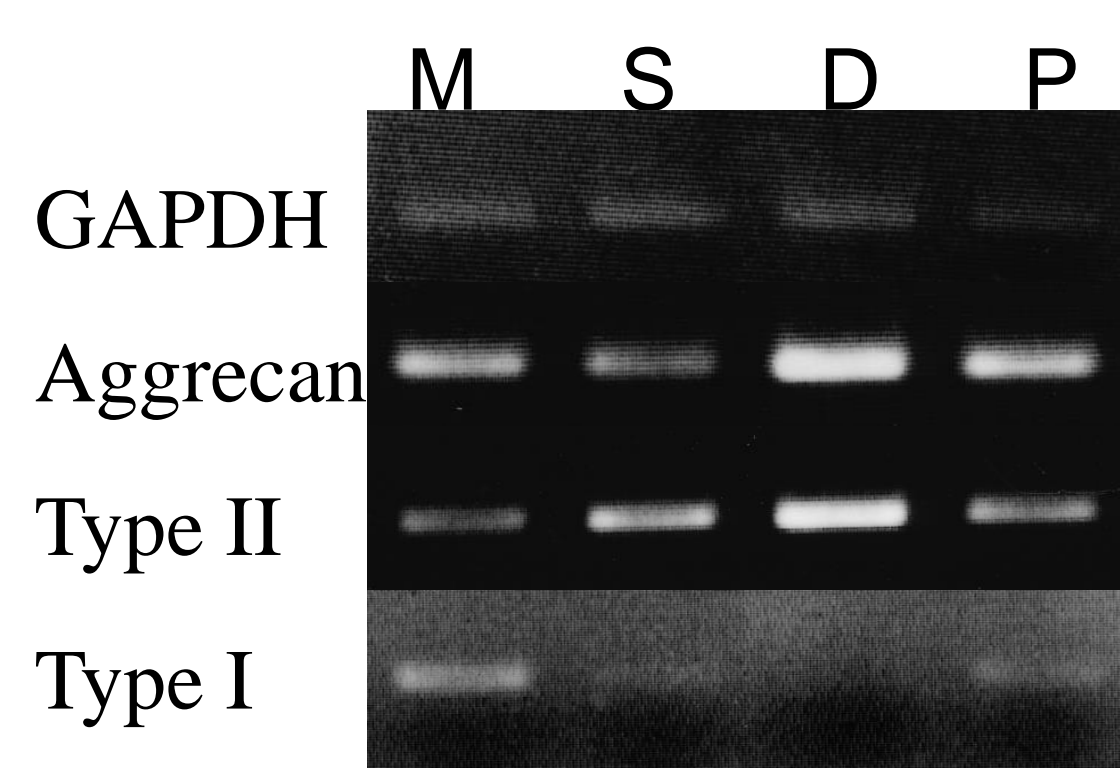
200µm

Proteoglycan Production Level



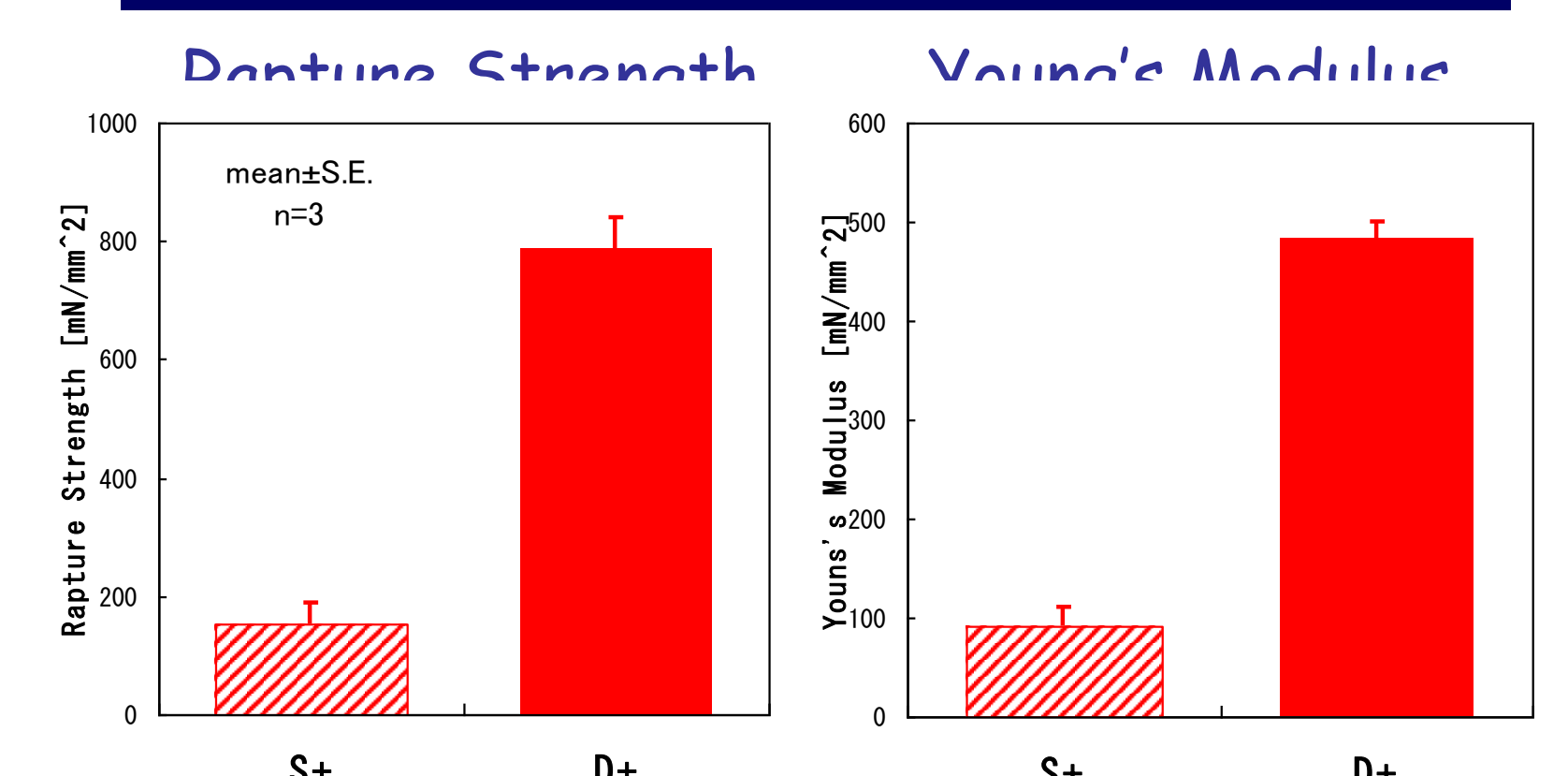
The tissue engineered cartilage cultured under dynamic condition showed the highest production of proteoglycan.

Gene expression RT-PCR analysis



M; monolayer, S; static culture of scaffold free cartilage, D; Rotational culture of scaffold free cartilage, P; Pellet culture.

Results of Mechanical Tests



The tissue engineered cartilage cultured under dynamic condition showed better mechanical properties than that of static one.

- Conclusion; It was suggested that cartilage tissue without any scaffold by a mold technique cultured under dynamic conditions has a possibility to become a suitable tissue-engineered cartilage model.