Physiotherapy of Lower Urinary Tract Dysfunction

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Lower Urinary Tract Dysfunction

- Urinary Incontinence

  Stress, urge, or mixed incontinence
- Frequency urgency syndrome
- Spastic urethral sphincter syndrome
- Poor relaxation of urethral sphincter
- Pelvic pain syndrome
- Chronic eliminative syndrome

Therapeutic modalities

- Medical treatment
- Surgical treatment
- Behavioral therapy
- Physiotherapy
  - Electrical stimulation
  - Biofeedback PFMT
  - Neuromodulation
  - Neurostimulation

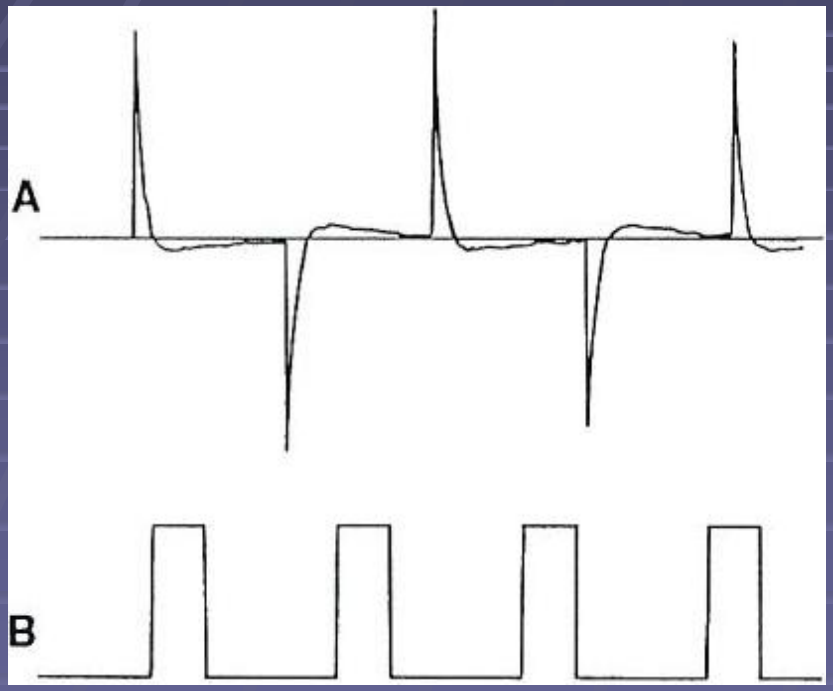
Functional Electrical Stimulation

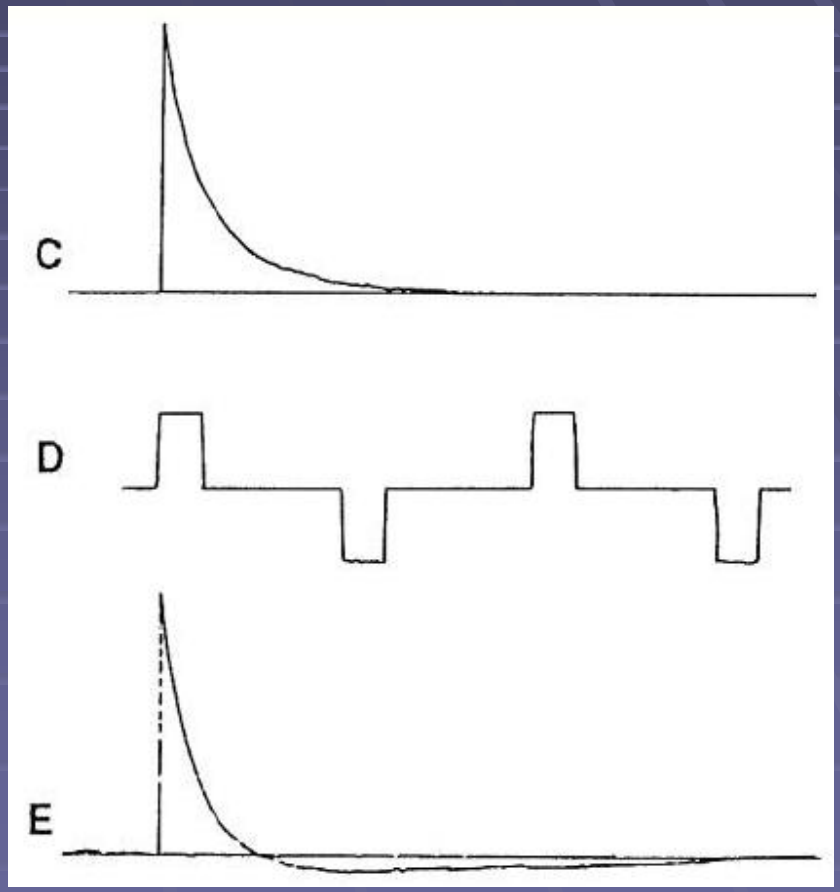
- Restoration of normal physiological reflex mechanisms in abnormal nerves and muscles
- Black torpedo fish in 46 AD
- Bors (1952) electrostimulation of pelvic floor
- Caldwell (1965) anal and urinary incontinence by electrical stimulator
- Alexander & Rowan (1968) electrodes on vaginal pessary
- Suhel (1975) integrated automatic vaginal stimulator

Neuromuscular Electrical stimulation

- Excitation of peripheral nerves using short pulses, adequate intensity and duration
- Current amplitude (intensity)
- Pulse width (duration)
- Pulse rise time
- Pulse repetition rate (frequency)

Types of Waveform





Muscle Fatigue

- Skeletal muscle is composed of aerobic slow contracting motor units and anaerobic fast contracting units
- Resistance to fatigue is inversely correlated to aerobic oxidative capacity
- At high frequency electrical stimulation the muscle fatigues rapidly due to impaired neuromuscular transmission and sarcolemmal excitation

