



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

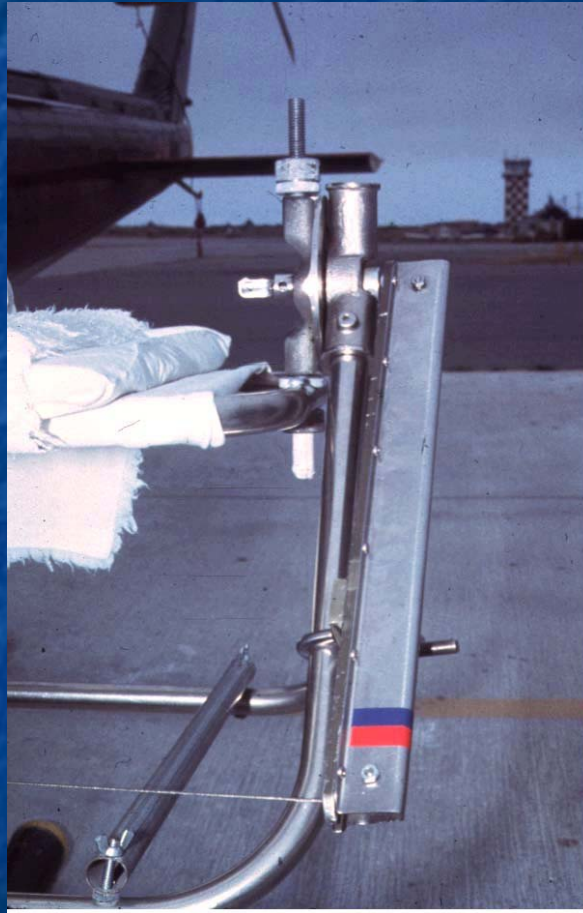
■ Support:

