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Investigating the homing behaviour of endogenous stem cells in a joint bioreactor to regenerate articular cartilage

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Articular cartilage: defect treatments

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Chondroplasty

Microfracture (MF)

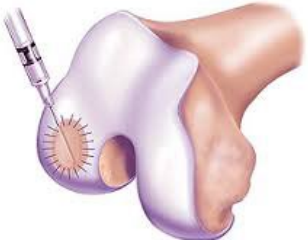
Focal chondral defect

Repair

Restoration

Osteochondral Allograft (OCA)

Autologous Chondrocyte Implantation (ACI)



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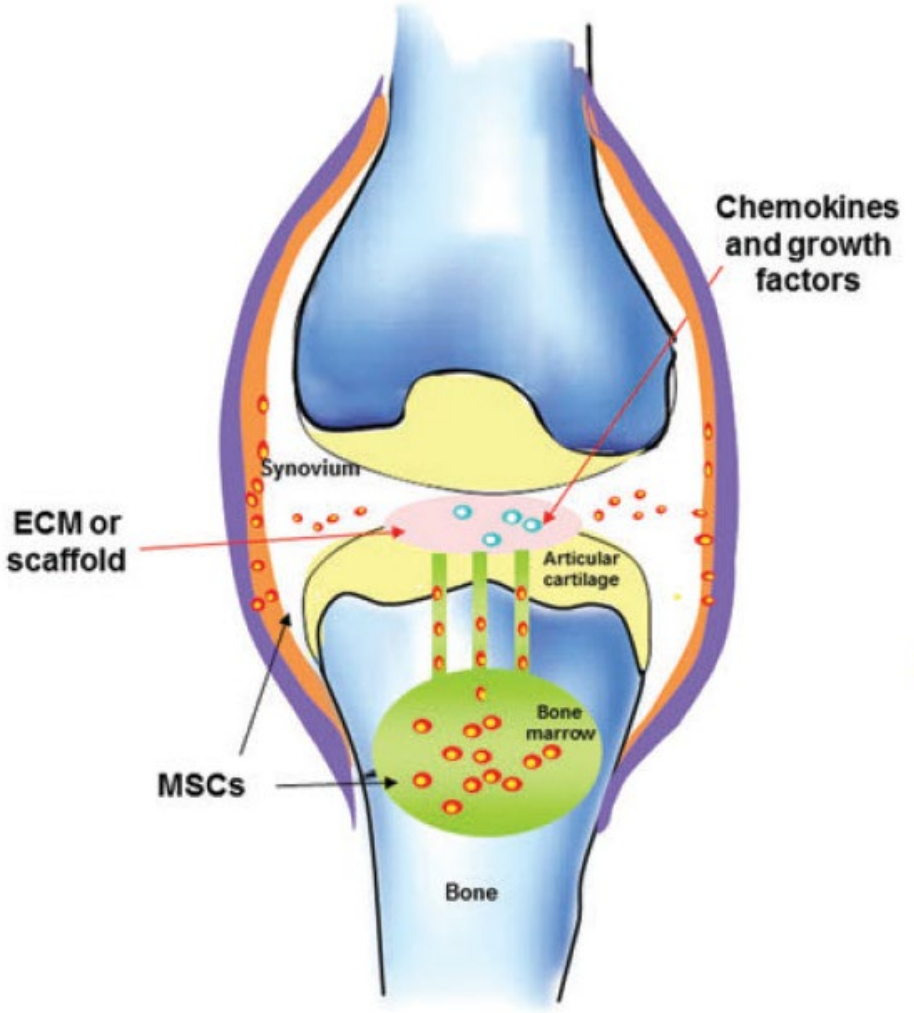
Falah M et.al. 2010, Internal Orthopedics. Review