Skeletal muscles

- Motor striated muscles are composed of slow, intermediate, and fast contracting muscles, fast muscle has 10-20 times more contraction force than slow fibers
- Intramural urethral sphincter – small slow muscle fibers
- Periurethral pelvic floor muscles – all types of muscles
- Provocative situation – fast fibers of PFM action to close urethra

Muscle Activity

- Plasticity of metabolic and functional properties of muscles
- Following denervation, muscles lose enzymatic difference
- Immobilization induced muscle atrophy
- Disuse atrophy the muscle response is weak and rapid fatigue

Chronic nerve stimulation

- To modify physiologic and metabolic characteristics of normal & atrophied muscles
- Transform fast to slow myosin subunits that are more fatigue resistance
- Anaerobic fast muscle turns into slow muscle with a high capacity for energy supply by aerobic oxidative process
- Increase myoglobin and mitochondria content
- Increase in capillary density

Muscle Transformation after Nerve Stimulation

- Transformation of fast to slow twitch muscles is progressive with the duration of stimulation
- The most extensive changes occur between 60 and 90 days
- The total number of fibers remains constant
- Intermittent phasic high frequency stimulation (40 to 60 Hz) induces transformation similar to that after low-frequency (10Hz) stimulation
- The reverse process occurs by inactivity and chronic immobilization

Pelvic Floor Muscle Stimulation

- Induces a reflex contraction of striated para- and periurethral muscles and a simultaneous reflex inhibition of detrusor contraction
- A sacral reflex arc and peripheral innervation must be intact
- No effect can be expected in complete lower motor neuron lesions

Nerve Stimulation for Urethral Closure

- Direct stimulation of efferent pudendal nerves
- Activation of efferent hypogastric fibers can contract smooth urethral muscles
- Efferent stimulation of pelvic nerves can increase intraluminal urethral pressure and increase urethral length
- Stimulation of pelvic floor afferents from anogenital muscles and mucosa may activate pelvic floor muscles through reflex connection

Nerve Stimulation for Bladder Inhibition

- A feedback system is present in micturition process
- Detrusor instability may be caused by ineffective inhibition by sphincter
- Intravaginal or pudendal nerve stimulation of sufficient intensity causes a complete bladder relaxation
- The higher intensity the more efficient bladder is inhibited via spinal reflex mechanism

Nerve Stimulation for Bladder Relaxation

- Maximal bladder inhibition is obtained at 2x to 3x of threshold intensity
- Relaxation of detrusor is accompanied by tightening of bladder neck fibers
- Detrusor inhibition after nerve stimulation may be caused by balance between cholinergic (M2,3-receptors) and beta-adrenergic (B3-receptors) neurotransmission
- After maximal stimulation, high beta-adrenergic activity and decreased cholinergic activity in rabbit detrusor strips

Chronic Pelvic Floor Stimulation

- Chronic long-term stimulation of anal and urethral sphincters applies relatively weak electrical impulses for 3 to 12 months
- Fast motor units are recruited first
- Increase frequency of slow-twitch fibers
- Accelerated sprouting of surviving motor units of partially denervated pelvic floor muscles
- High frequency (25-50 Hz) is advised in treating stress incontinence

Selection of Electrical Parameters

- Patient adapt to current intensity within a few minutes
- The stimulation is constructed to increase current intensity from 0 to maximum within a few minutes
- A pulse length of 0.5 to 1.0 minutes is optimal to muscle contraction
- Biphasic pulses give 30% to 40% better therapeutic response than monophasic pulses

Selection of Frequency of Electrical Stimulation

- Maximal detrusor inhibition is obtained with a frequency of 5 Hz
- No difference in MUCP change in the range of 10- 50 Hz
- Good therapeutic results in stress and urge incontinence with a fixed frequency of 25 Hz
- Intermittent ES is superior to continuous ES to avoid muscle fatigue during long-term stimulation
- The most effective rest period is 3 times longer than active period

Functional ES for Stress urinary incontinence

- Successful pelvic floor stimulation was reported in 50- 92 % women with incontinence
- Patients without previous incontinence surgery have the best result
- Urodynamic parameters change little after functional ES for SUI
- Patients with SUI may have a better pelvic floor muscle contractility after ES that results in increased urethral resistance during stress

Long-term electrostimulation

- At least 6 to 8 hours daily ES is needed either anally or vaginally
- A treatment period of 3 to 6 months is necessary to achieve success
- Kegel exercises should be followed after discontinuing FES to keep pelvic floor muscles in optimal condition
- Treatment combined with estrogen is recommended in menopause women
- Mechanical vaginal mucosal irritation may occur in atrophic vaginitis

Short-term Maximal stimulation

- Intact reflex arc must be present
- Maximal ES can inhibit overactive detrusor muscle, can be an alternative in treating detrusor overactivity and urge incontinence
- 5 to10 Hz can give optimal inhibitory effect
- The current intensity is successively increased below pain level of patient
- Duration of maximal ES is 15 to25 minutes, 4 to 10 repetitions daily for 2 to 3 days

Therapeutic Results after Short-term electrostimulation

- Successful maximal ES for pelvic floor in female urge incontinence was reported to be 52 to 92%
- A recurrence rate of 25% after discontinuing maximal ES in urge UI
- Recurrence rate of 15% within 1 year
- Success rate of 75% in recurrent urge urinary incontinence
- Repeat stimulation is needed for recurrence

Electrical Stimulation for SUI

- Transvaginal ES has been used for genuine SUI, urge and mixed urinary incontinence
- Reported efficacy ranges 35 to70%
- A placebo-controlled study revealed after 15-week treatment course, pad usage diminished by >50% in 62% women compared to 19% in sham device, incontinence episode reduced >50% in 48% women compared to 13% in sham device

Transvaginal electrical stimulation

- Low frequency (20 Hz) was applied
- Contrasting data of effects on genuine SUI
- Transvaginal ES is effective in urge UI
- First line treatment for women with pure urge incontinence
- For the women with mixed type UI who does not wish to undergo PME or surgery