- 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

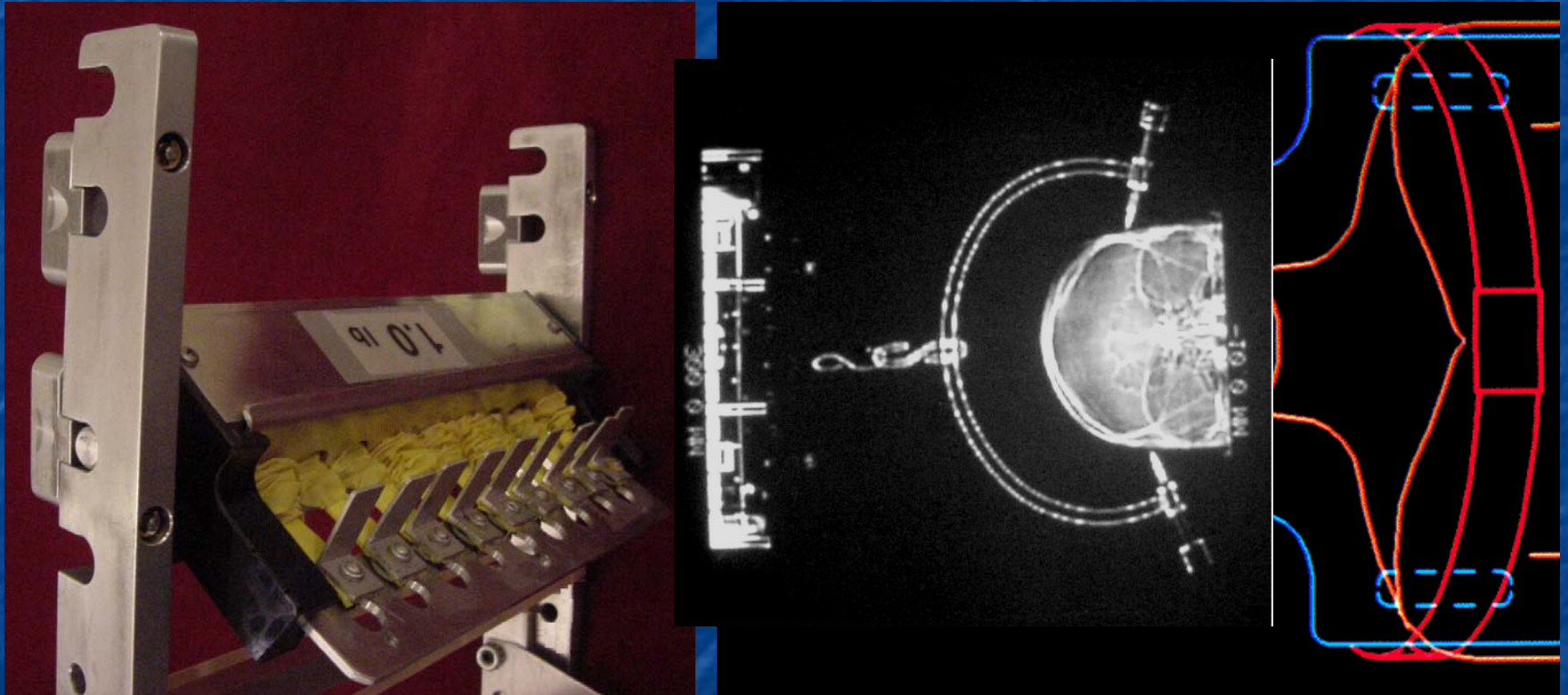


(above) wood board
prototype 1982

(right) fiberglass
prototype 1986

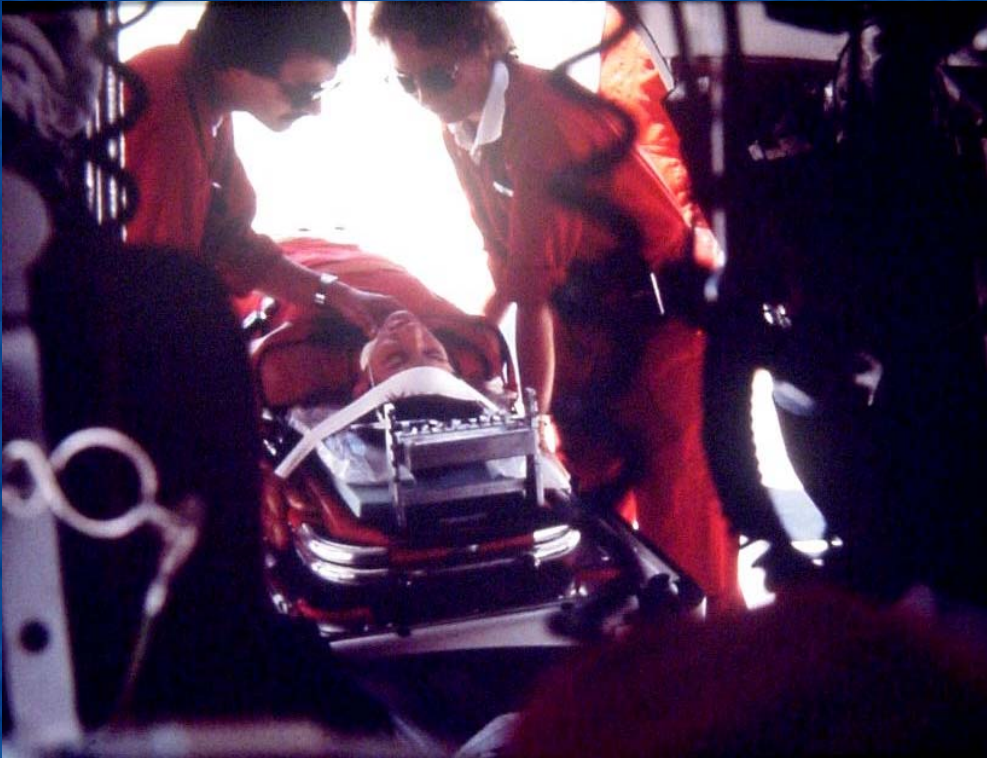