The general concept of endogenous cartilage regeneration



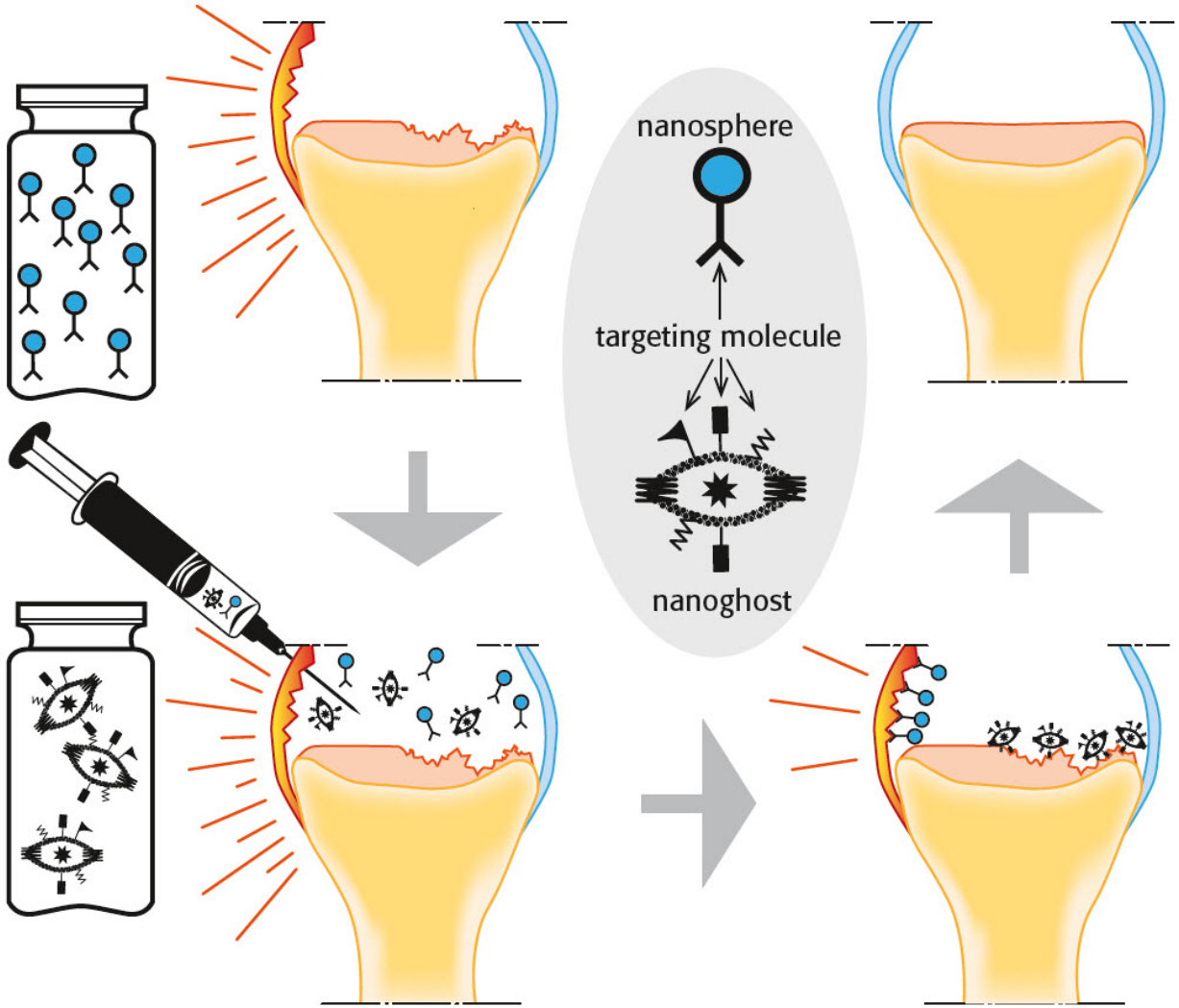
Migration of MSCs into cartilage defects