Transvaginal electrical simulator

Transvaginal electrical stimulation for Urge incontinence

- Leach reported 6% after long period of stimulation
- McGuire observed improvement in 93% women with urge incontinence
- Plevnik found 52% improved (30% cured) in pure urge incontinence
- Brubaker used 20 Hz frequency current and cured 49% with urodynamic DI
- Smith found ES reduced urine loss by 50% in 20women
- Sand reported 38% success rate in 20 women with DI

Contraindication of ES

- Heart pacemakers
- Pregnancy women
- Urethral obstruction and overflow incontinence
- Complete peripheral denervation
- Urinary tract infection
- Uterine prolapse or high grade cystocele
- Low compliance and cooperation of patient

Biofeedback

- Detectable or measurable response: bladder pressure or pelvic floor muscle activity
- A detectable response
- A perceptible cue : sensation of urge or tightness
- Active involvement of a motivated patient

Biofeedback for LUTD

- Fail to inhibit detrusor contraction
- Fail to adequately contract striated urethral sphincter of the pelvic floor
- Failed to relax the urethral sphincter or pelvic floor muscles during micturition
- Chronic pelvic pain due to hypertonicity of pelvic floor muscles

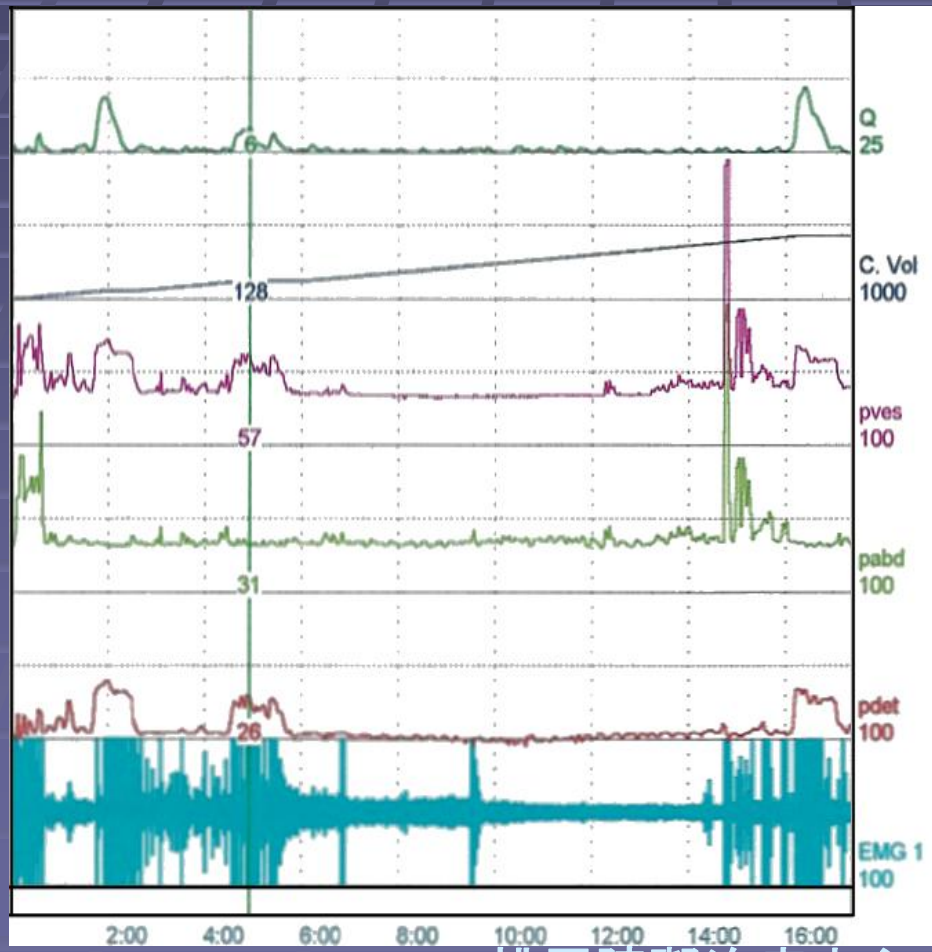
Cystometry biofeedback for urge incontinence

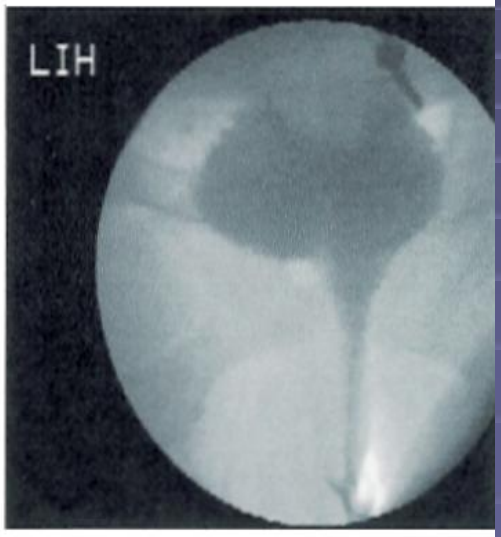
- For women who failed electrical stimulation, were intolerant to anticholinergics,
- Urodynamic detrusor overactivity was proven
- Performed several voluntary PFMC at episodes of DI while watching CMG tracing and EMG activity
- Try to inhibit urge incontinence as longer duration as possible at home