CFTU Cervical Traction



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

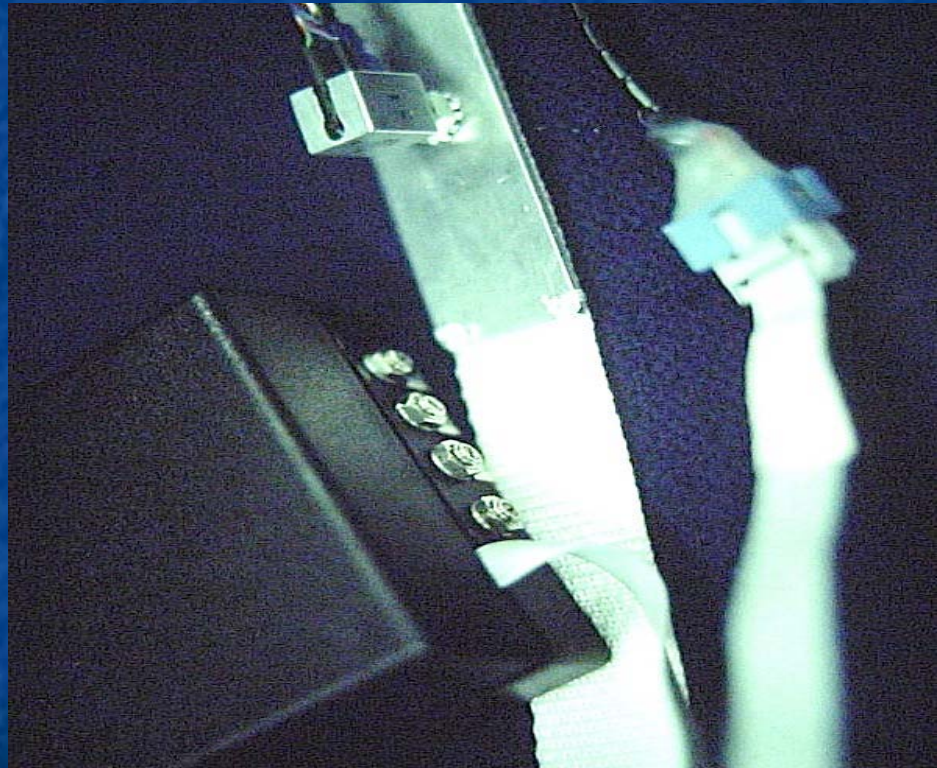
CFTU traction - Current status

- 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