Induction of chondrogenic differentiation in the defect

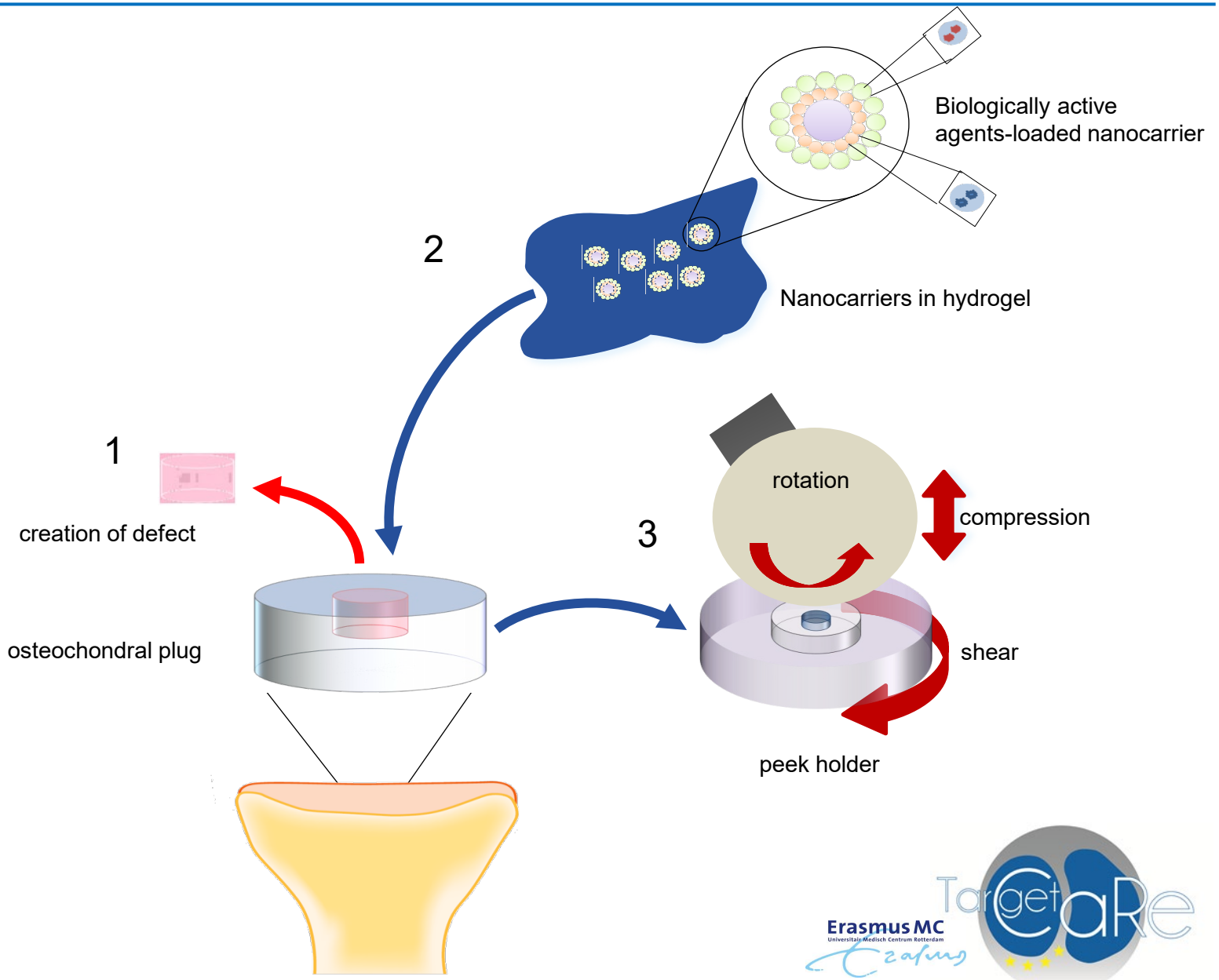
Regeneration of hyaline cartilage

Gun-Il Im (2016), Tissue Eng B

TargetCare Project Aim

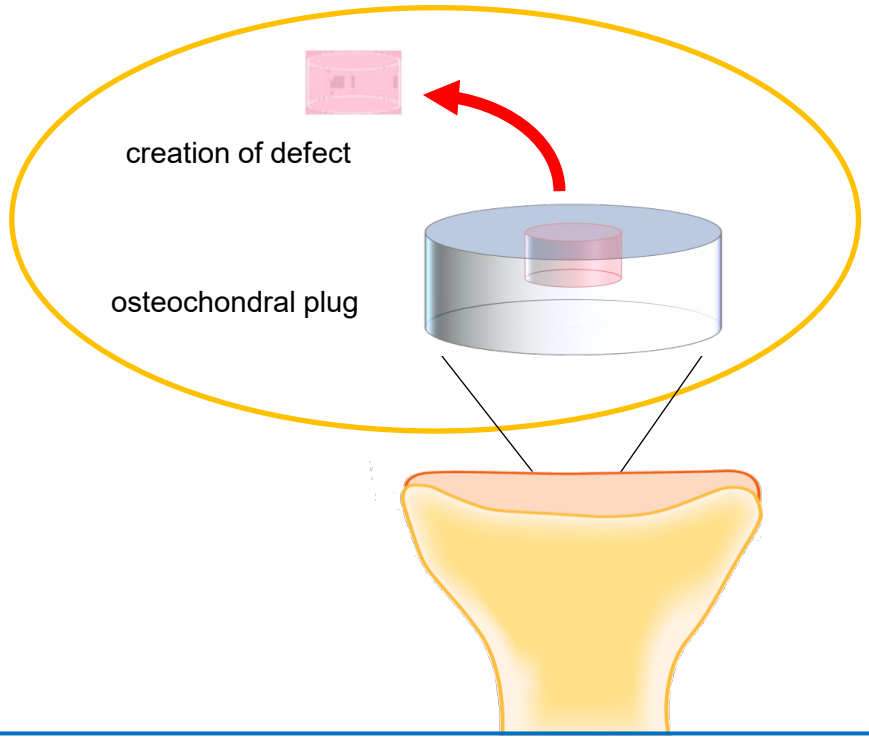


Experimental flow chart



Aims of the project

1. Osteochondral defect model obtainment



Osteochondral defect model obtainment

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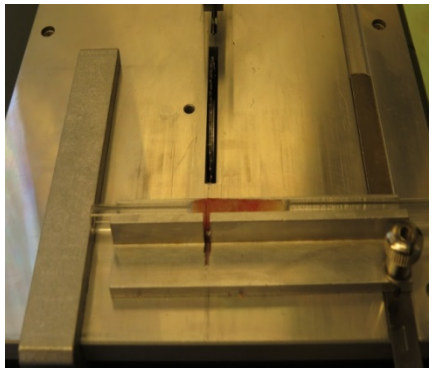
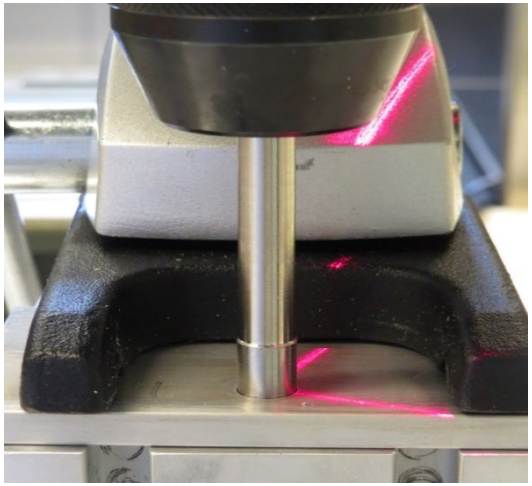
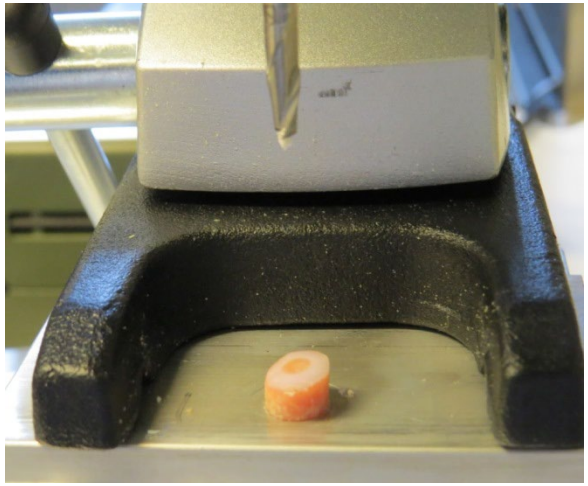
How to harvest osteochondral explants