Bladder biofeedback

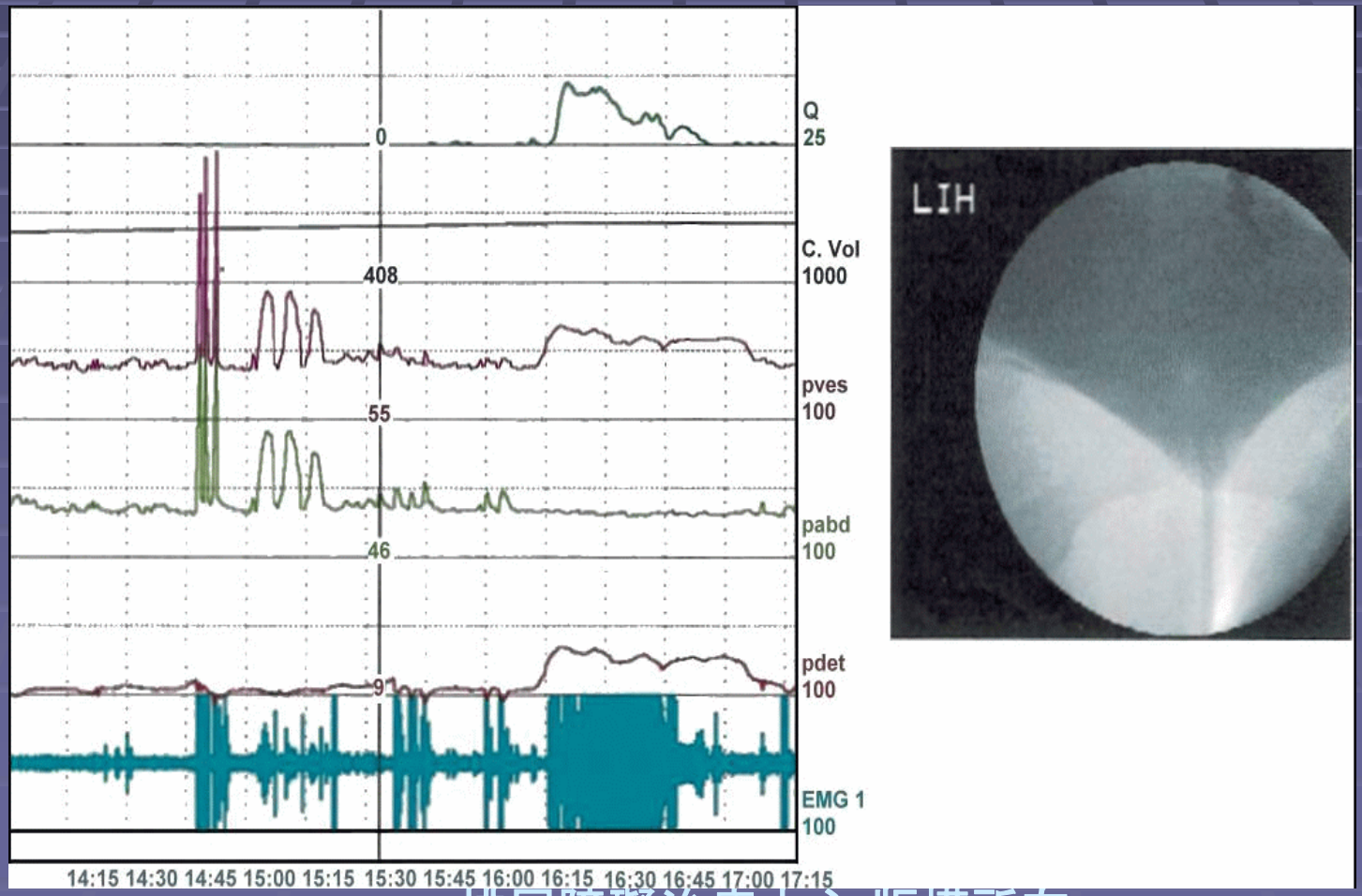
- Train patients to inhibit detrusor contraction voluntarily and to contract periurethral muscles selectively
- Bladder pressure biofeedback to treat urge incontinence by watching intravesical pressure rise during CMG
- 81% improvement rate was reported and 36% success rate at 5 year follow-up

Detrusor overactivity and CMG biofeedback



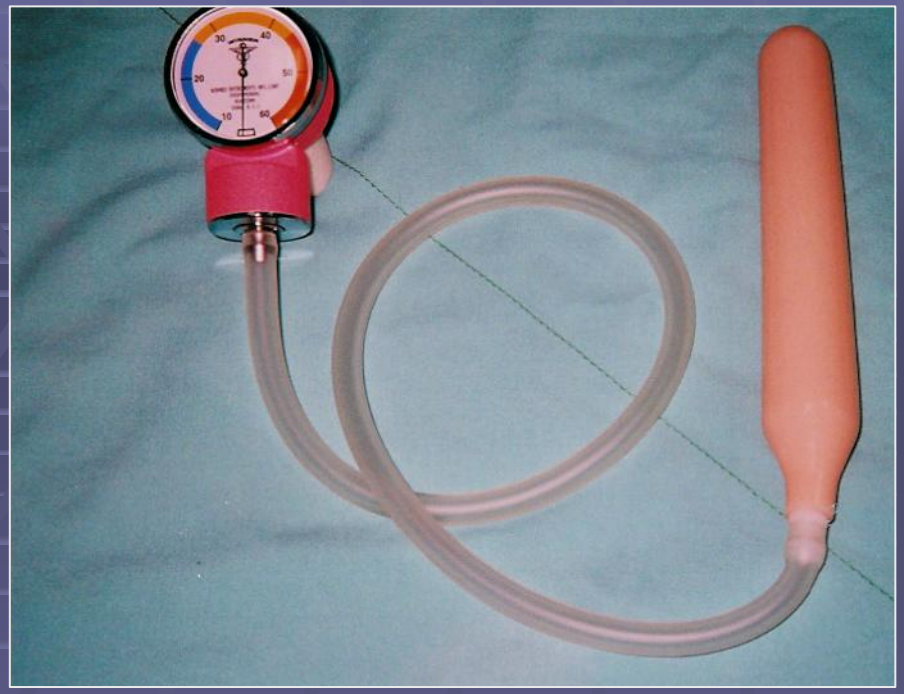


Biofeedback to inhibit detrusor instability



Pelvic Floor Muscle Biofeedback

- Vaginal manometry – by perineometry Kegel reported a 90% improvement rate
- Vaginal electromyography – in 8 week program 80% younger and 67% older group reported no more incontinence
- Anal sphincter biofeedback – by perineal surface EMG or rectal probe



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Pelvic floor hypertonicity & overactivity

Etiology

- Persistence of a reaction phase to noxious stimulus of LUTS (e.g. inflammation, infection, irritation, post-surgery)
- learned dysfunctional voiding behavior
- Persistent transitional phase in the development of micturition control
- Sexual abuse

