Lower Urinary Tract
Technology response

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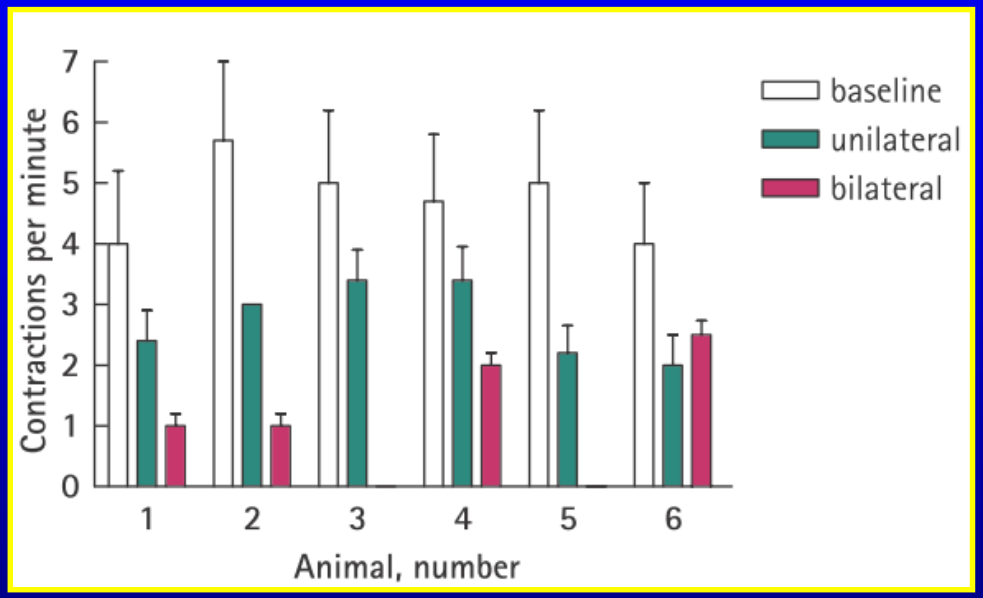
Human vs animal

Pig



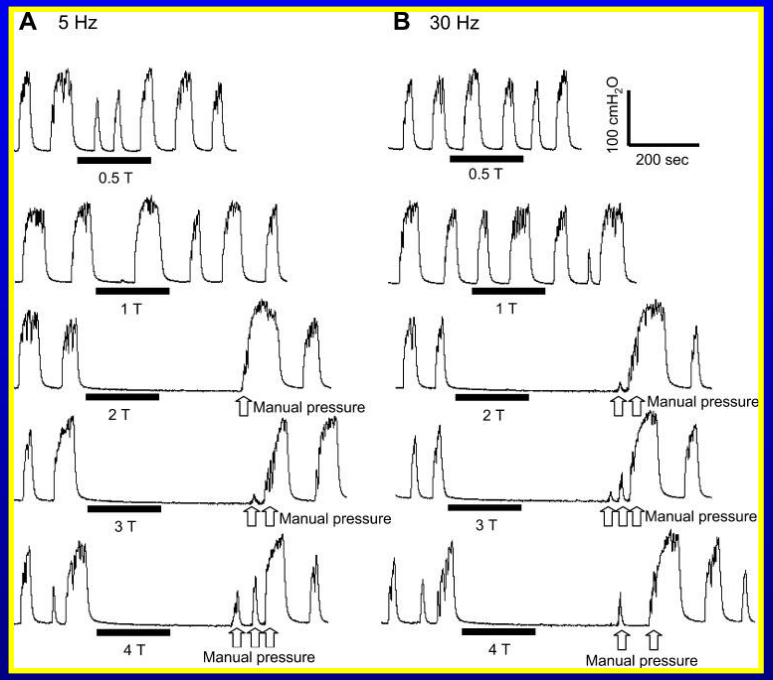
Kaufman et al, BJUI, 2008

- Dorsal sacral root stim
- Bladder irritated by formaline
- Conclusion: Bilat. SNM is better and should be tried in patients unresponsive to unilat. Stim

- Inflammation, acute effect, too high stim ampl.