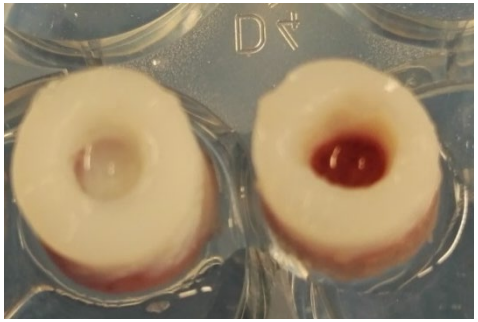
How to create defect in the explant





Chondral defect

Osteochondral defect



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Assessing explant viability: LDH assay

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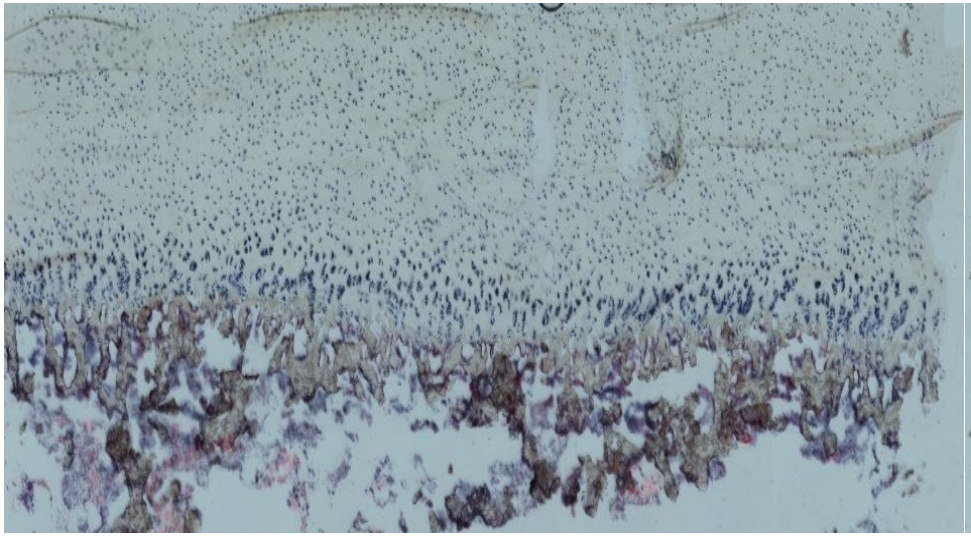
Osteochondral explant



Osteochondral defect

Cryosection of undecalcified plugs (10um)