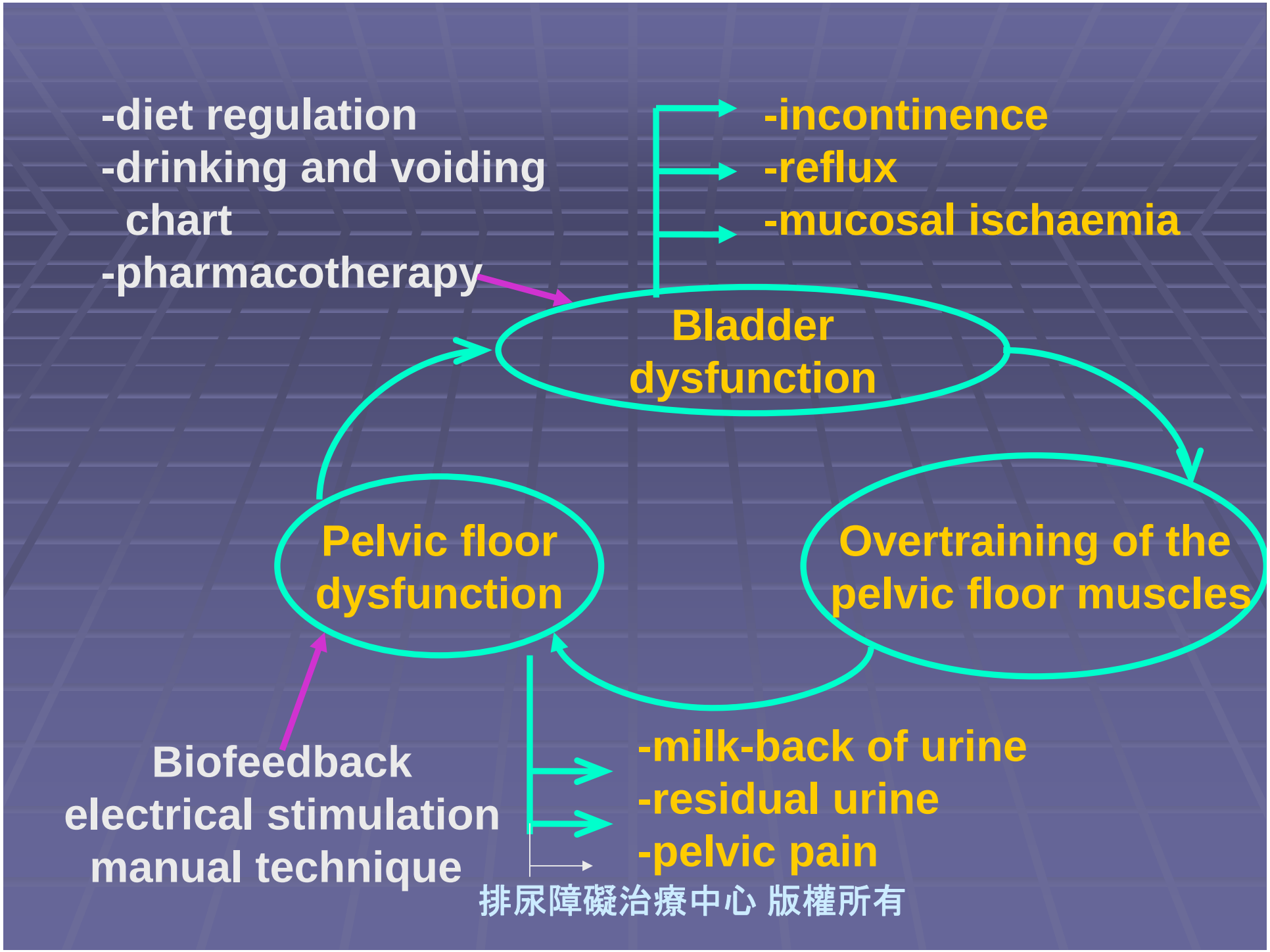
Clinical presentation

- Dysfunctional voiding

  Increased pelvic floor activity during voiding

  Urgency frequency, poor stream, intermittency, hesitancy
- Urinary retention
- Constipation
- Pelvic or perianal pain

  Certain pelvic pain (e.g. interstitial cystitis, prostatodynia, urethral syndrome) is associated with pelvic floor hypertonicity



Aims of physical therapy

- To improve dietary and micturition routine
- To improve proprioception and body awareness of PF: focus on relaxing the PF and voluntary sphincter control
- To decrease any associated hypertonicity or pain in the PF
- To optimize functional use of PF

Evaluation

A complete history

- Frequency /volume chart for 3 days

Neurological examination (lower quarter)

- proprioception, sensation
- Peripheral reflexes

Physical examination

PF function: Rectal /vaginal tone, contractility, endurance, ability to contract and relax PF voluntarily, relation between PF & adjacent pelvic viscera

- pelvic pain: trigger point, tenderness
- Sacroiliac & coccygeal position /mobility

Behavioral modification

- Instruction on urinary system and PF dysfunction
- Diet: avoid bladder stimulants, high fiber
  adequate daily intake of water
- General recommendations for changing wrong voiding behavior

  take time for micturition, do not push

  Instruct a proper toilet posture:

  sit for voiding every time (men also)

  no straining

  timed voiding (3 ½~4 hours)

