

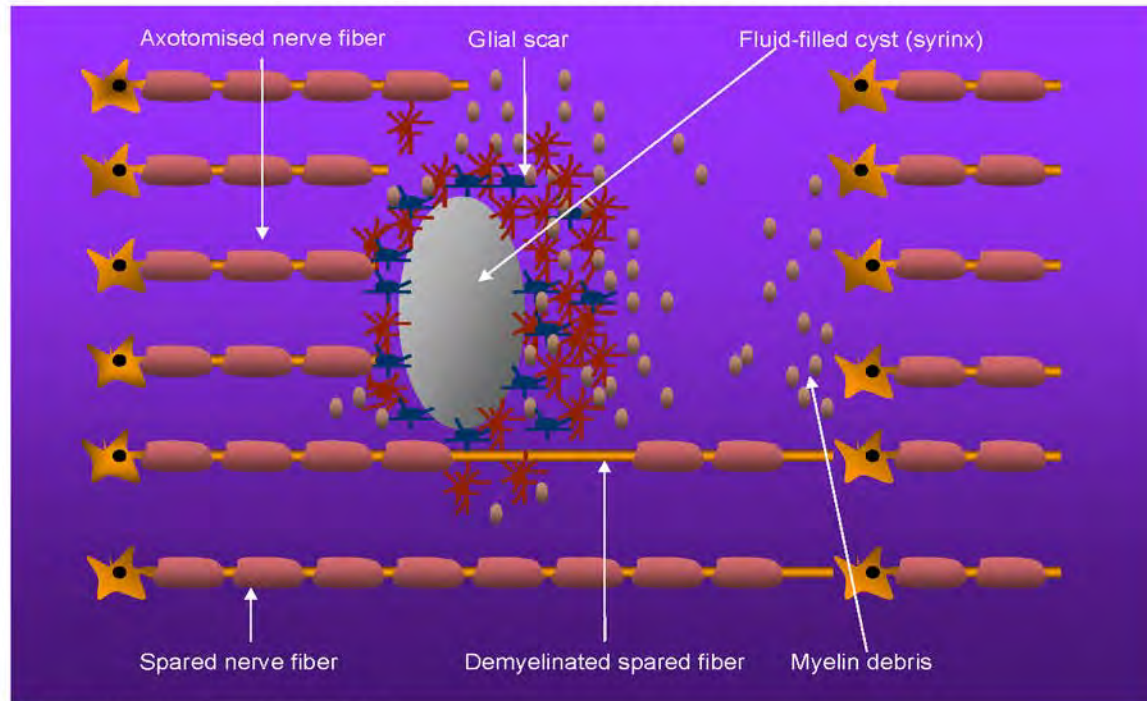
# 3R i Regenerativ Medisin

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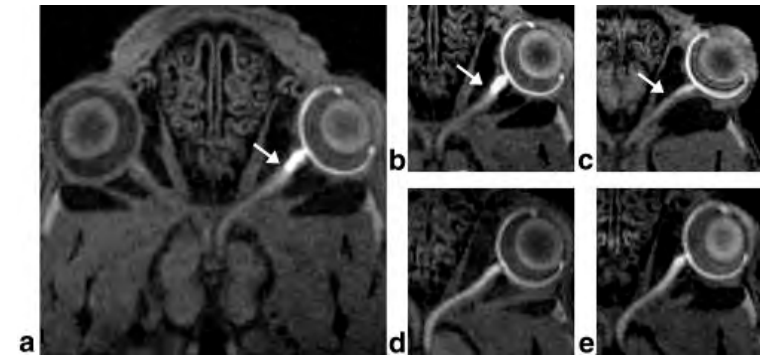
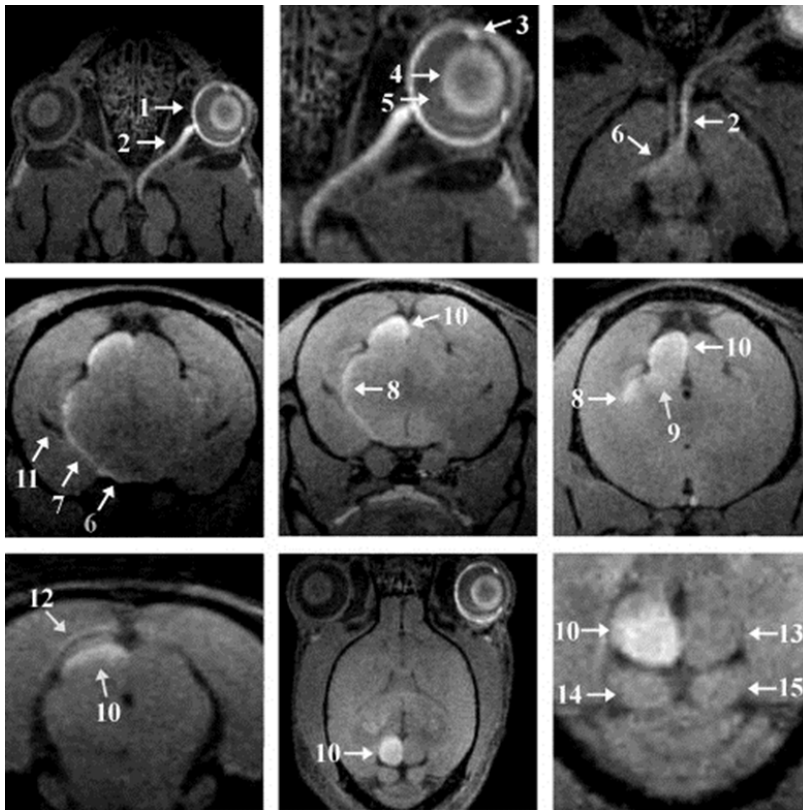
Norecopa Meeting, Oslo 05-06-14

## Bakgrunn

- Regenerativ nevrobiologi er studiet av hvordan man kan reparere skader og sykdommer i det sentrale nervesystemet
- Genetiske, molekylære og cellulære mekanismer
- *In vitro* versus *in vivo* modellsystemer
- Modellsystemene bør representere en skade eller sykdomsprosess



(I Sandvig - Adapted from Barnett & Riddell, 2007)



Thuen M, Singstad TE, Pedersen TB, Haraldseth O, Berry M, **Sandvig A** and Brekken C. Manganese-enhanced MRI of the visual pathway and optic nerve injury in adult rats. *J Magn Reson Imaging* 2005;22:492-500.