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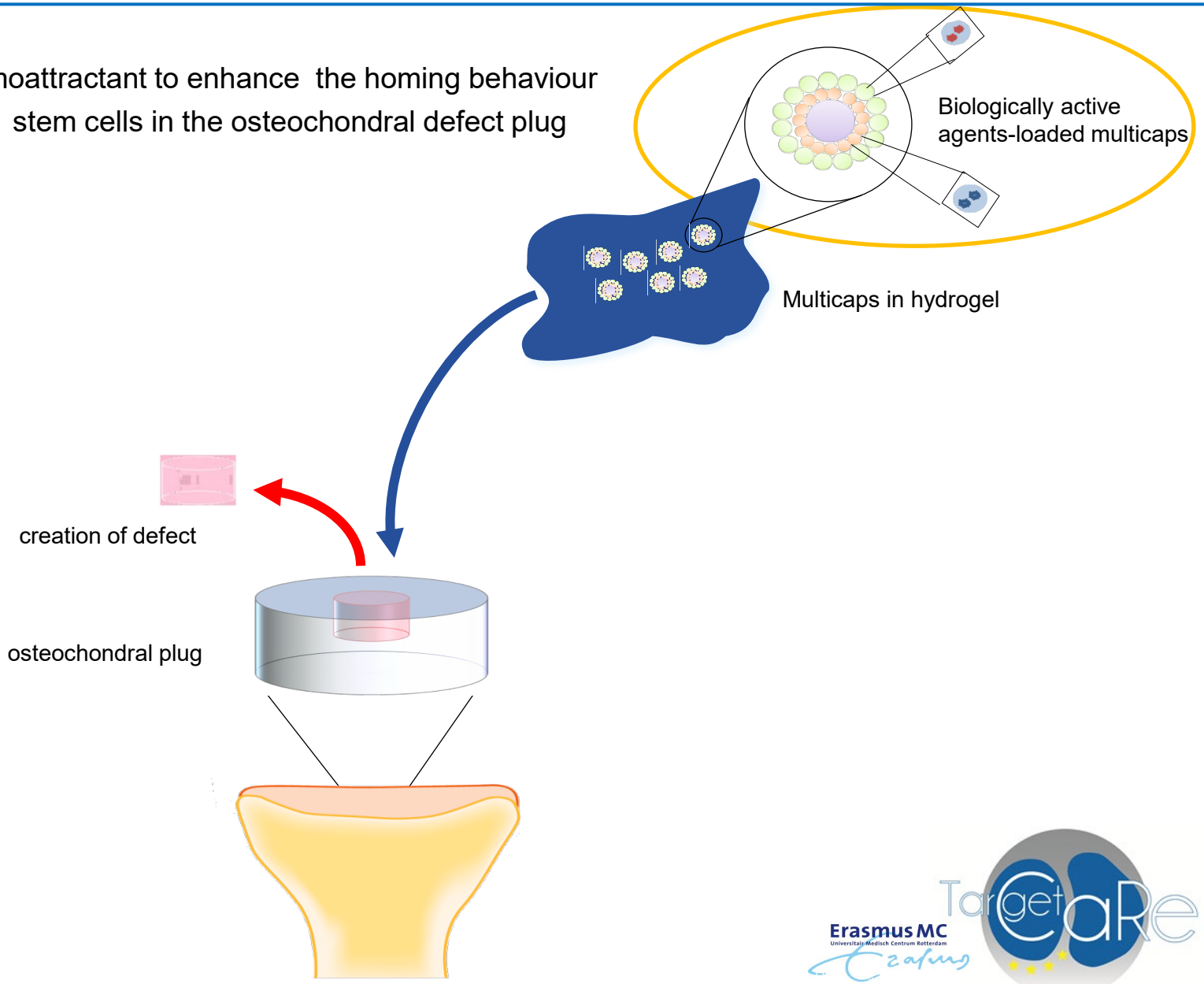
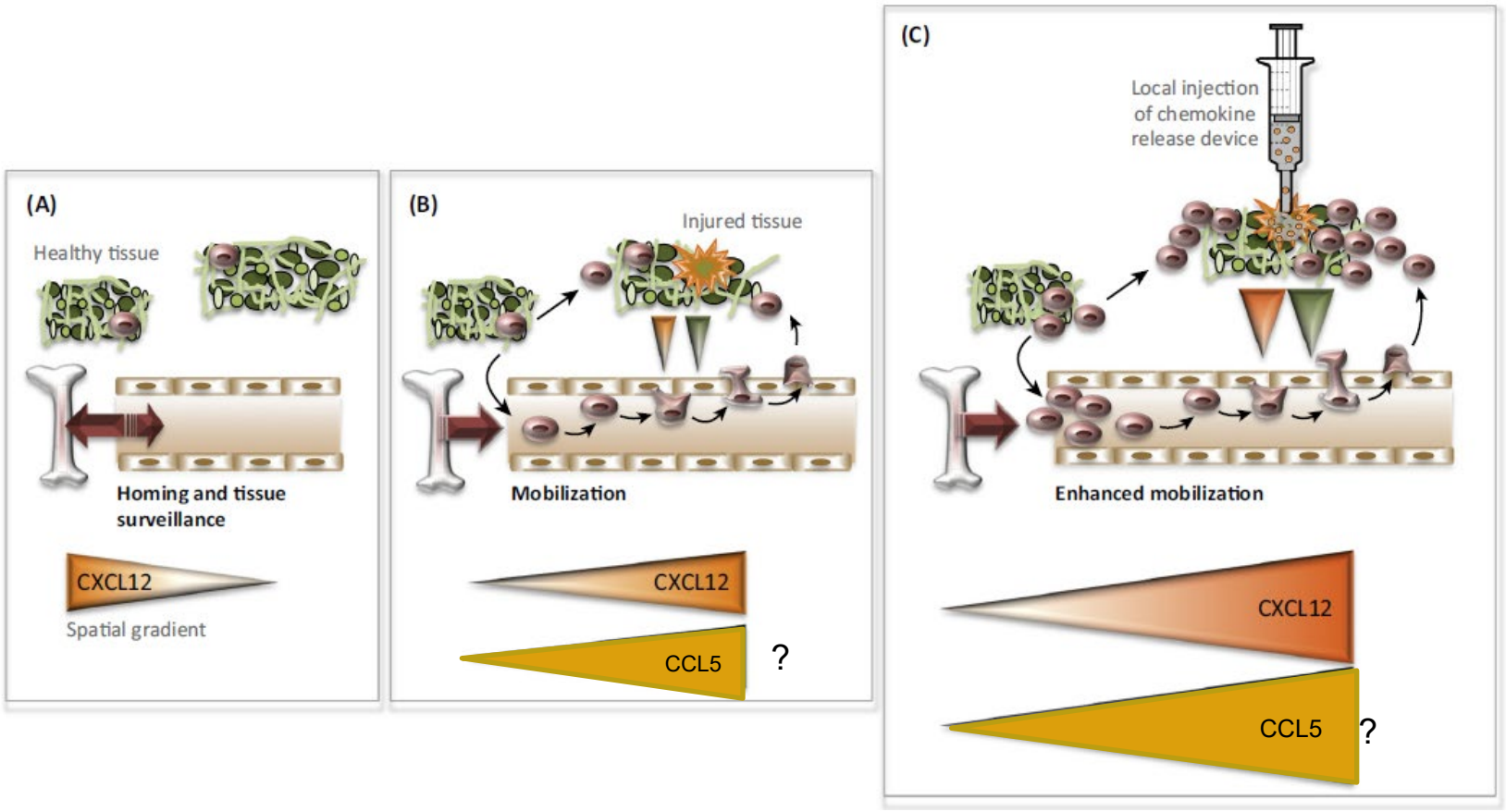
Aims of the project