Manual technique

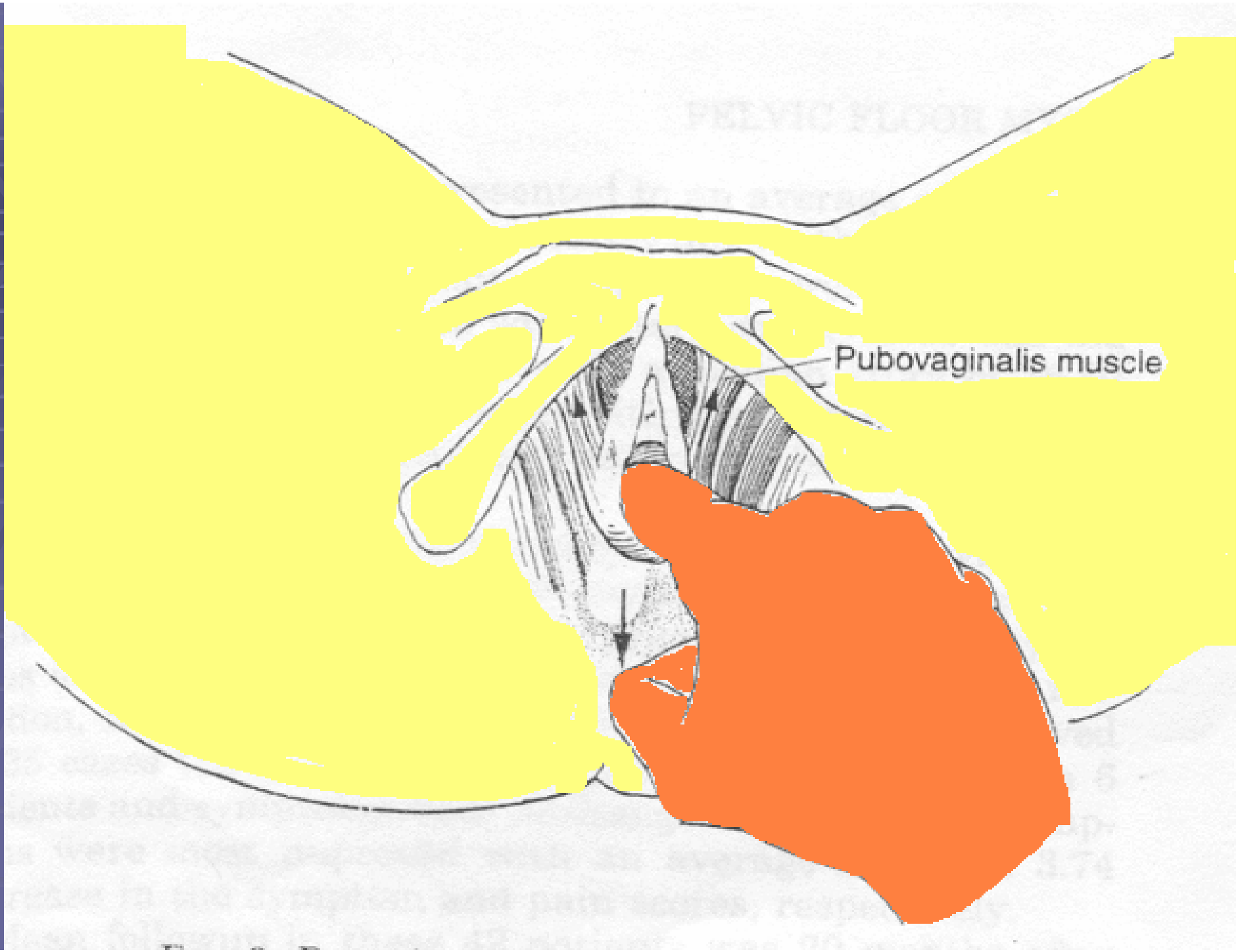
To restore sacroiliac & sacrococcygeal alignment

To improve proprioceptive awareness

- Muscle energy technique
- Proprioceptive technique: direct pressure, tapping, use of stretch reflex

To decrease tension and promote relaxation of the musculature

- Massage
- Trigger point pressure
- Myofascial release


Pubovaginalis muscle

Clinical effectiveness

- Standford CA

  internal myofascial release, 18 sessions

  ↓hypertonus & ↓pain in type III chronic prostatitis

- Jerome MW

  myofascial release, 8-12 weeks

  83% urgency-frequency syndrome

  symptom relief & ↓hypertonus

  70% interstitial cystitis

Pelvic floor exercise (PME) with EMG biofeedback

- Convert pelvic floor/urethral sphincter activity into visual or auditory signal
- Goal:
  - to help identify pelvic floor musculature
  - to perceive difference between contraction, relaxation, and straining
  - to voluntary relax & control pelvic floor

EMG biofeedback: children with dysfunctional voiding

- Anal plug or surface electrode on perineal skin
- Protocol:

  a short submaximal contraction (3 sec)

  → a prolonged relaxation (30 sec)