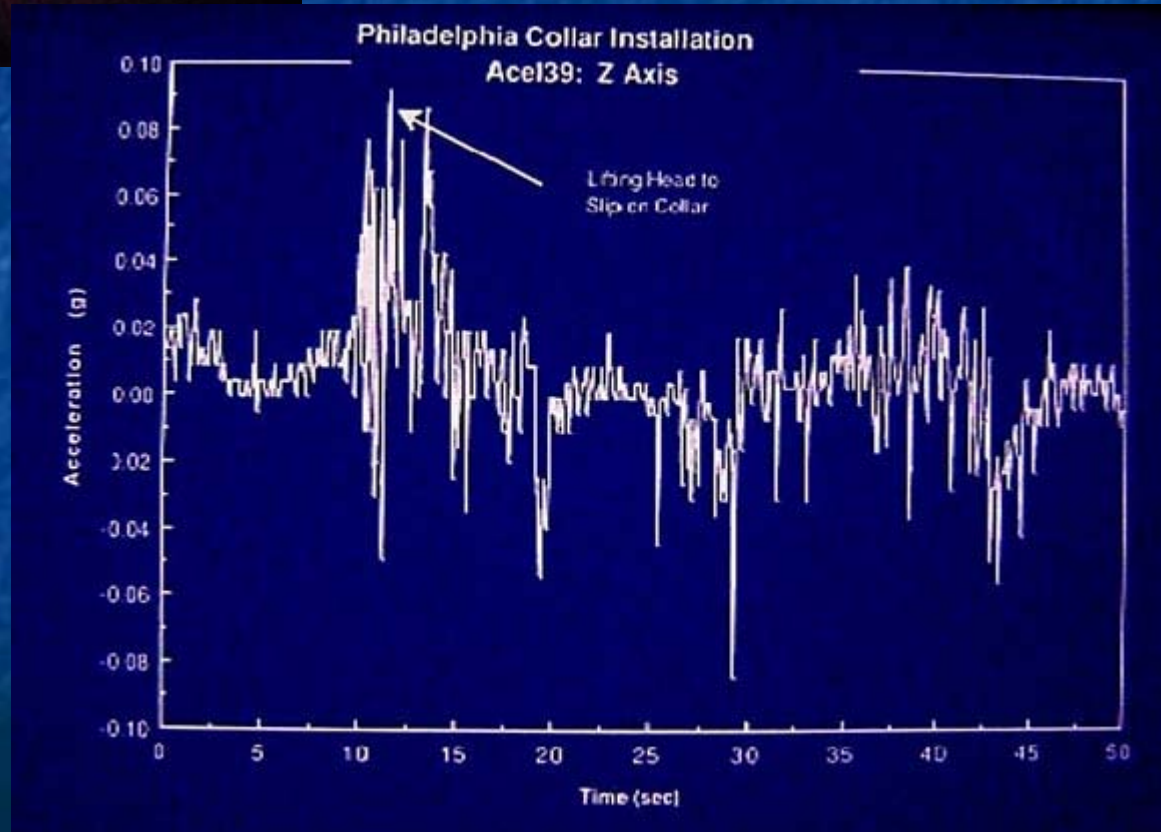
- Goal:
 - Does motion environment put injured spinal cord at risk?
- Method:
 - 3-axis accelerometers at forehead and chest
 - Load cell in traction cable