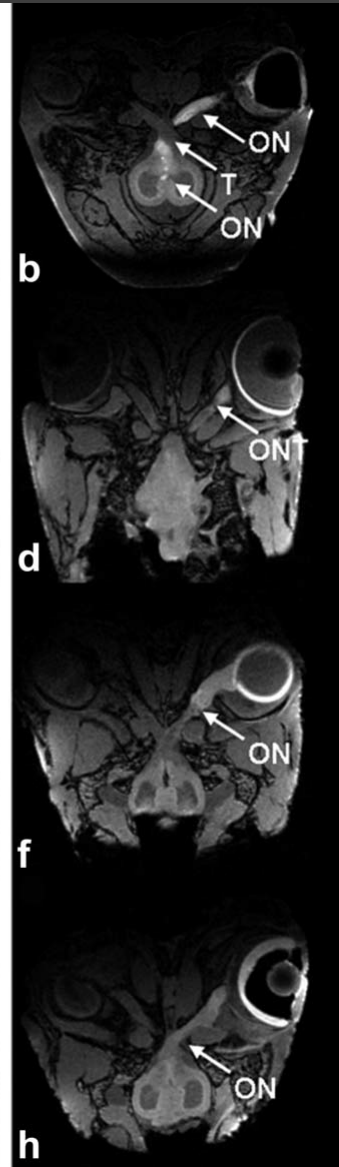
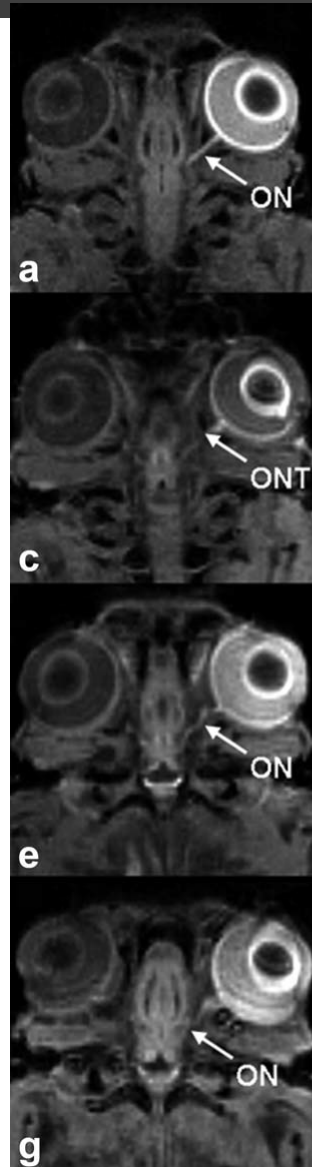
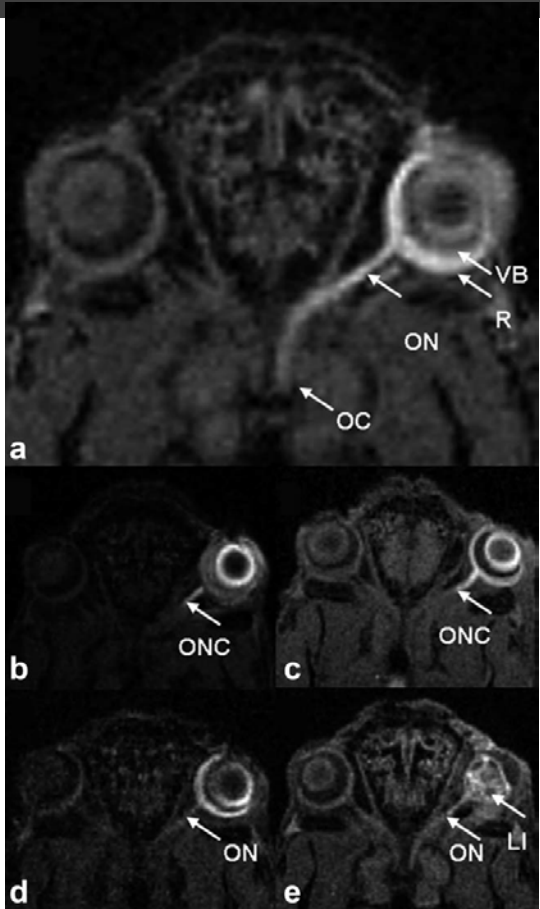
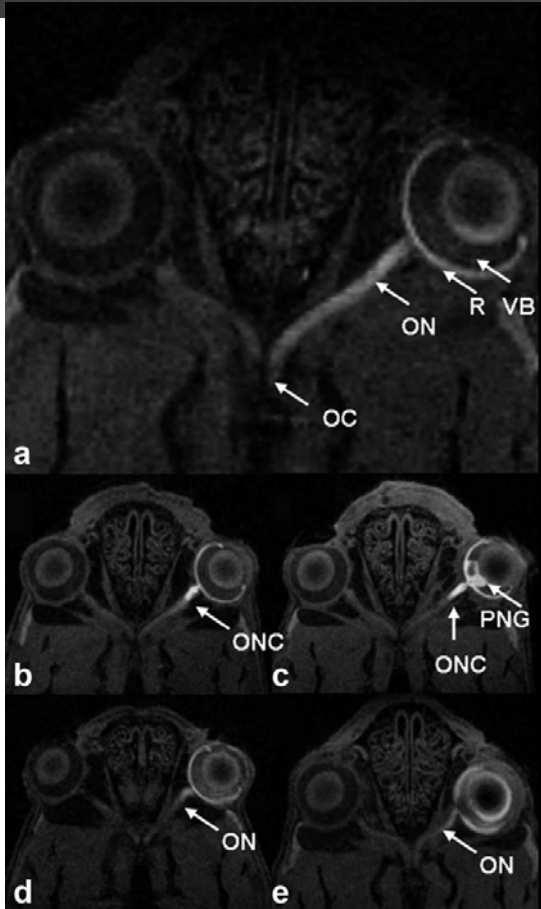
**Sandvig I** and **Sandvig A**. Using manganese enhanced MRI to assess optic nerve regeneration. In 'Axon Growth and Regeneration: Methods and Protocols'. *Methods Molecular Biology* 2014 ; 1162:233-49