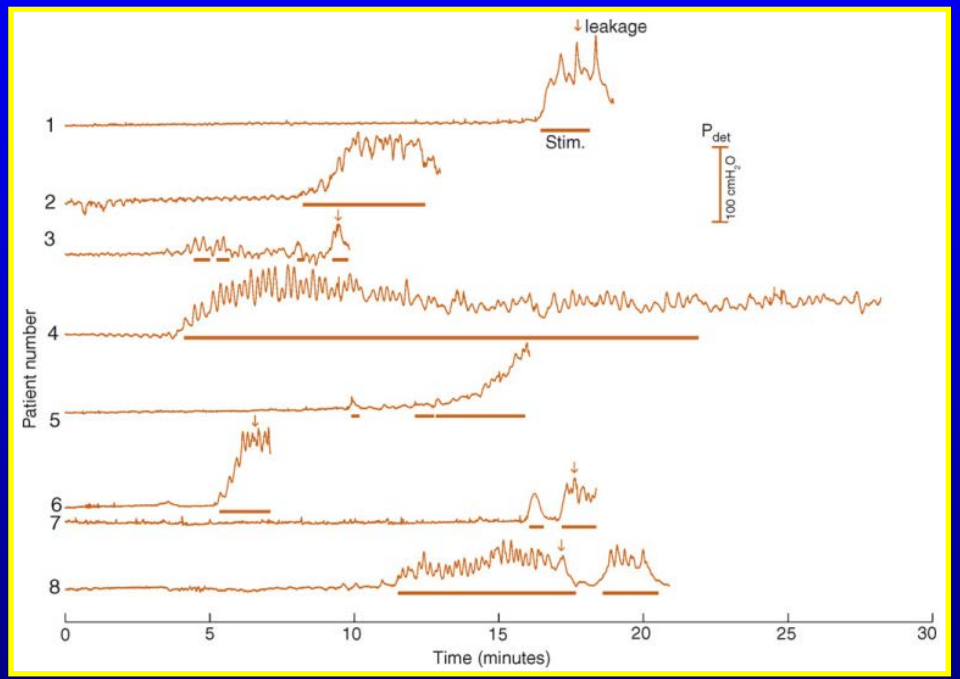
Human vs animal

Cat



Tai et al, Am. J. Physiol, 2011

MS patients



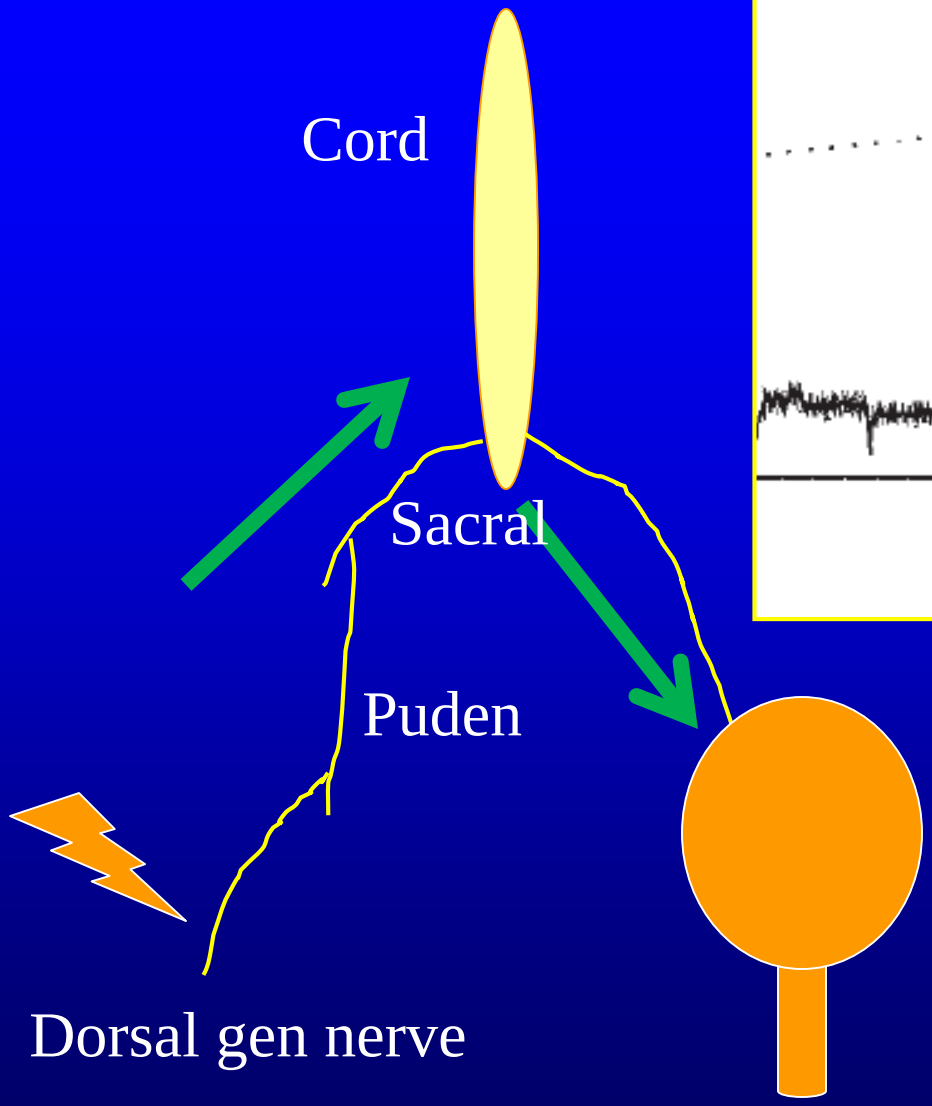
Fjorback et al, Eur. Urol, 2007

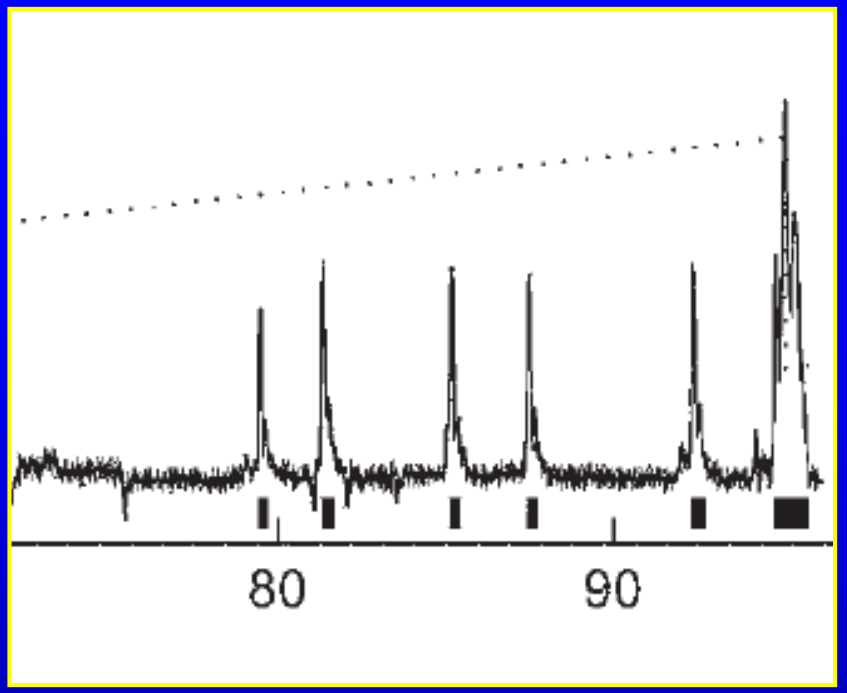
Human vs animal

- Difficult to create animal model with relevant disease (OAB, frequency, urgency)
- Neuromodulation may affect extensive networks – not the same in animals
- Patients: longterm – Animal: acute
- Results may be obtained with parameters not possible in patients
- Where possible do human experiments!
- Animals for ‘simple’ experiments

Current devices perfect?