2. Choose a chemoattractant to enhance the homing behaviour of endogenous stem cells in the osteochondral defect plug

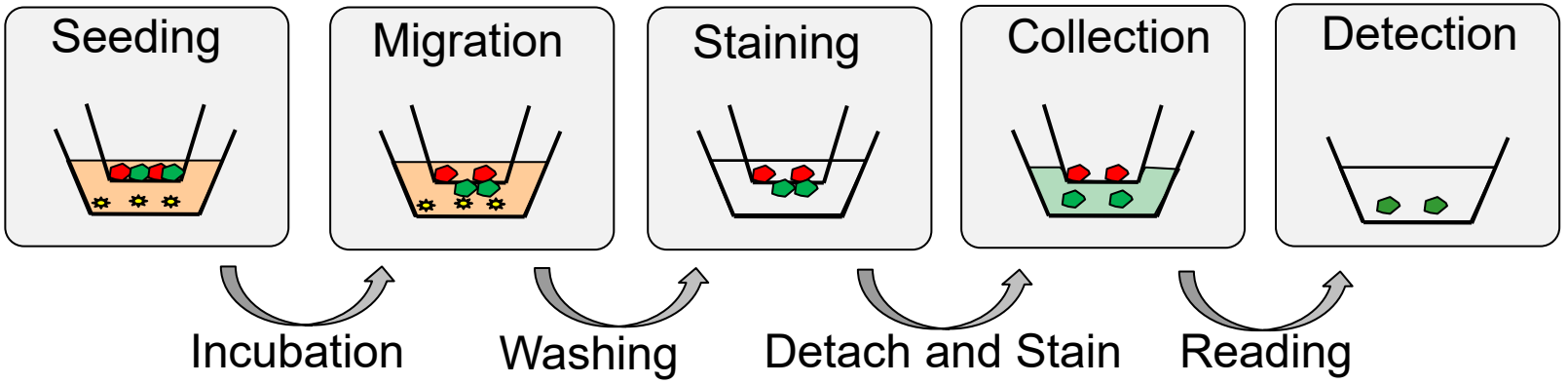


Toward *in situ* tissue engineering: chemokine-guided stem cell recruitment



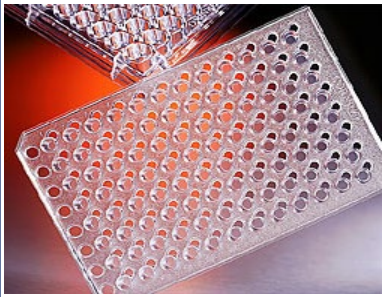
Kristin Andreas et al, 2015 Cell Press

Chemotaxis assay – Design



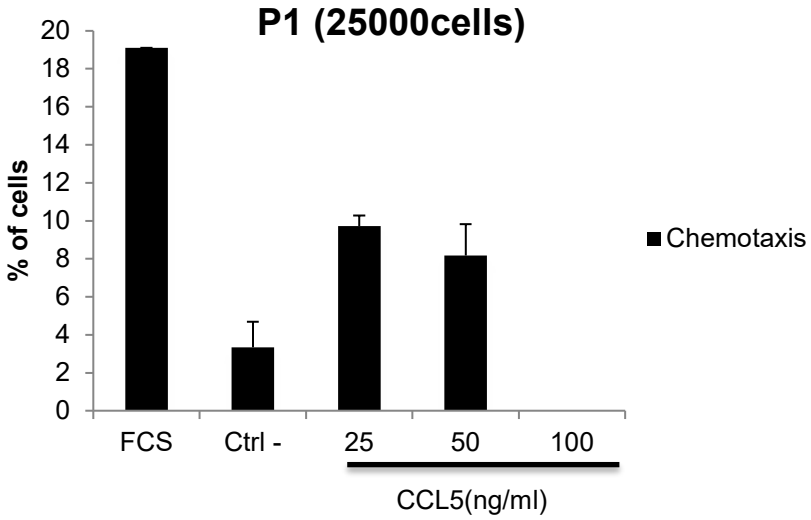
hMSC population: Are they attracted by CCL5?