  for 30 times with diaphragmatic breathing

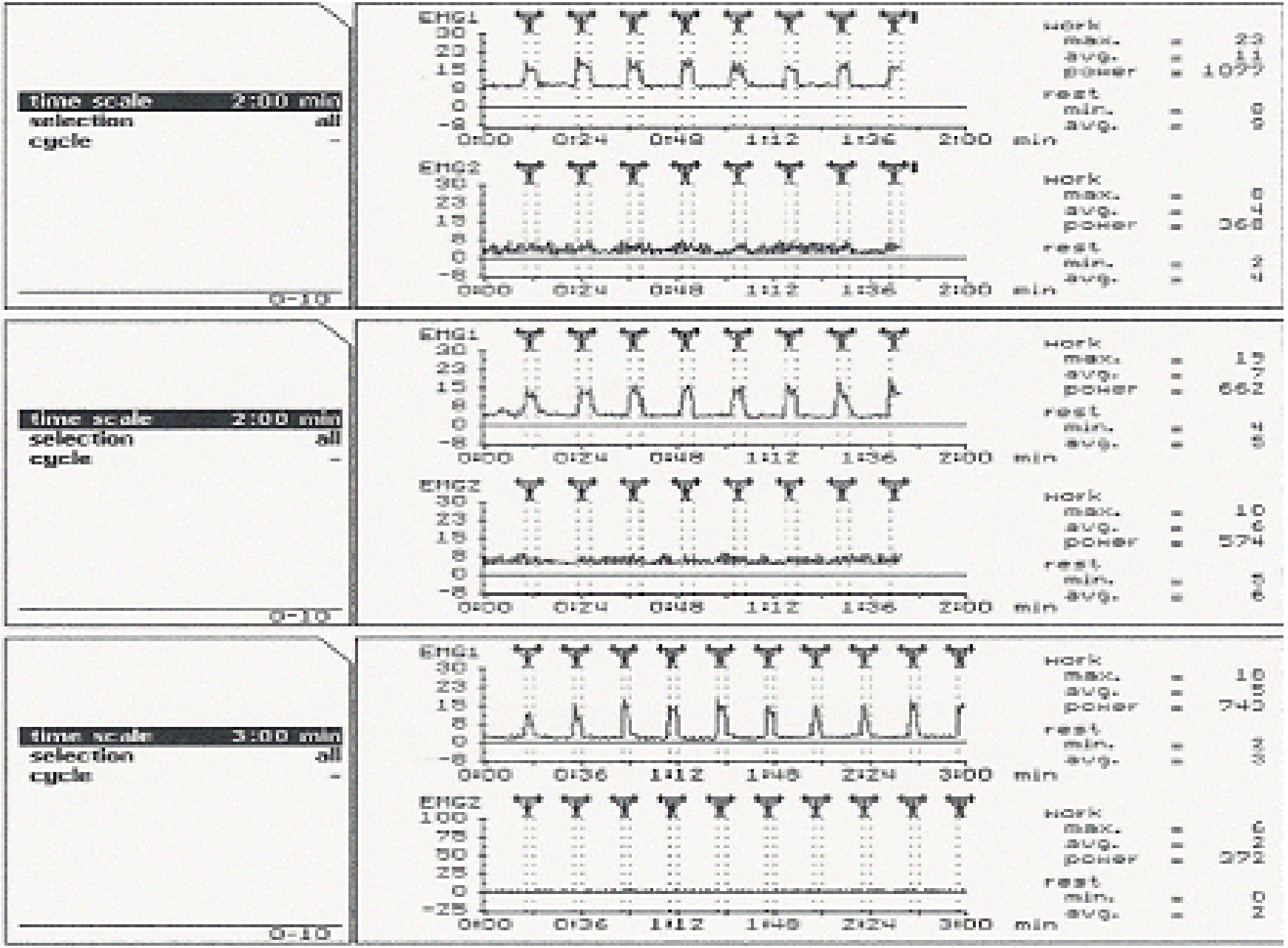
  progress:

  increase holding time (10 s) followed by prolonged relaxation (30 s)