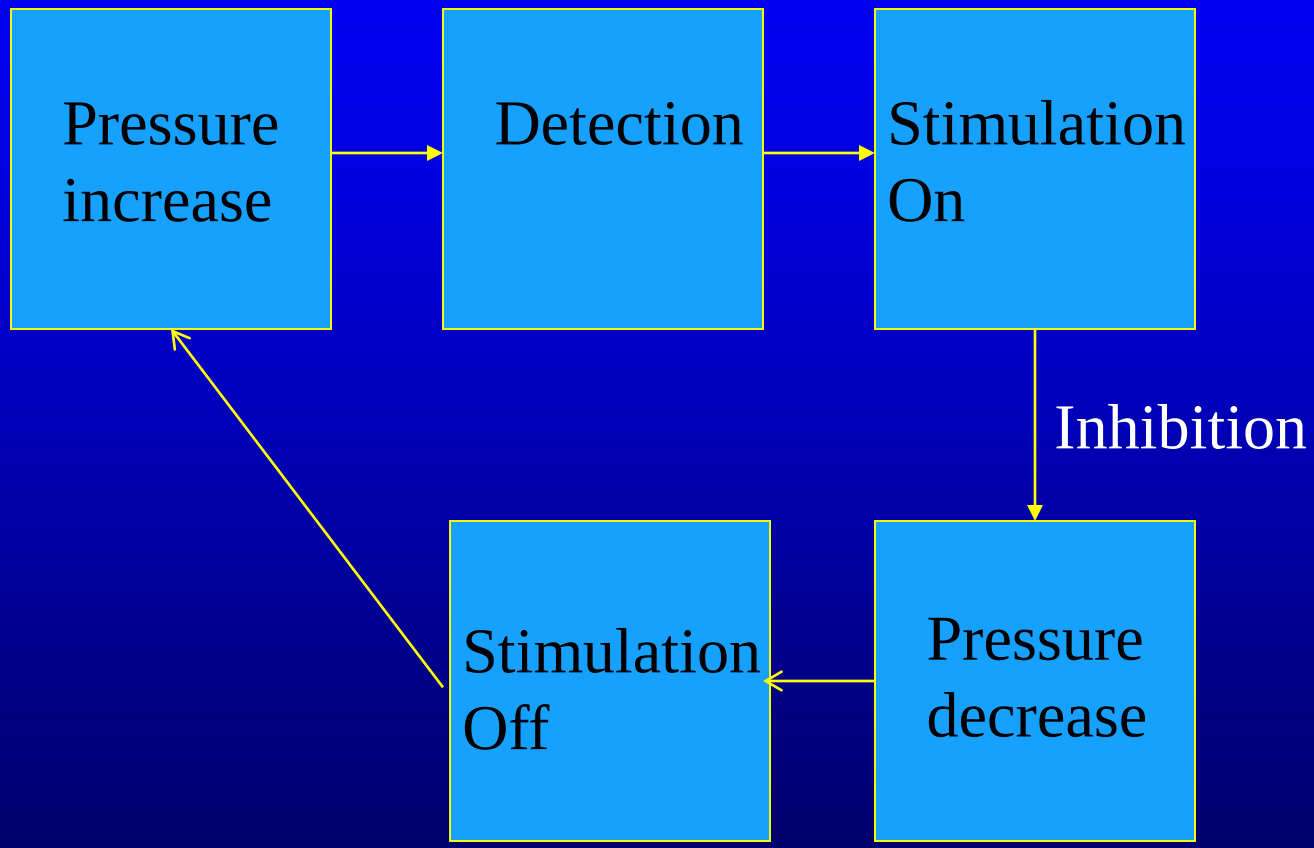
- Interstim for OAB & retention
  - 60-80% respond successful (> 50% improvement)
  - 10-20% are symptom free
  - Numbers are AFTER a test!
  - Better numbers for FI
- Urgent PC for OAB
  - Similar outcome



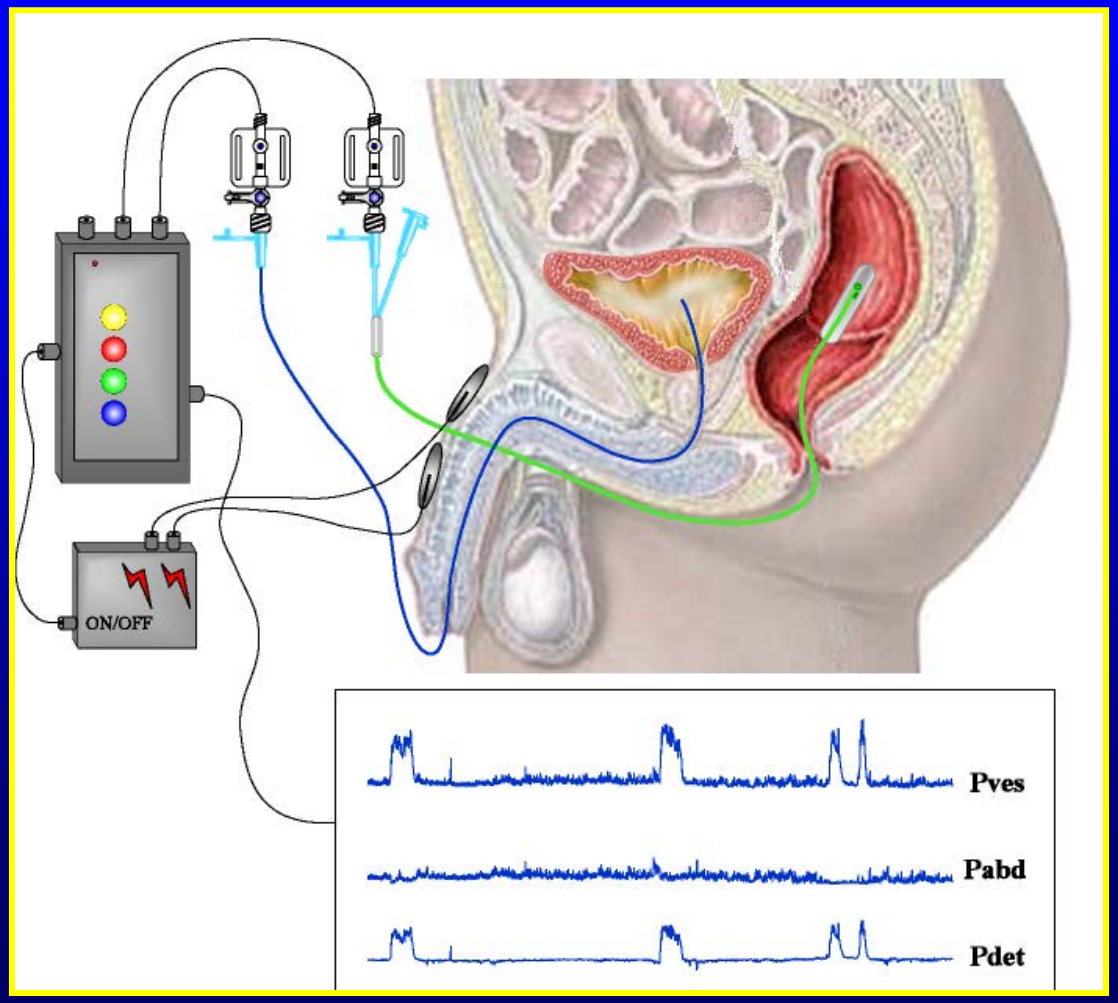


- On demand genital nerve stimulation
  - Supresses urgency & bladder contraction
  - Could fully restore continence
  - May also prevent habituation