Rotte

Mus

Frosk

Fisk

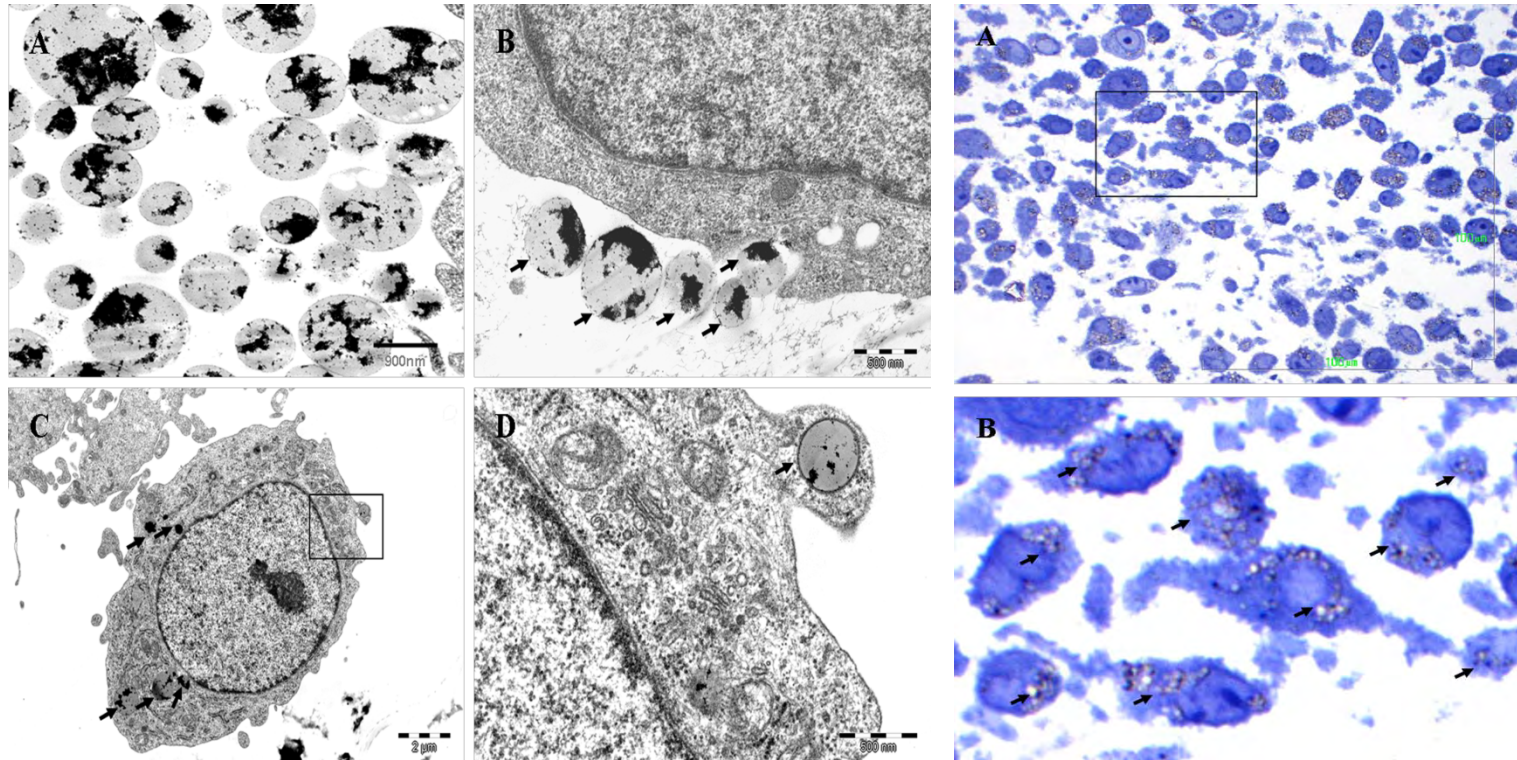


Sandvig A, Sandvig I, Berry M, Olsen Ø, Pedersen TB, Brekken C and Thuen M. Axonal tracing of the normal and regenerating visual pathway of mouse, rat, frog, and fish using manganese-enhanced magnetic resonance imaging (MEMRI). *J Magn Reson Imaging* 2011;34:670-675.

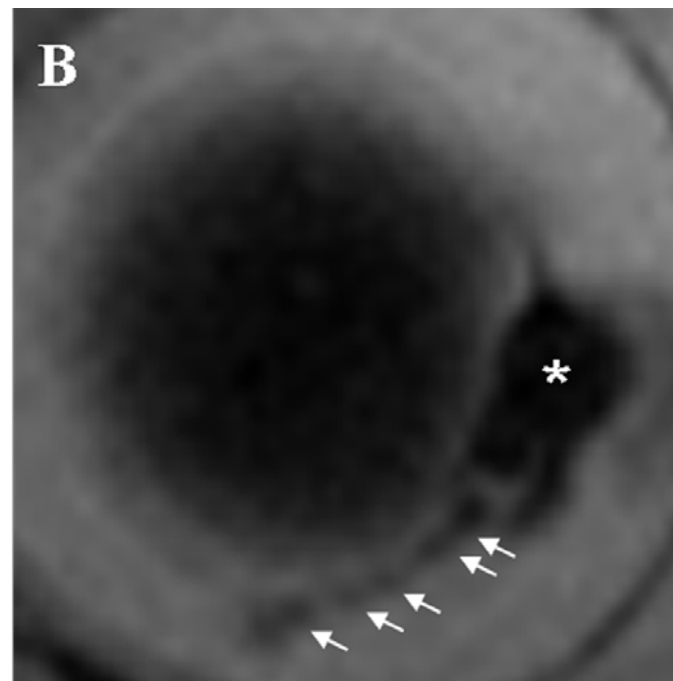
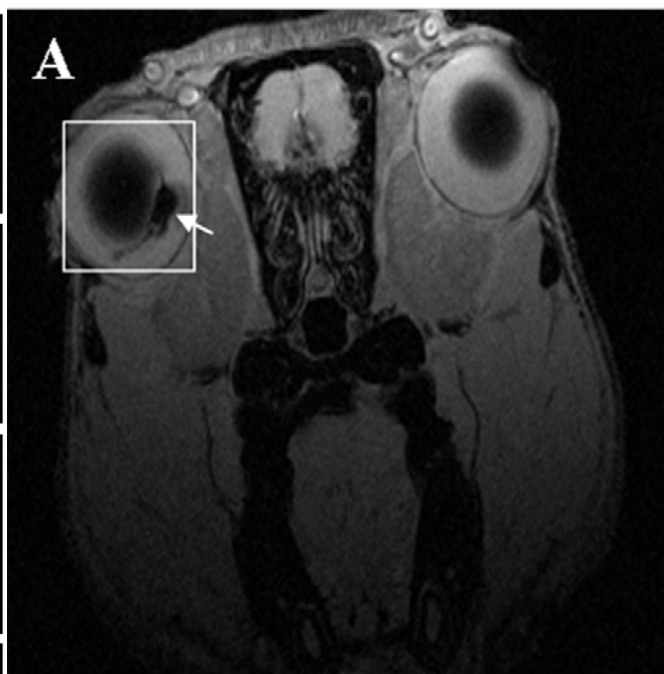
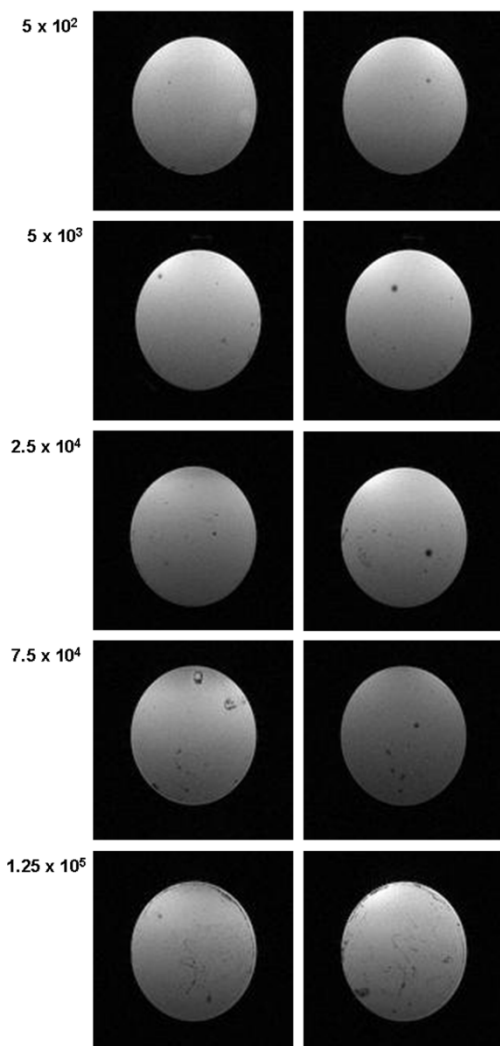