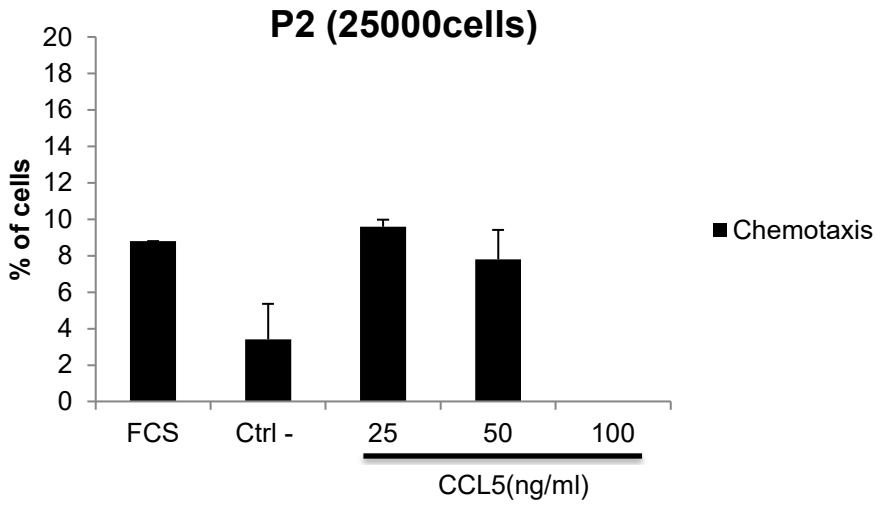
	Chemotaxis
Well	1
Top	Cells
Bottom	CCL5



96 well Transwell ®

Migration assay (17h incubation)

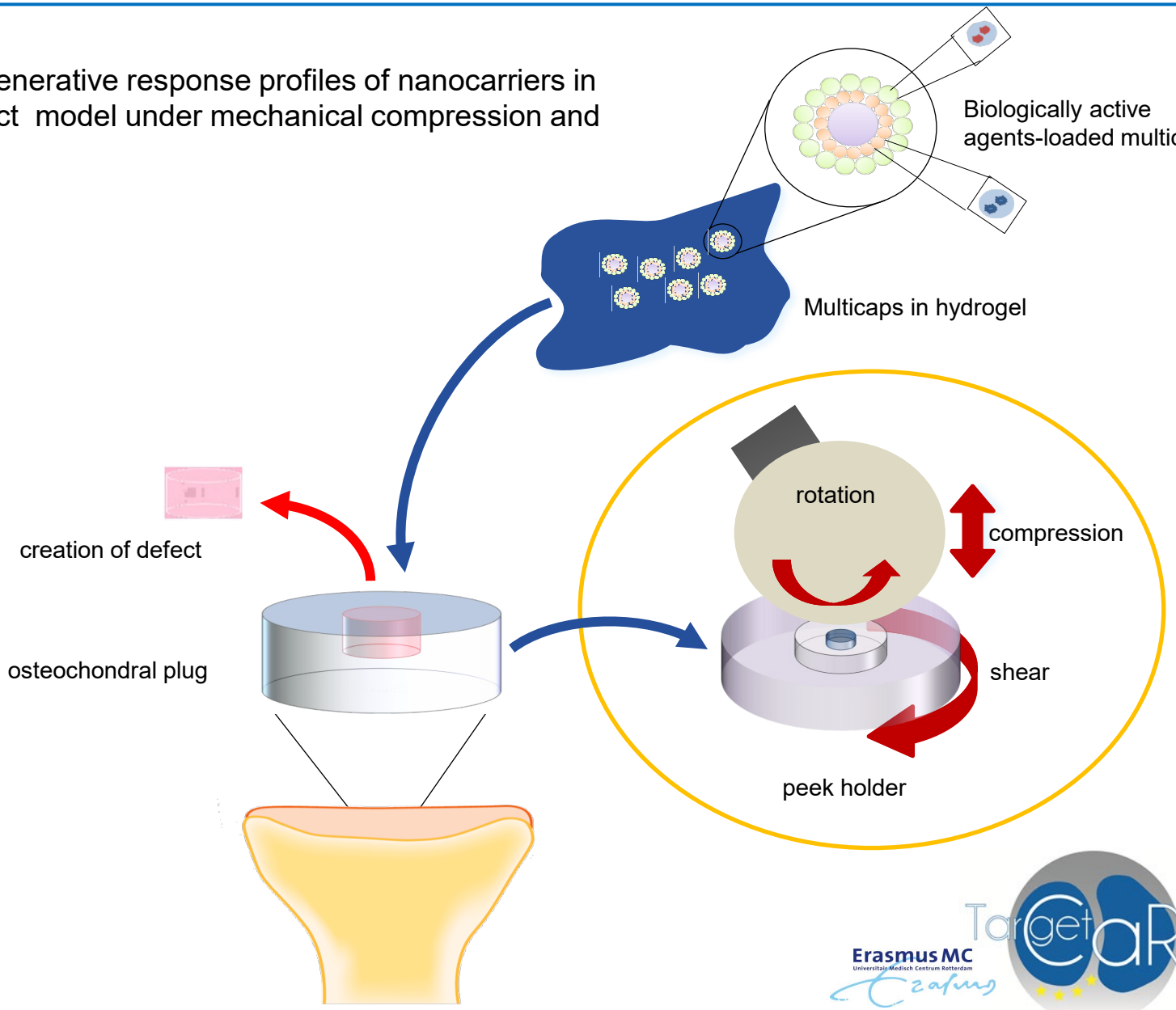




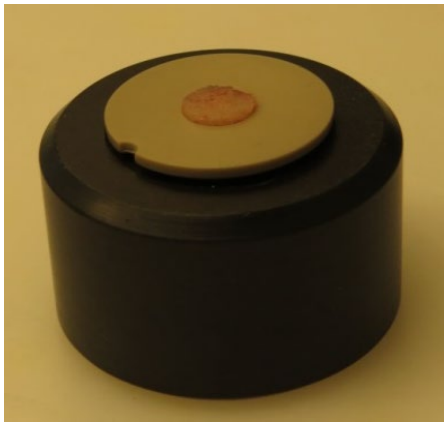
- No clear difference between P1 and P2
- The lowest concentration of CCL5 seems to work better.