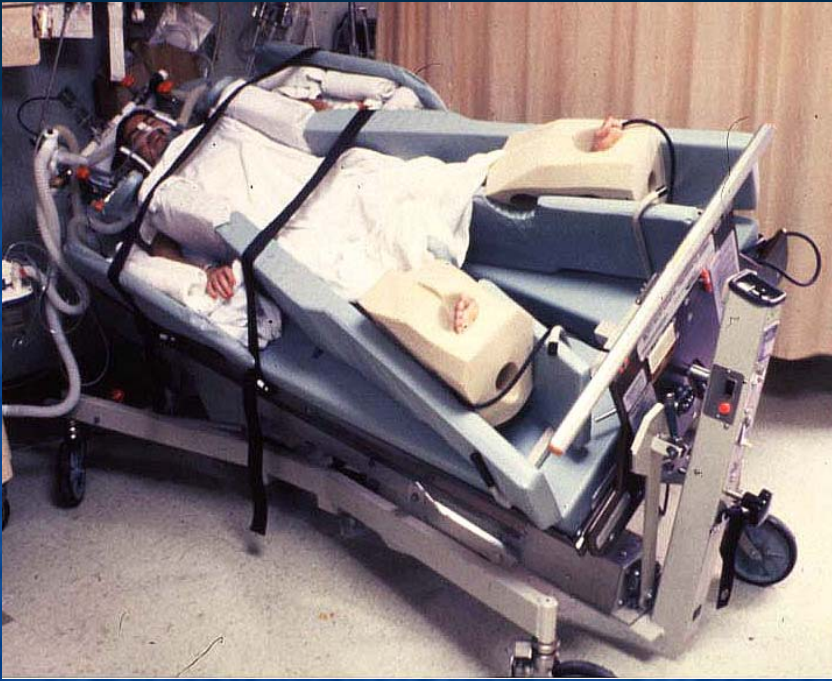


Simulation of traction, turning & head restraint

(above) 1st generation CFTU
(right) transient acceleration installing Philadelphia cervical collar nearly 0.1 g