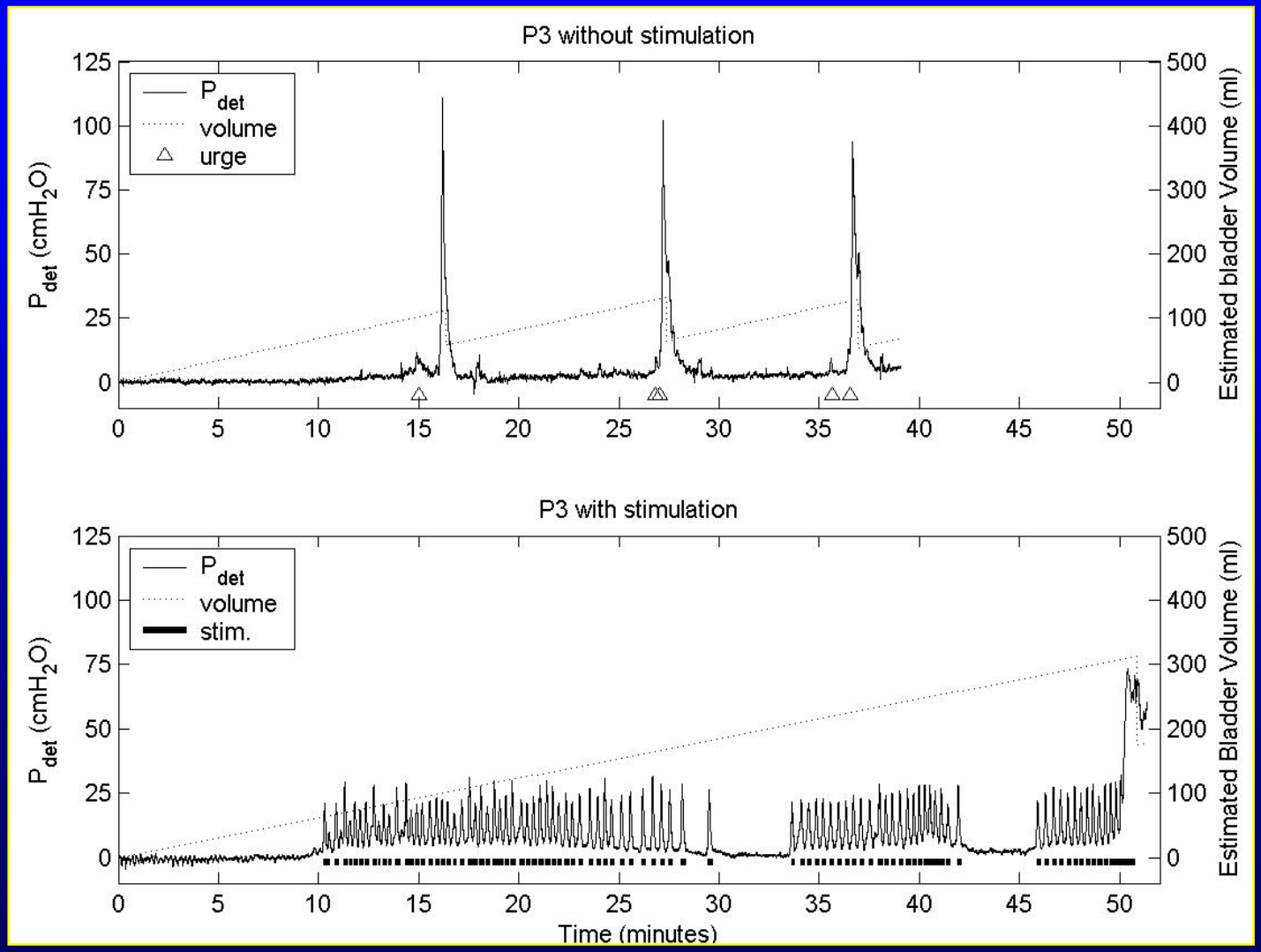
Closed loop event driven stimulation



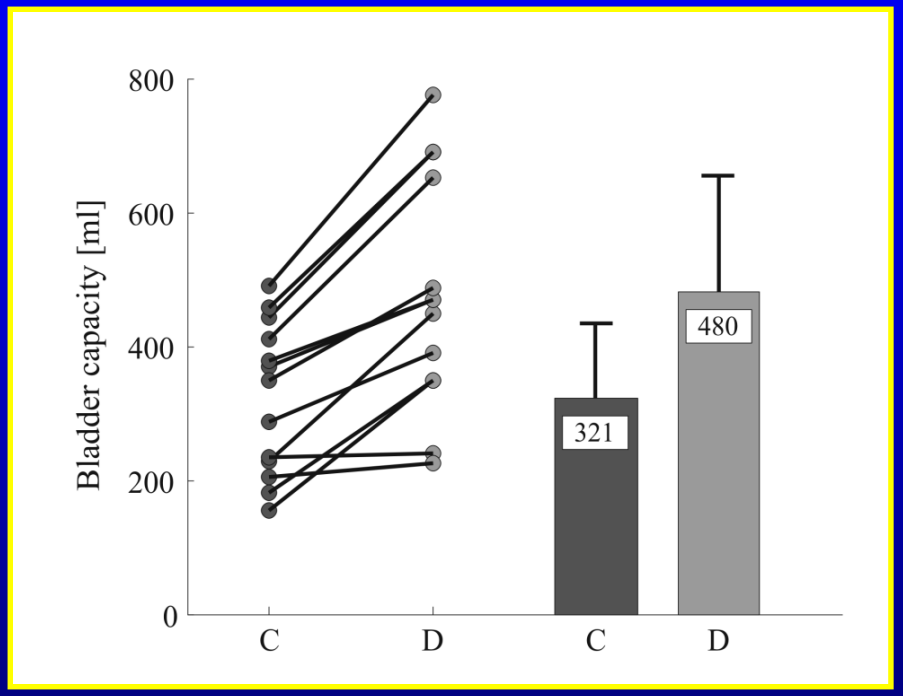
Test conditional stimulation



Human recordings



Results in 13 SCI patients



Hansen et al, J. Urol, 2005

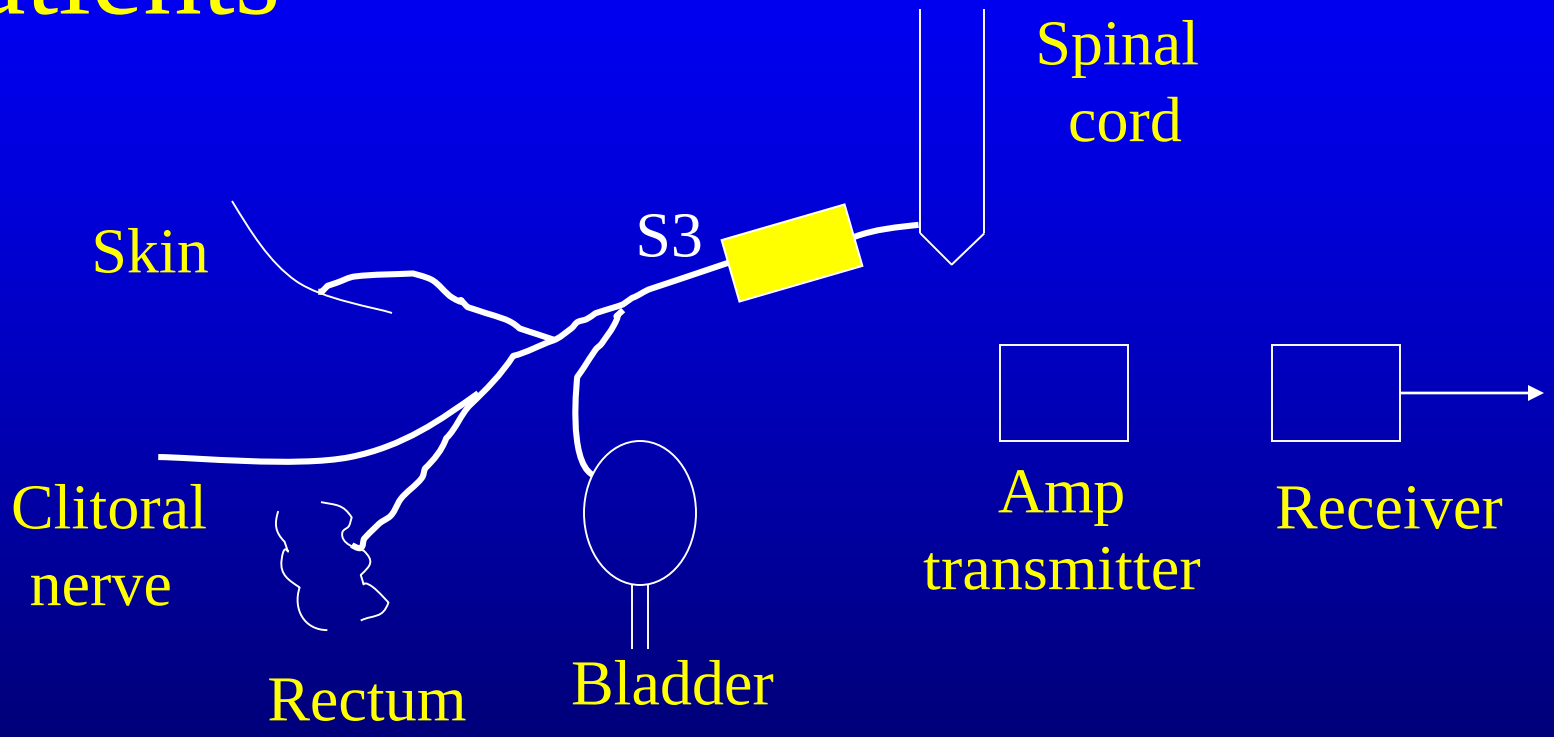
But ..

- Surface electrodes cause problems
- Implanted electrode near genital nerve
- Several short term studies (1-2 weeks) shown feasibility

- Long term pressure recording not possible
  - Sacral root ENG
  - Artificial sensor
  - Patient controlled