Kunnskap for en bedre verden

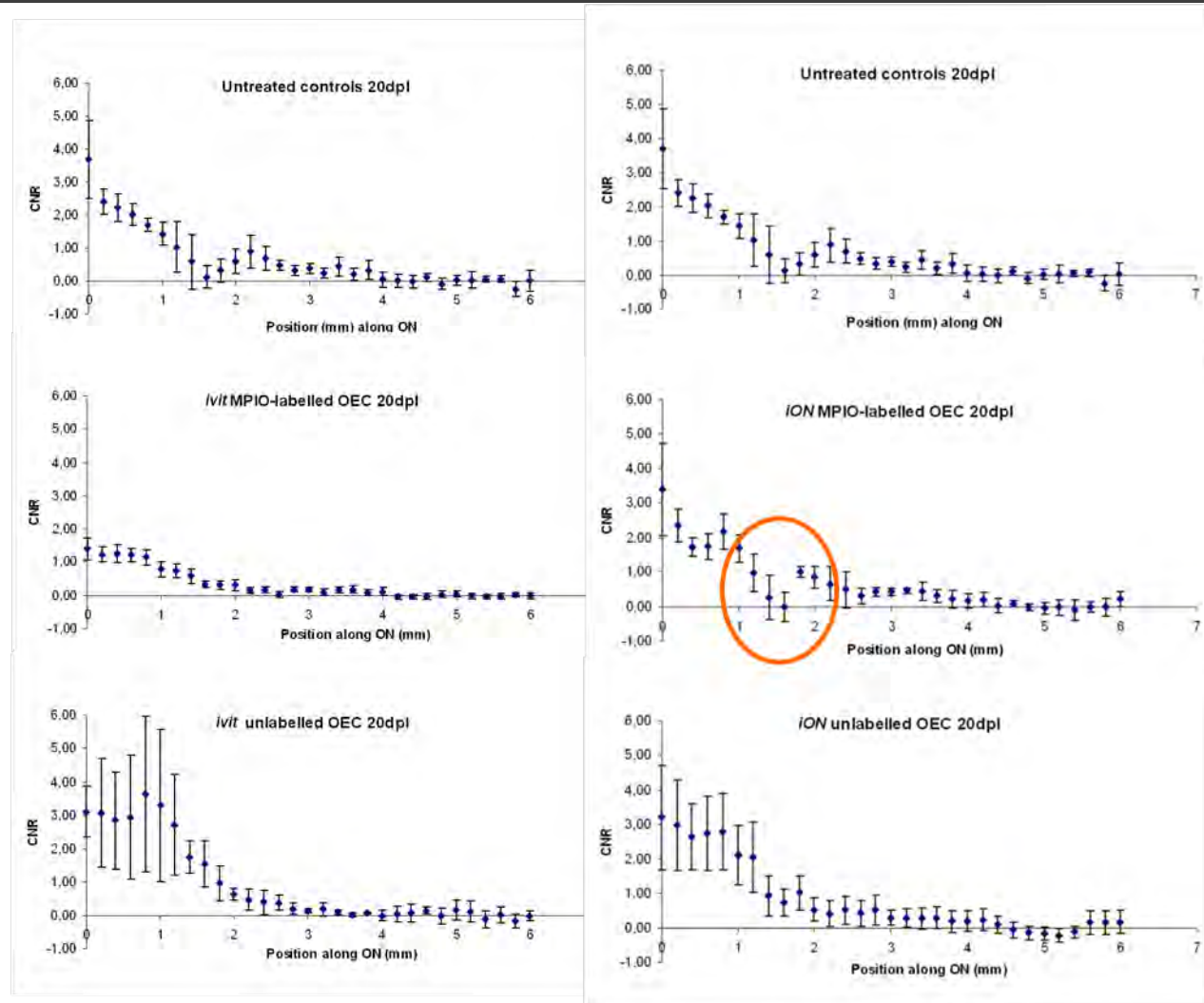
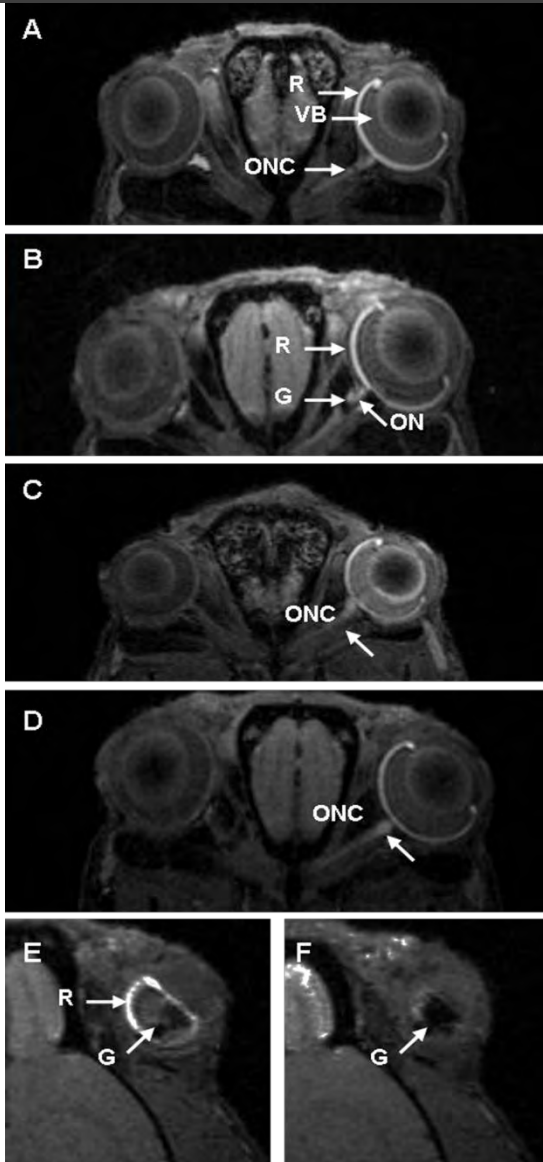
Utvikling av spesifikke protokoller for effektiv intracellulær merking med jern mikro/nanonanopartikler