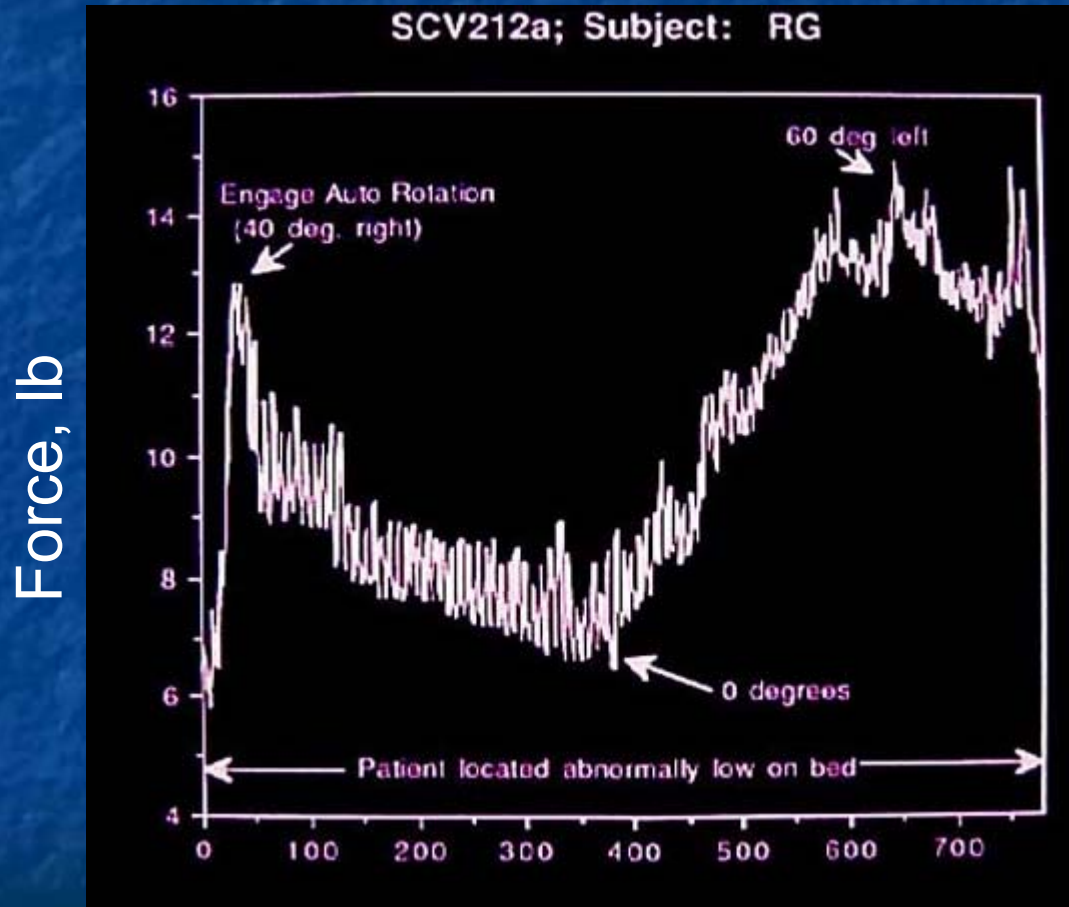
SCI patient on “RotaRest” kinetic bed



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



Traction force on RotoRest bed



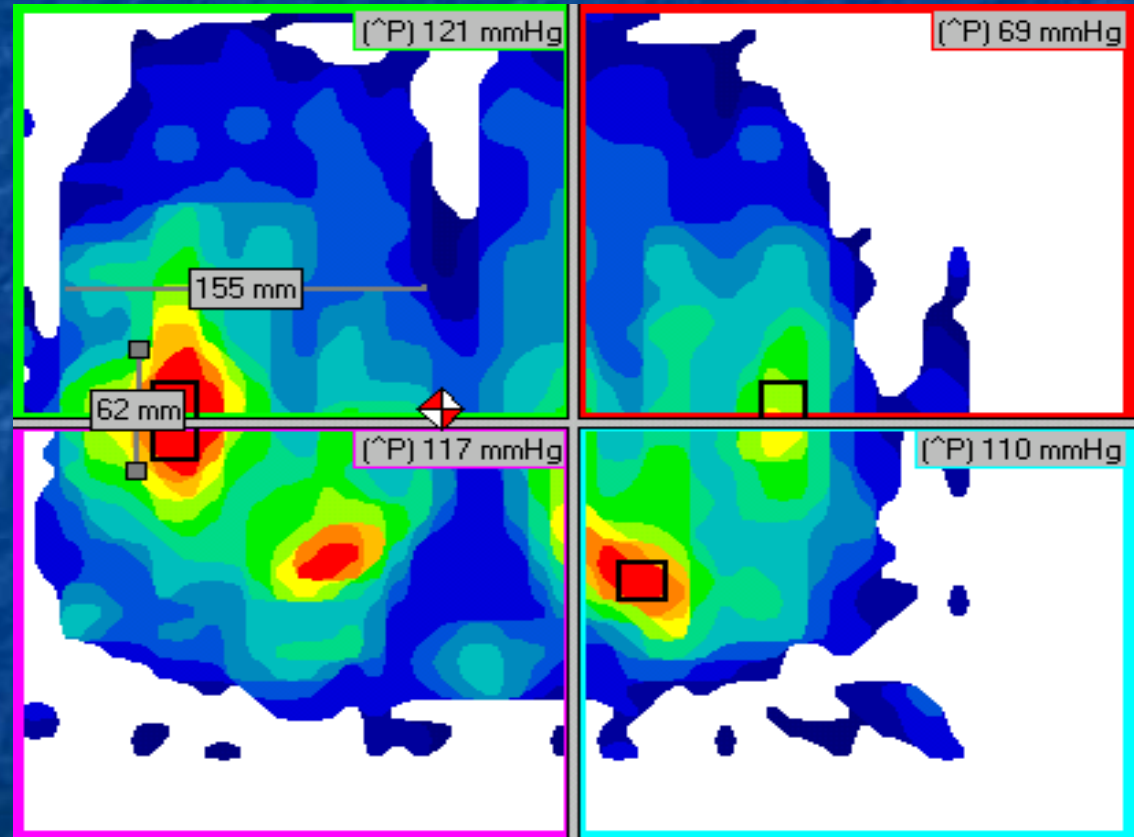
Recording motion during inpatient or post-hospital skin care