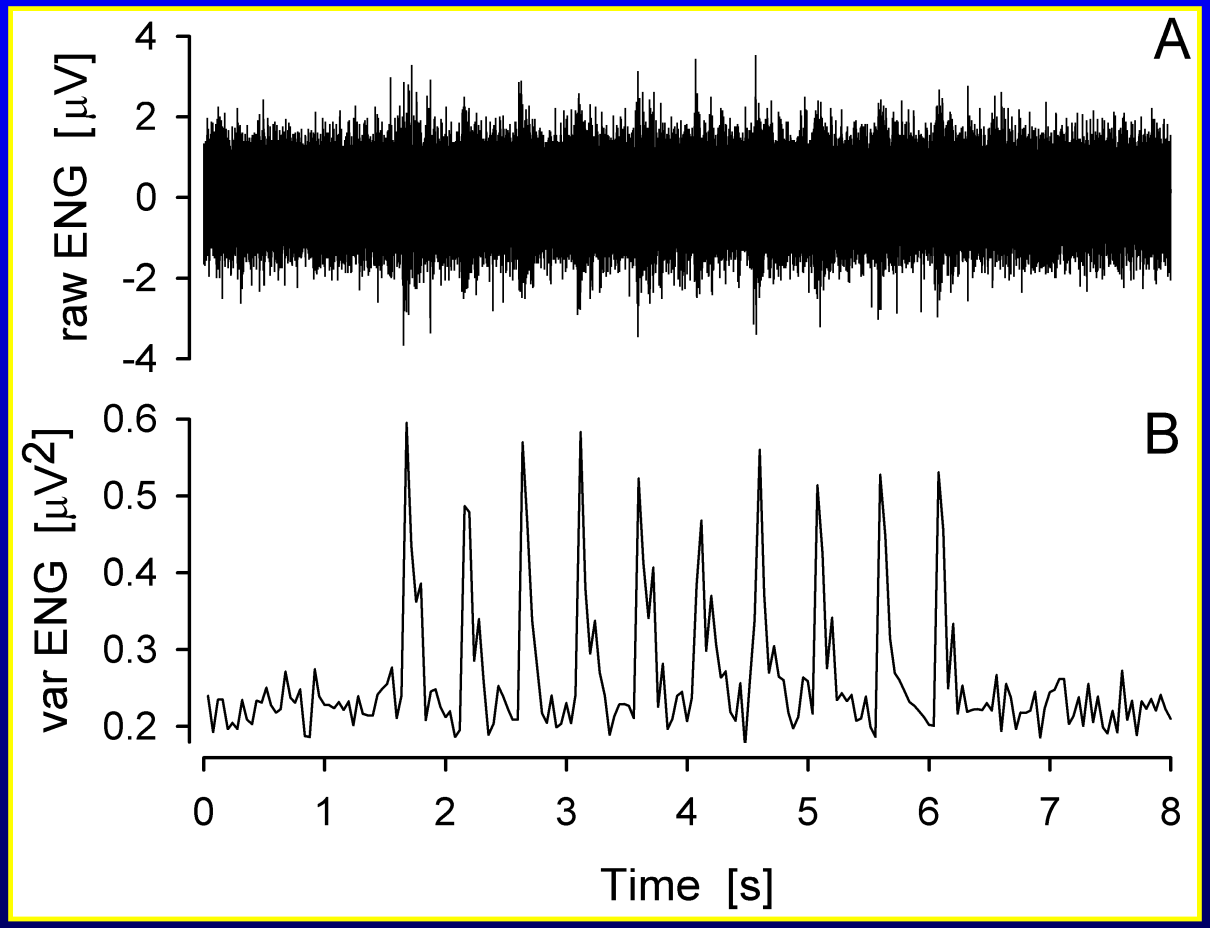
Experimental setup

6 Patients

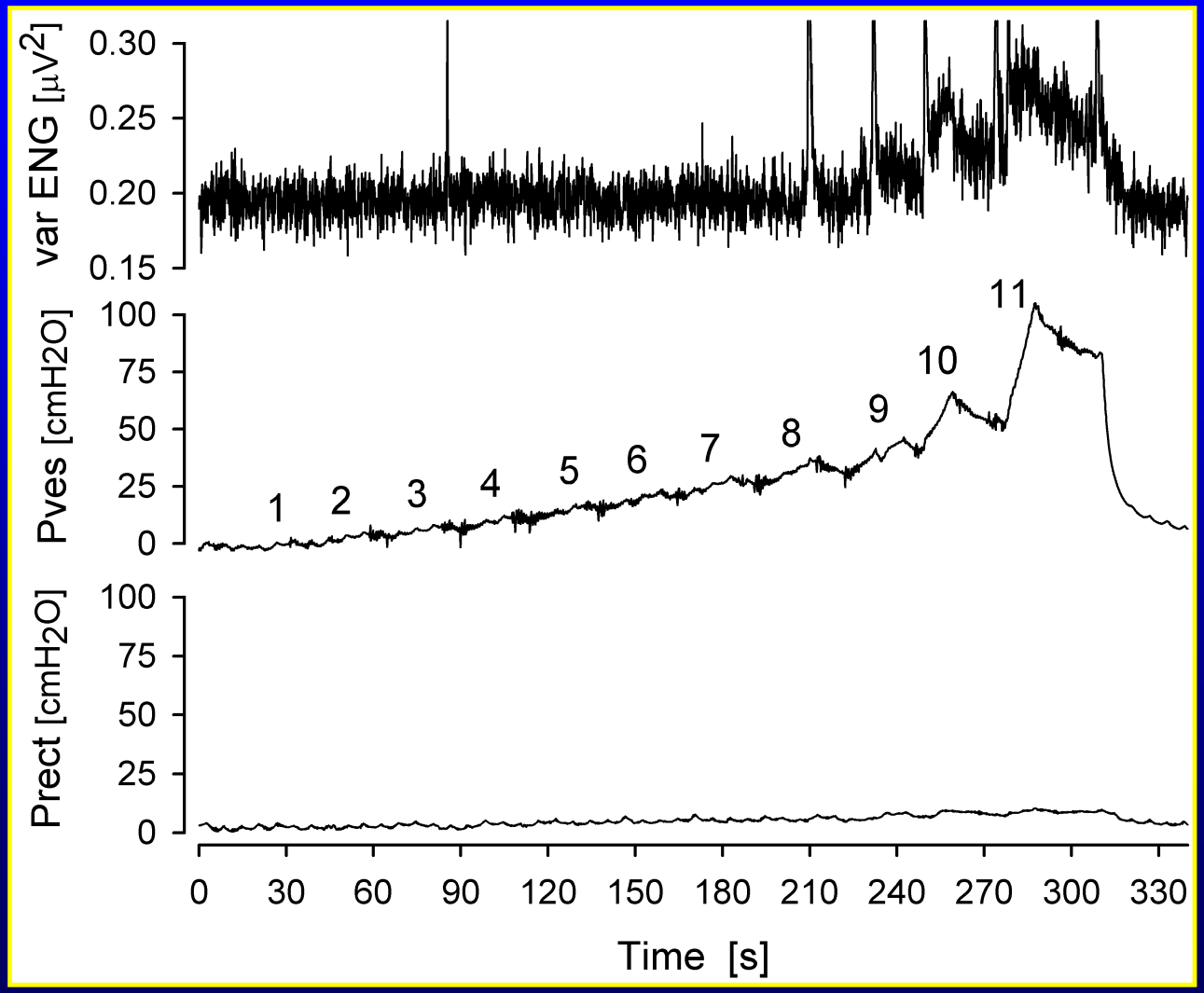


Kurstjens et al, J. Urol, 2005

Cutaneous

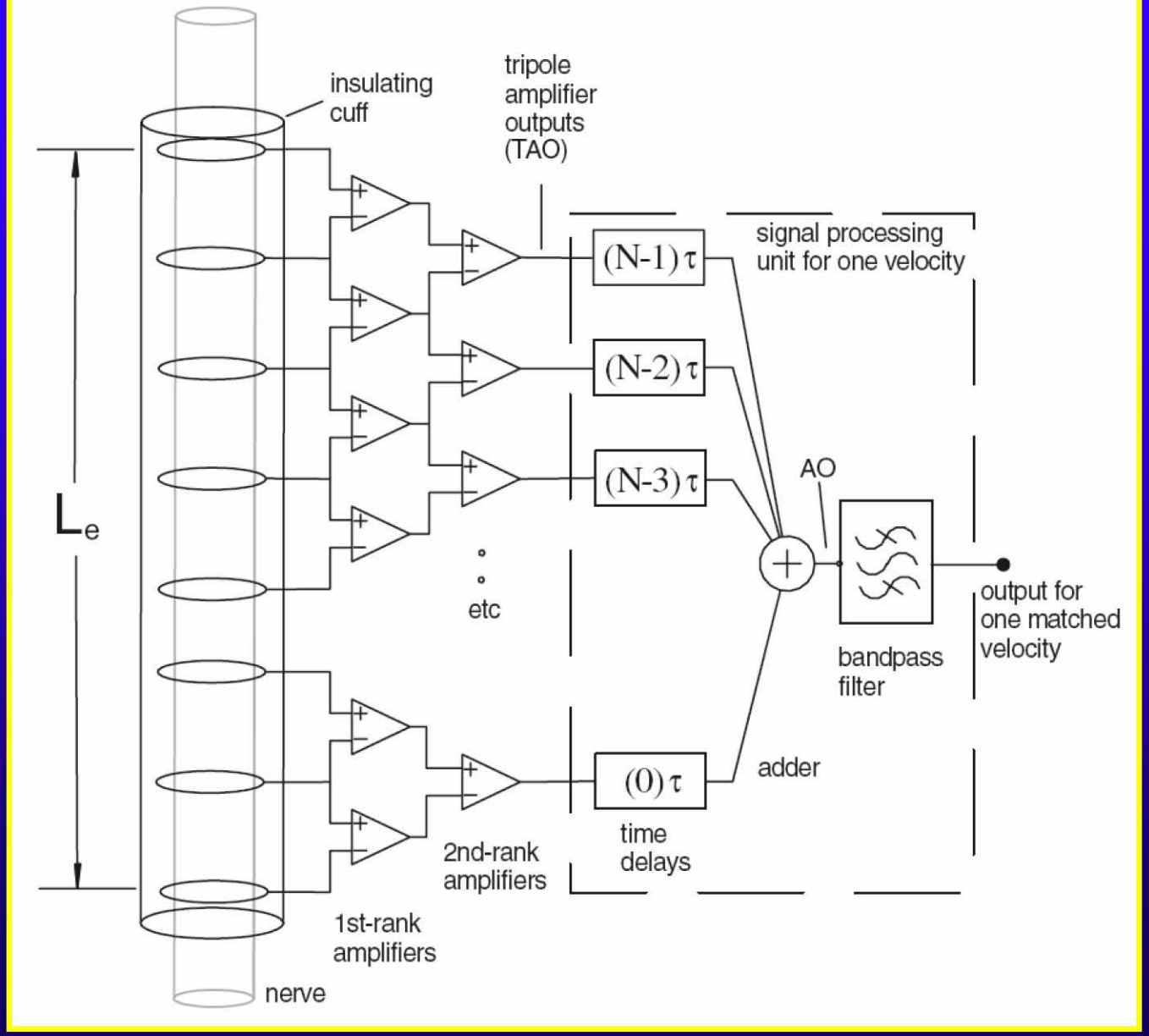


Bladder filling

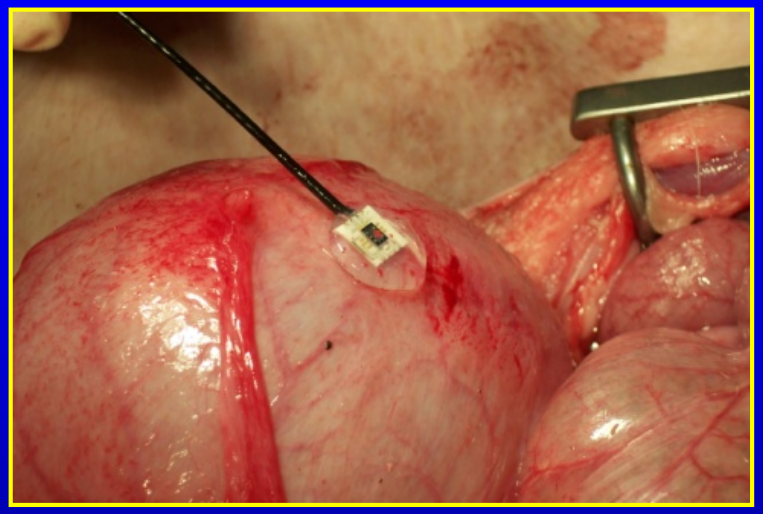


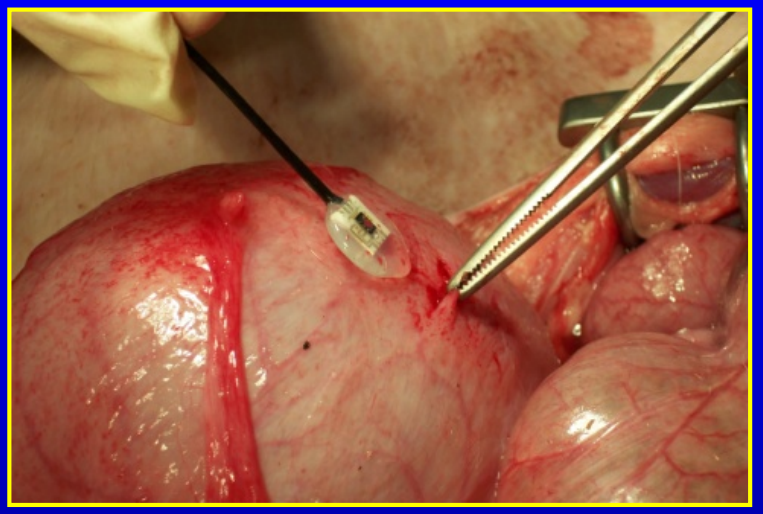
ENG from bladder

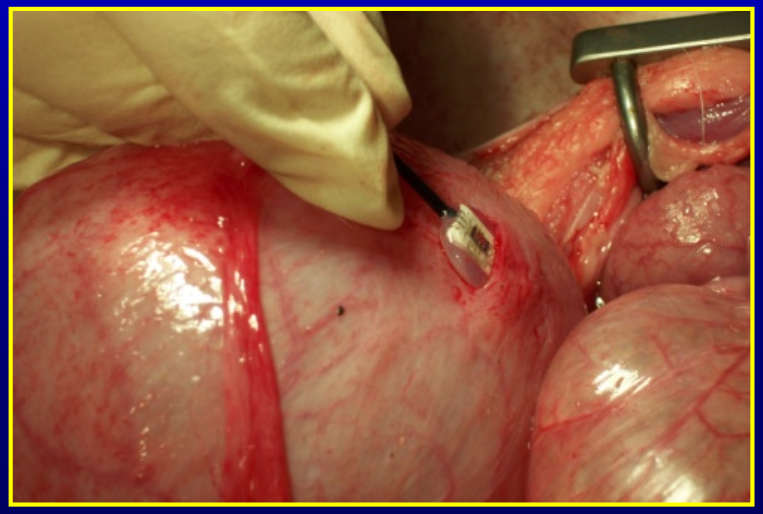
- Possible to record bladder related ENG in humans
- Signal amplitude and S/N is small
- Technical improvements needed
  - Smaller cuff on intradural dorsal root?