**Sandvig I**, Hoang L, Sardella TCP, Barnett SC, Brekken C, Tvedt KE, Berry M, Haraldseth O, **Sandvig A** and Thuen M. Labelling of olfactory ensheathing cells (OECs) with micron-sized particles of iron oxide (MPIO) and detection by MRI. *Contrast Med Mol Imaging* 2012; 7:403-410.



**Sandvig I**, Hoang L, Sardella TCP, Barnett SC, Brekken C, Tvedt KE, Berry M, Haraldseth O, **Sandvig A** and Thuen M. Labelling of olfactory ensheathing cells (OECs) with micron-sized particles of iron oxide (MPIO) and detection by MRI. *Contrast Med Mol Imaging* 2012; 7:403-410.

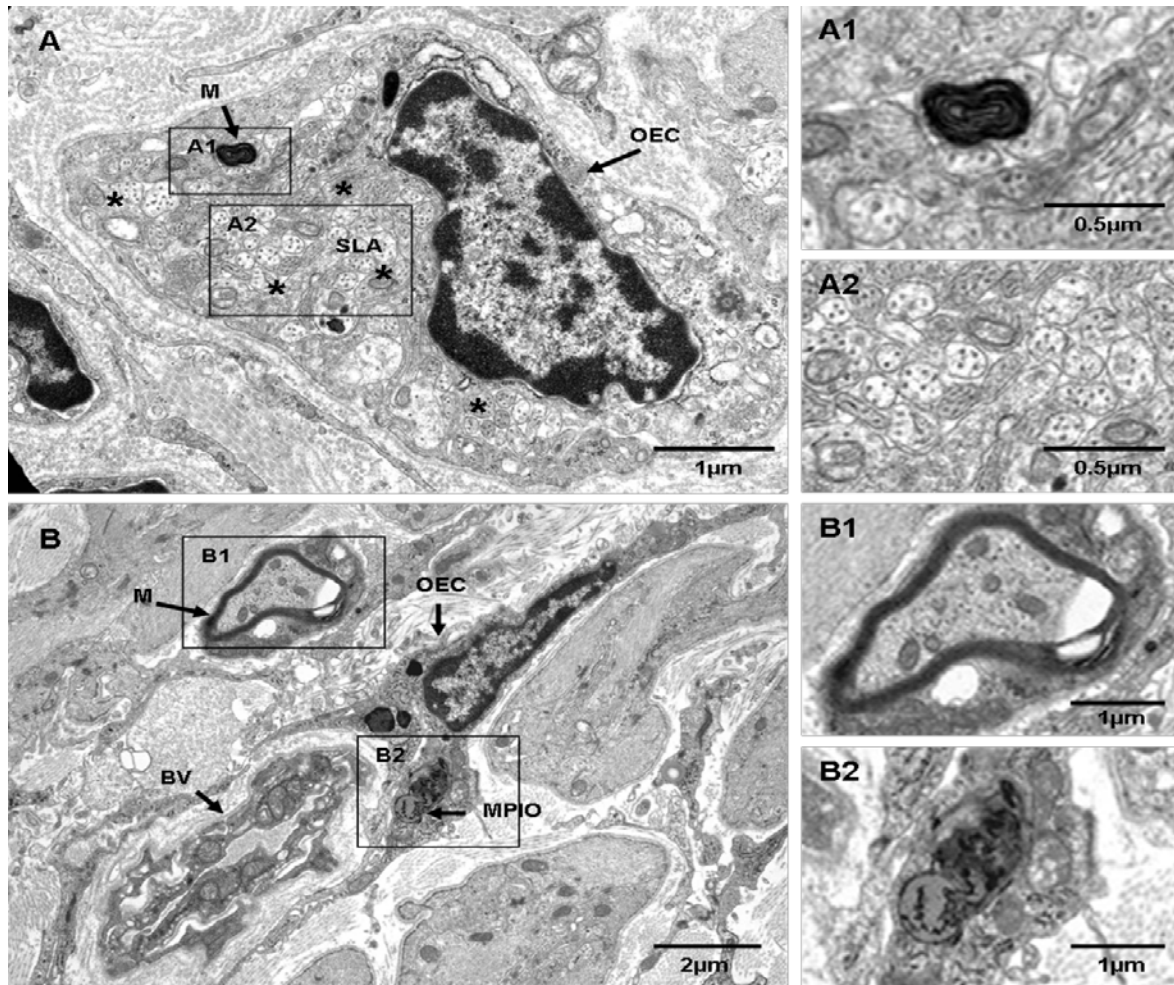


Sandvig I, Thuen M, Hoang L, Olsen Ø, Sardella TCP, Brekken C, Tvedt KE, Barnett SC, Haraldseth O, Berry M and Sandvig A. *In vivo* MRI of olfactory ensheathing cell grafts and regenerating axons in transplant-mediated repair of the adult rat optic nerve. *NMR Biomed* 2012;25:620-631.