- 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

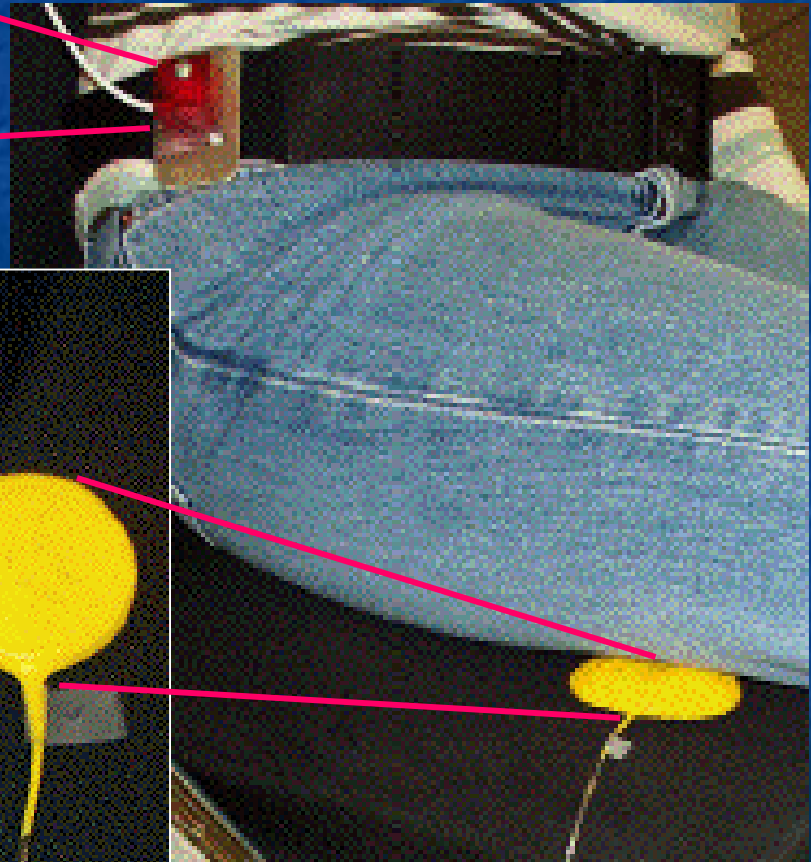


TekScan

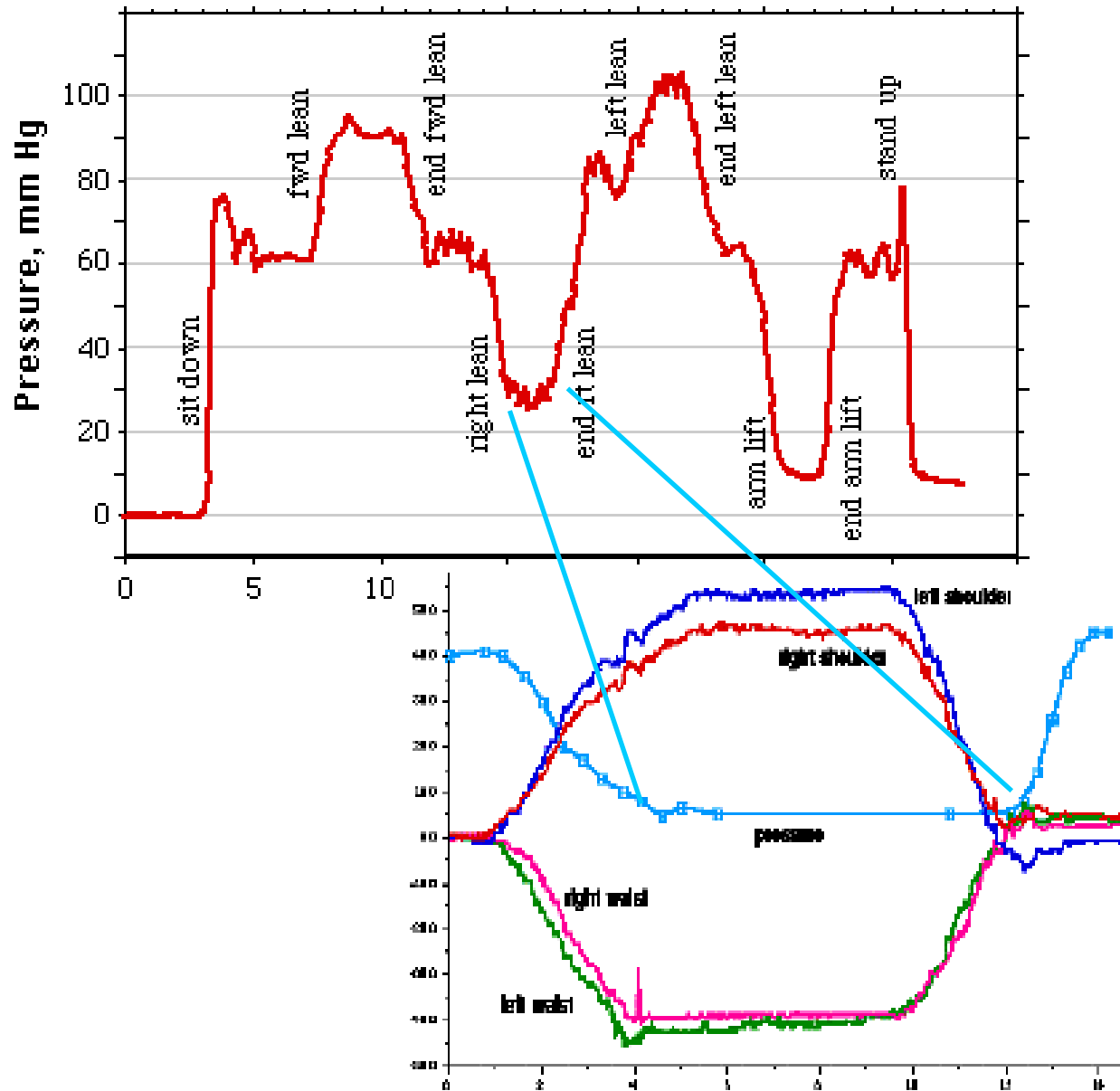


Xsensor

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.