    - Extradural cuff: 2.8 – 3.6 mm diameter
    - Intradural cuff: 1.4 – 1.8 mm diameter
  - Record from ganglion
  - Intrafasicular electrode
  - Multicontact cuff electrode

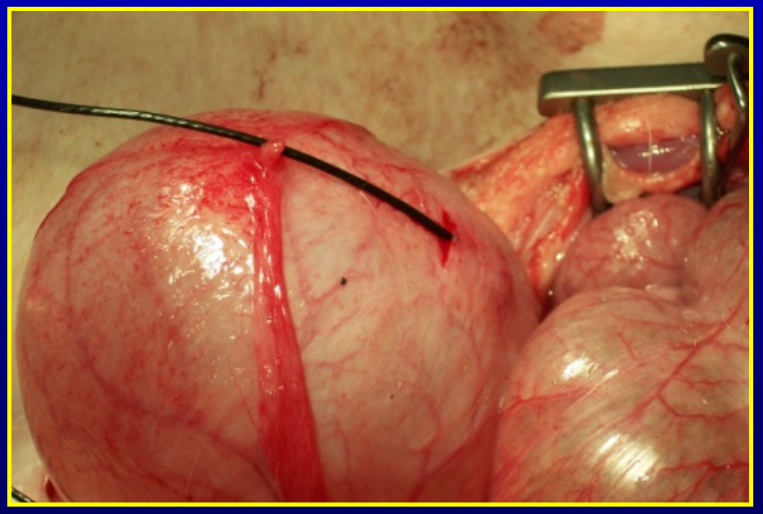

insulating
cuff
tripole
amplifier
outputs
(TAO)
signal processing
unit for one velocity
(N-1) τ
(N-2) τ
(N-3) τ
AO
L_e
etc
output for
one matched
velocity
bandpass
filter
adder
(0) τ
time
delays
2nd-rank
amplifiers
1st-rank
amplifiers
nerve

Bladder sensor

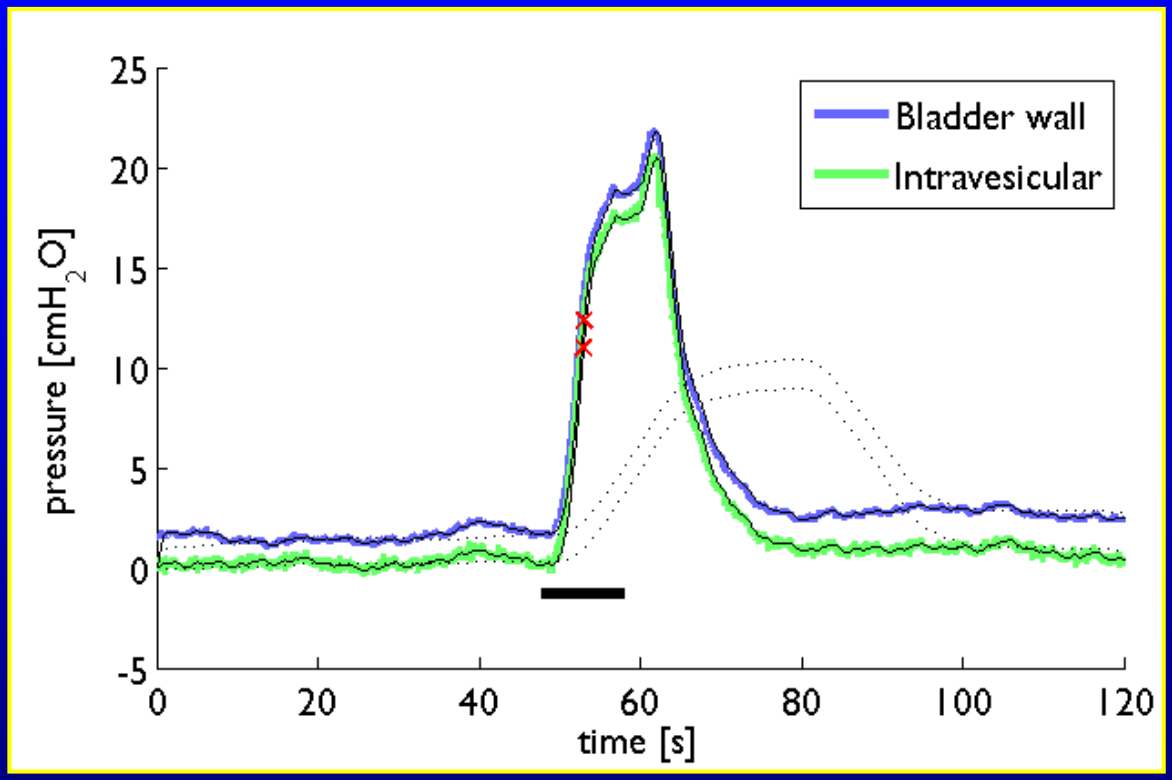








Recording in acute pig



Patient controlled

- Most patients can ‘feel’ their bladder
- Results show feasibility
- ~15 patients (SCI, OAB wet) have used this at home with good results
- Fast intent detection is important

Summary

- Limited usefulness of animal work for therapy optimization
- On demand stimulation of the DGN may fully restore continence
- Most simple: patient controlled
- Automatic control most likely preferred – requires a sensor
- Invasive, complexity, userinteraction