Indusert aksonal plastisitet, neovaskularisering, og remyelinisering

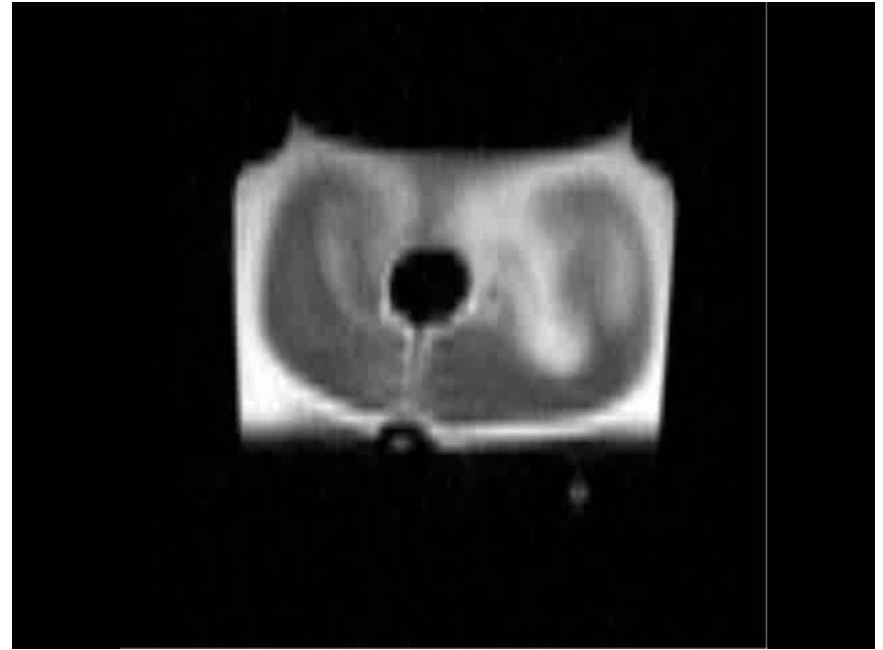
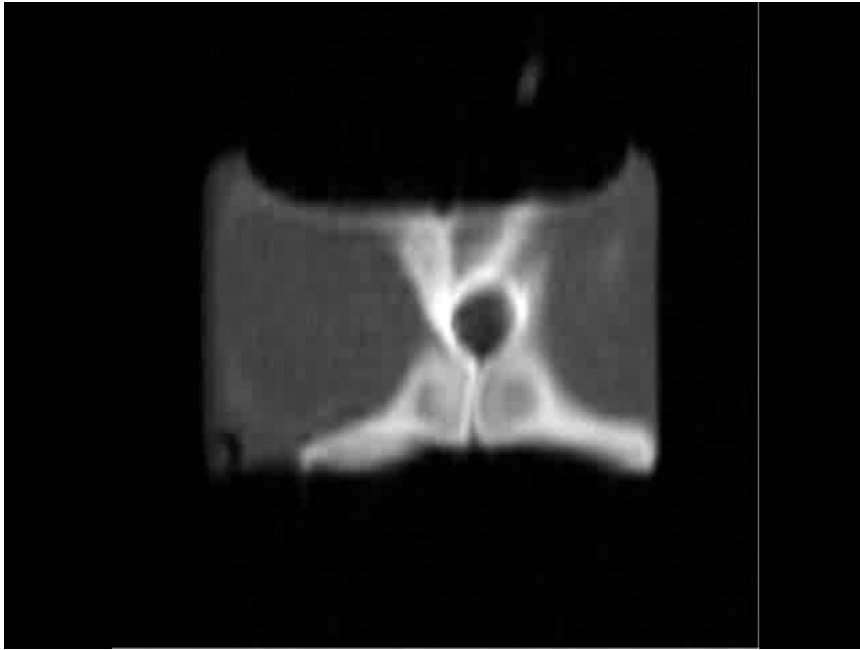
MI•Lab



Sandvig I, Thuen M, Hoang L, Olsen  $\emptyset$ , Sardella TCP, Brekken C, Tvedt KE, Barnett SC, Haraldseth O, Berry M and Sandvig A. *In vivo* MRI of olfactory ensheathing cell grafts and regenerating axons in transplant-mediated repair of the adult rat optic nerve. *NMR Biomed* 2012;25:620-631.

Kunnskap for en bedre verden

Mangan frisetting i 2 forskjellige alginat 3D matriser

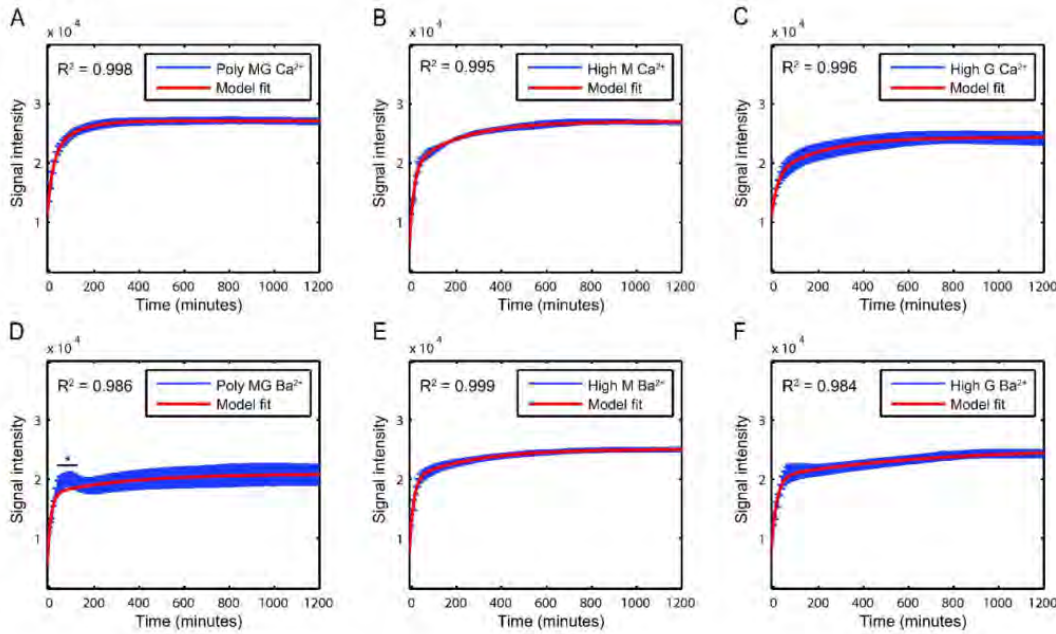


Mørch Ý, Sandvig I, Olsen Ø, Donati I, Thuen M, Skjåk-Bræk G, Haraldseth O, Brekken C. Mn-alginate gels as a system for controlled release of  $Mn^{2+}$  in manganese-enhanced MRI. *Contrast Med Mol Imaging* 2012;7:265-275.

