Lifting and Moving Fragile People

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VA projects on patient handling

- Acute spinal cord injury patient transport
- Recording motion during patient care:
  - Acute SCI patients in kinetic bed
  - Weight relief to prevent pressure sores
Acute SCI patient transport

Goals:
- stable cervical traction during in-hospital & aeromedical (helicopter) patient movement
- Compatible with CT scanner (later: MRI)

Components:
- Backboard - wood, fiberglass, carbon fiber
- Traction unit (CFTU) - 4 iterations using constant-force springs

Support:
- local VA Rehab R&D, Paralyzed Veterans of America
Spinal stabilization equipment

Miller board (commercial)

Collins traction on Stryker frame

Carbon fiber board + 3rd generation CFTU
Design iterations

(above) wood board prototype 1982
(right) fiberglass prototype 1986
CFTU Cervical Traction

2 to 9 2.5 lbf constant-force springs connected to Gardner-Wells skull tongs or halo
Testing of CFTU + C-fiber board

Loading simulated patient on Life Flight BK-117

Actual SCI patient arriving at Santa Clara Valley Medical Center
CFTU traction - Current status

- In-hospital use by SCVMC
- Flight use by REACH Air Medical
- FDA license to manufacture
- MRI-compatible design done
Recording motion during SCI patient care

- **Goal:**
  - Does motion environment put injured spinal cord at risk?

- **Method:**
  - 3-axis accelerometers at forehead and chest
  - Load cell in traction cable
Simulation of traction, turning & head restraint

(above) 1st generation CFTU
(right) transient acceleration installing Philadelphia cervical collar nearly 0.1 g
SCI patient on “RotaRest” kinetic bed

- Continuous +/- 60° rotation
- Prevents pressure sores, lung & venous complications
- Stability of spine is at risk
Traction force on RotoRest bed

Diagram showing force in lb as a function of time with annotations indicating key points such as 'Engage Auto Rotation (40 deg. right)' and '60 deg. left'.
Goals:
- Prevent skin breakdown in SCI or frail individuals who need to monitor soft tissue pressure.
- Tell individual or caregiver if activity intended to reduce pressure sore or ulcer risk is correctly performed.

Method:
- 3-axis accelerometers on waist & edge of bed.
- Pressure sensors under body segment not at risk.
Commercial seat pressure sensor arrays

TekScan

Xsensor
Acceleration sensor & pressure-sensing balloons
mid-thigh pressure during simulated weight relief activities
VA Long-Term Care residents require assisted pressure relief

Assisted turning (left) and axial shifting upon sitting up (right) were done using a draw-sheet.
Pressure/motion monitoring
Current status

- VA released intellectual property to inventors.
- 4th generation wearable computer designed.
- Preliminary patent for analysis algorithm filed.
- Possible integration with telemedicine system.
- Pressure sensors adapted for measuring pressure under tourniquets for snakebite treatment.