The Journey of Exploration: Where Medicine Meets Mars

Dr. J.D. Polk
Chief Health and Medical Officer
NASA HQ
Small stone with twinkling
High Intensity Focused Ultrasound
3D Printing for skin and flesh tones

Scan of remaining eye to create exact duplicate eye with 3-D printer

Computer scanned, then flipped images of remaining limb to create “3-d duplicate”

Wake Forest University: Printing skin directly onto the burned limb.
3D Printers and Human Tissue
3-D printed ears that can hear...

- Princeton 3-D printed ear with acoustic ear coil transmission.
Insertion of Progenitor Cell Lines
First Use of 3D printed tissue to make Trachea

University of Michigan implants first 3-D printed tissue into infant

Artificial Heart

Wake Forest Institute for Regenerative Medicine, 3-D printed beating cardiac cells
But could you make a cell like a cardiac cell, neuron, or insulin secreting cell?

Dr. Kate Rubins sequences DNA and grows cardiac cells on orbit.
Vaccine and Pathogen Research in Microgravity on the Shuttle and ISS

Dr. Cheryl Nickerson of the Biodesign Institute at Arizona State University works on NASA granted research.
Salmonella

Microgravity Vaccine Research (NLP-Vaccine-Salmonella)
Parkinson’s Disease

Microgravity LRRK2 Protein Research (CASIS PCG 7)
The Case for Intracranial Hypertension

- Several known cases predominantly in long duration crew members
  - Each with different degrees of symptoms
  - Elevated measures of Intracranial Pressure (ICP) post flight
  - Evaluation of shuttle fliers showed mild changes in the optic nerve diameter, even in 14 day missions.

- Hyperopic Shifts - Up to +1.75 diopters
- Globe Flattening
- Choroidal Folds - parallel grooves in the posterior pole
- Optic Disc Edema (swelling)
- "cotton wool" spots
- Increased Optic Nerve Sheath Diameter
- Scotoma

MRI Orbital Image showing globe flattening
Axial T2-weighted images of the brain obtained before (Panel A) and after (Panel B) this astronaut had long-duration spaceflight on the International Space Station. The astronaut presented with optic-disk edema syndrome after spaceflight. Crowding of the sulci can be seen at the vertex. The gyrus* is the precentral gyrus (primary motor cortex).

Cerebral edema present. Clearly not solely an eye issue.

From Donna Roberts’ Study,
Impacts to Design
Questions?