Proof-of-concept for utvikling av skreddersydde system for kontrollert frisetting av terapeutiske substanser og vekstfaktorer



Figure 6

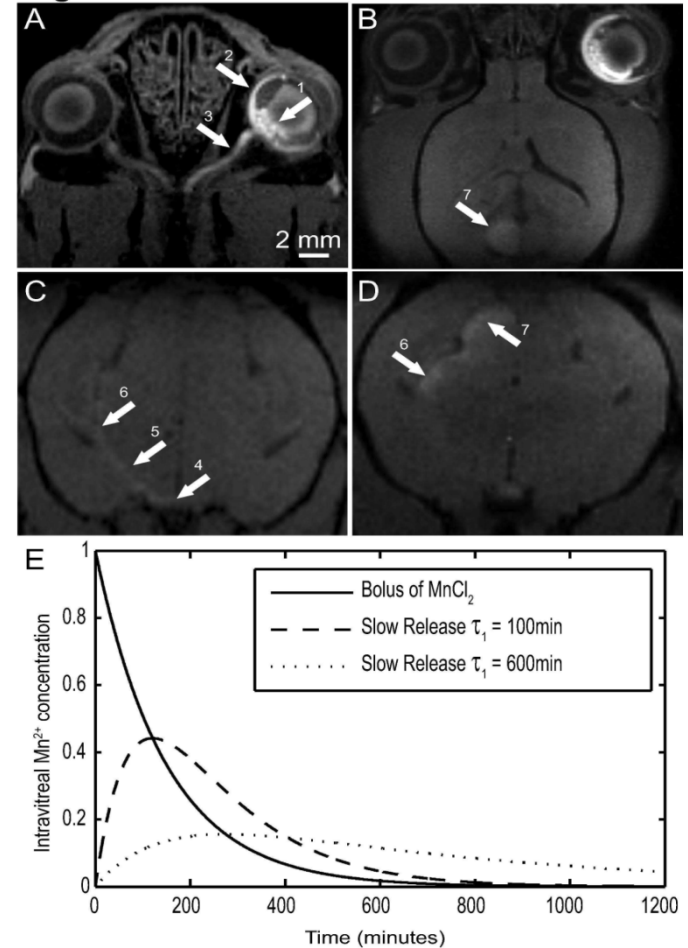


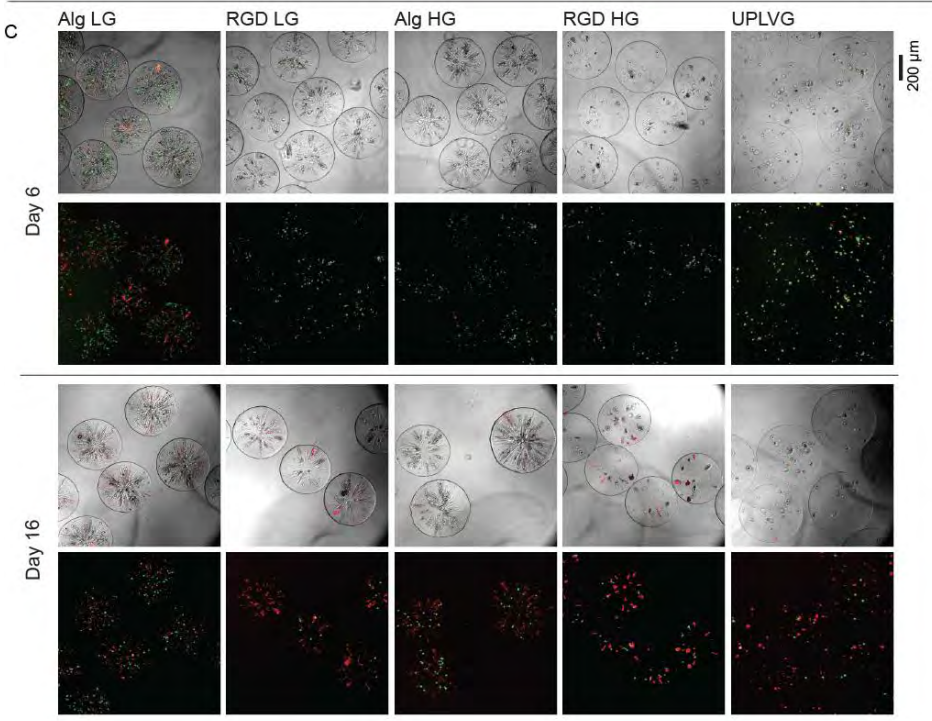
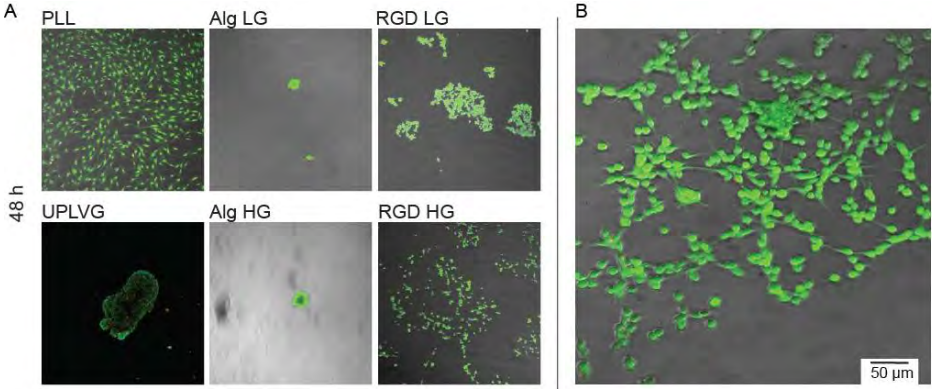
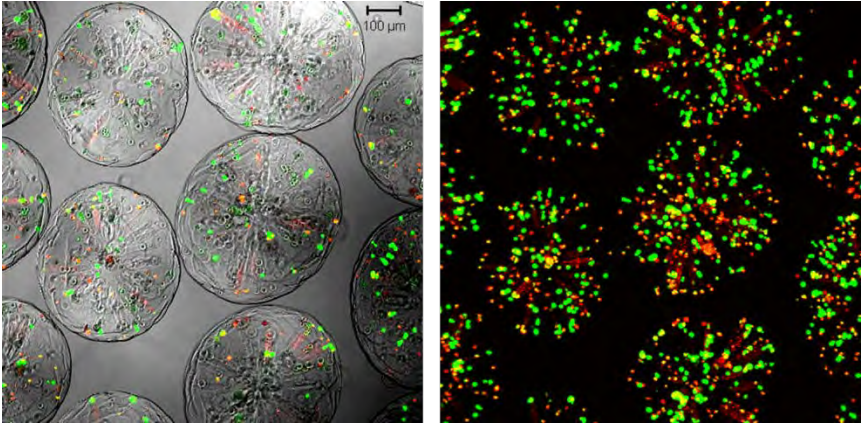
Mørch Ý, Sandvig I, Olsen Ø, Donati I, Thuen M, Skjåk-Bræk G, Haraldseth O, Brekken C. Mn-alginate gels as a system for controlled release of  $\text{Mn}^{2+}$  in manganese-enhanced MRI. Contrast Med Mol Imaging 2012;7:265-275.