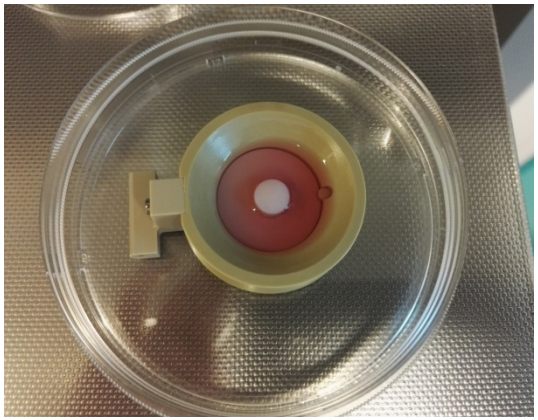
Aims of the project

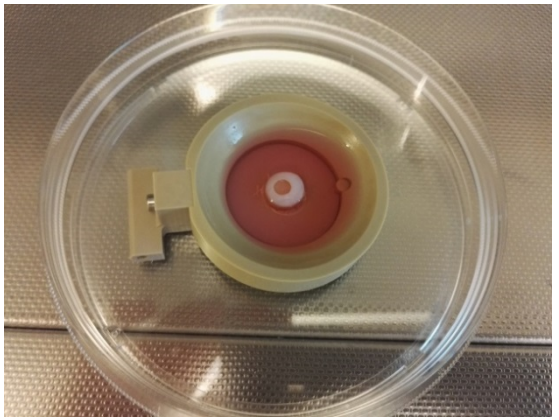
3. Investigate regenerative response profiles of nanocarriers in the cartilage defect model under mechanical compression and shear

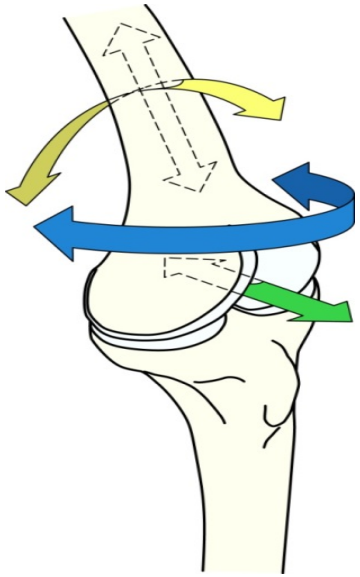


Joint Bioreactor loading – Pilot Study

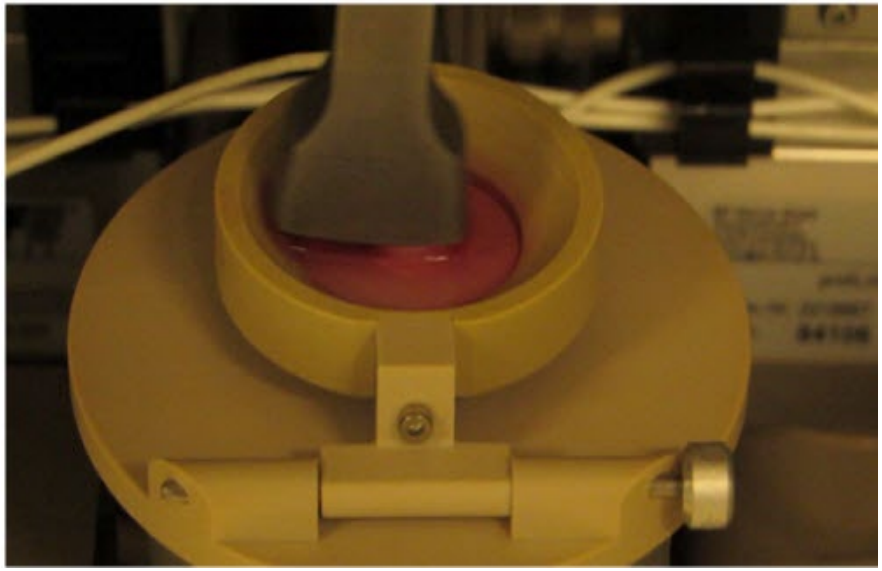








In-vivo



Ex-vivo

Force applied: 30N
Displacement: 0.6mm
Rotation: 6.5°

Grad et al, (2011)…

Summary

- Establishment of osteochondral defect model
- Viability assay has been optimized for osteochondral explants on cryosections
- Migration assay suggests dose dependent effects
- Bioreactor loading of explants is feasible

Acknowledgment

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