Kunnskap for en bedre verden

Figure 7



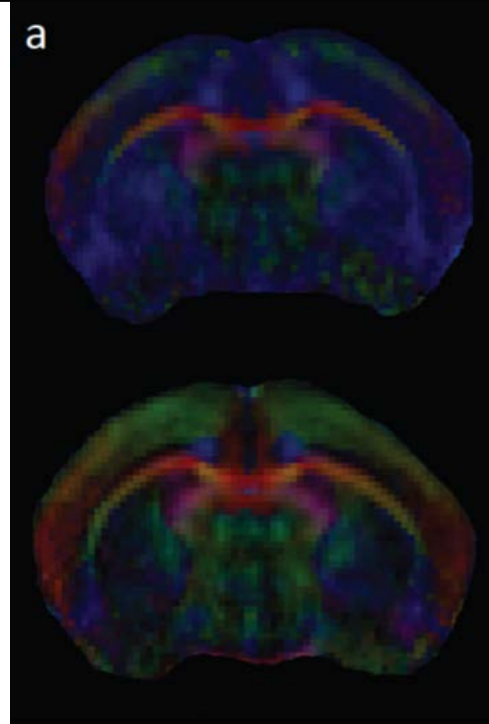
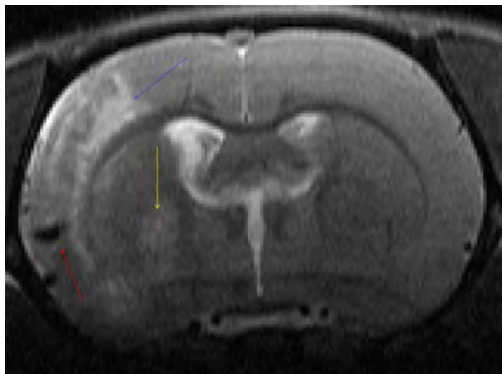
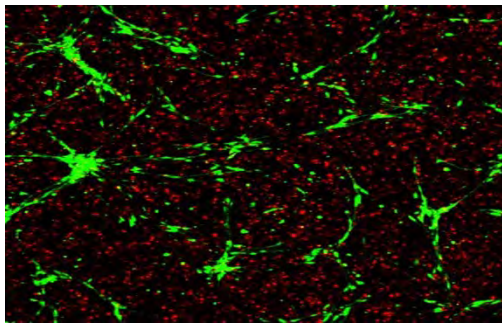


Sandvig I, Karstensen K, Rokstad AM, Formo K, Aachmann F, Sandvig A, Skjåk-Bræk G, Strand BL. RGD- peptide modified alginate by chemoenzymatic strategy – effects of matrices on olfactory ensheathing cells and myoblasts in vitro. *J Biomed Mater Res A*. 2014;15: doi: 10.1002/jbm.a.35230



Kunnskap for en bedre verden

Integrasjon av stem celle terapi/in situ tissue engineering, avansert neuroimaging, and nanomedisin i behandlingen av hjerneslag og PD



Work in progress

## Videre forskning

- Integrering av genetiske, molekylære og celleterapeutiske metoder for å studere skader og sykdomsprosesser i sentralnervesystemet
- Integrering av bioteknologiske, nanomedisinske samt multimodale visualiserings teknikker i studier av skade og sykdommer i sentralnervesystemet
- *In vitro* sykdom modellering (stroke og Parkinson's sykdom) ved bruk av iPSCs og cerebrale organoider
- Translasjon av forskningen inn i klinikken

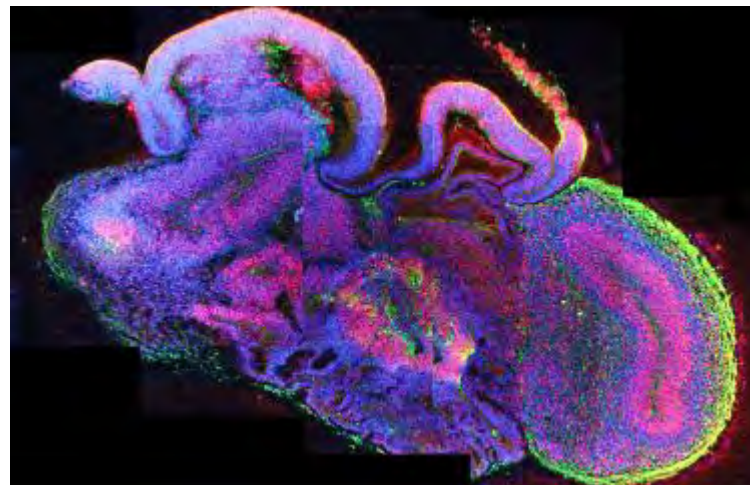


Image from Lancaster et al, 2013



**NTNU**

Professor Olav Haraldseth – MRI  
Professor Asta Håberg – fMRI  
Dr Berit Strand – Alginates  
Dr Yrr Mørch - Alginates  
Ling Hoang – SEM, TEM  
Dr Christian Brekken – MRI  
Dr Marthe Thuen - MRI  
Dr Øystein Olsen – Mathematical modeling  
Ingrid Lovise Augestad – In situ tissue engineering in stroke  
Sulalit Bandyopadhyay – Multifunctional NPs  
Birgitte Hjelmeland McDonagh – Multifunctional NPs  
Axel Nyman (forskerlinje) - Neuroimaging  
Kristin Karstensen – Functionalised alginates  
Alex Ignatius Costa – Cell-biopolymer scaffolds

**Samarbeidspartnere**

Professor Martin Berry, University of Birmingham  
Professor Sue Barnett, University of Glasgow  
Dr Mike Modo, University of Pittsburgh  
Dr Jonathan Gilthorpe, University of Umeå

**Forskningsmidler**

Functional Genomics (FUGE)  
MI Lab – Senter for forskningsdrevet innovasjon (NFR)  
Nano2012 (NFR)  
Samarbeidsorganet, Helse Midt-Norge-NTNU  
ALF-medel, Nevrosentrum, NUS, Sverige



TAKK