PME with EMG biofeedback

- Intravaginal/ intra-anal EMG sensor
- Glazer Protocol

1. One minute rest, pre baseline
2. Five rapid contraction (flicks) with 10-s rest between each
3. Five 10-s contractions with 10-s rest between each (tonic)
4. A single endurance contraction of 60-s
5. One minute rest, post baseline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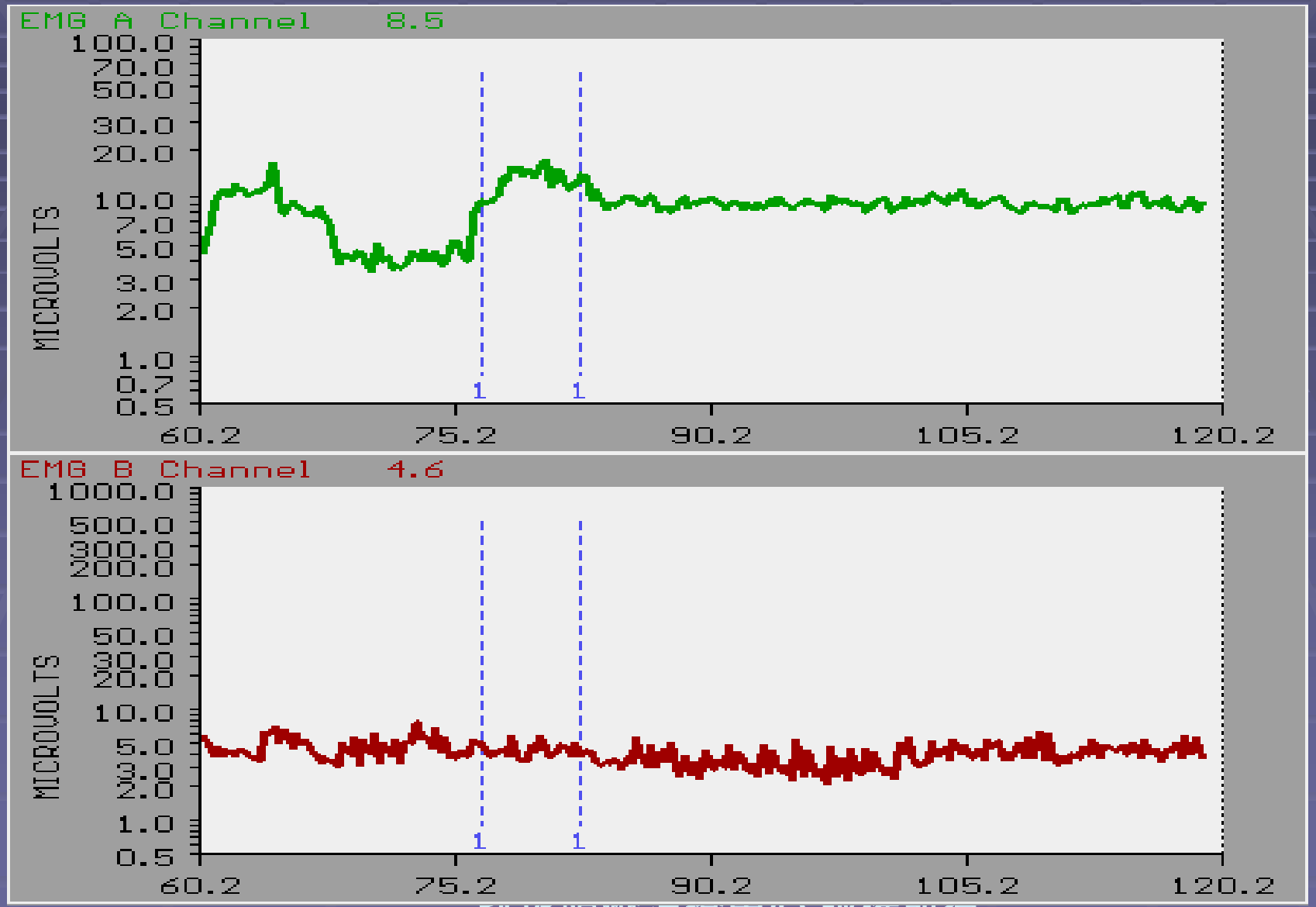
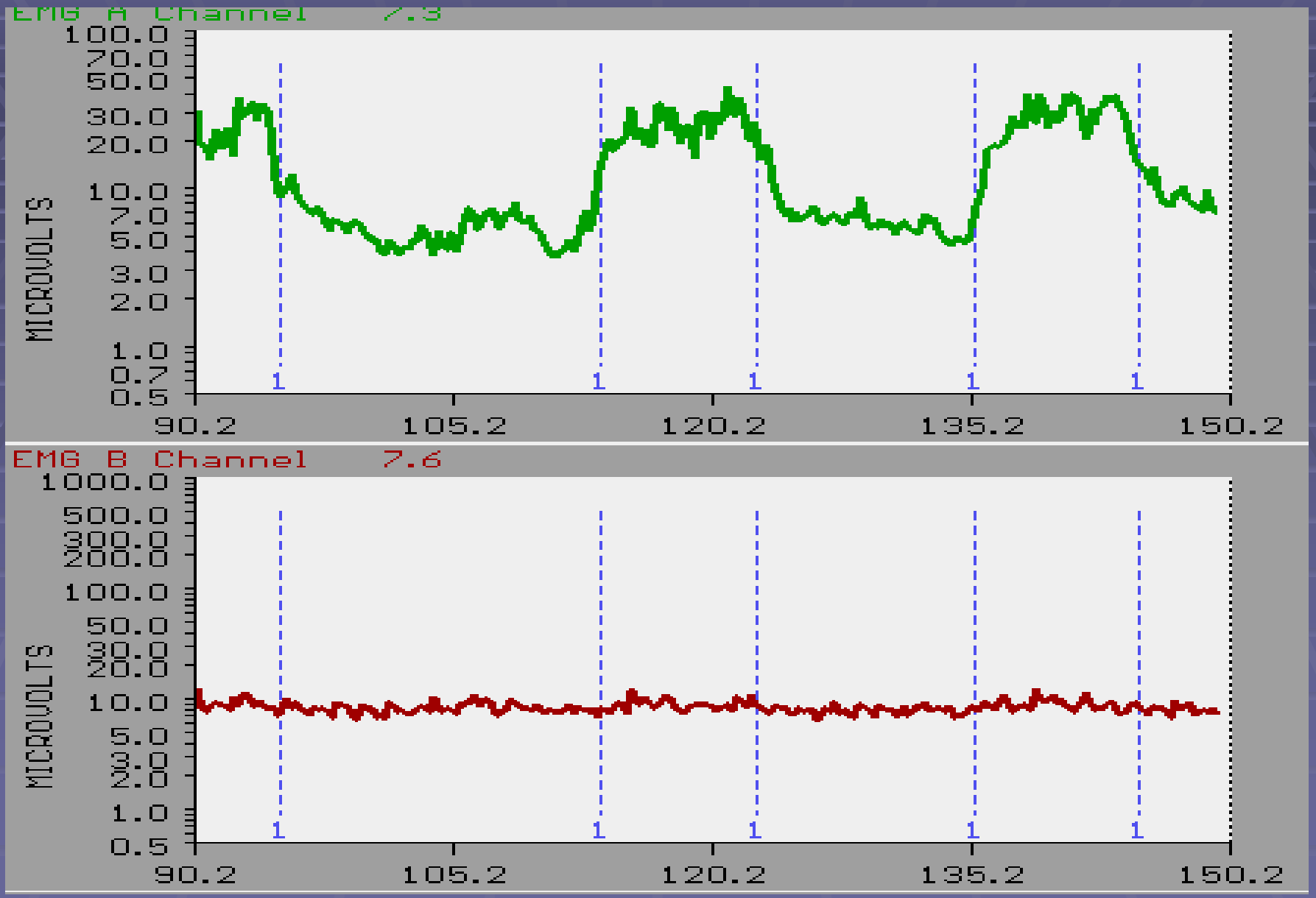
劉xx,40y/o for PME training first time



劉xx,40y/o for PME training 3month



- **Home program**:
  5-s contraction/10-s relaxation
  60 repetitions twice daily
  progress to 10-s contraction/10-s relaxation
- **Functional application** in corresponding situation during daily life
  - practice in different posture
  - practice relaxation during voiding
  - anticipate urge situation by submaximal PF contraction
- **EMG + uroflowmetry**
- **Cystometric biofeedback : cyclic filling**

Clinical effect

- **For dyfunctional voiding**

  51-83% improve for the long term follow up

  - normal flow curve & good pelvic floor relaxation
  - no significant residual urine
  - improve constipation
  - decrease occurrences of UTI

- **For pelvic pain**

  - 43-100% pain relief in levator syndrome
  - 83% pain relief in vulvovaginal pain

Additional treatment for other urological symptoms

- **Detrusor instability:** anticholinergic drugs
- **Recurrent UTI:** antibiotics
- **Chronic constipation**
  - regulation of diet
  - bowel training
  - drug therapy

*** Neuman et al:** UTIs were largely resolved after treating obstipation

Important factors for success

- **Motivation and cooperation**
- **Appropriate selection of patients**

  intact nervous system

  Biofeedback training (Deindal et al):
  - Improvement in women with inappropriate pubococcygeal activity
  - Not in those with urethral sphincter repetitive discharge

Other Non-surgical Therapies for Incontinence

- Vaginal cones are a method of biofeedback
- 70% (19/27) with mild SUI had complete or >50% improvement after vaginal cone therapy, 7/50 with severe SUI had similar success rate
- Electrostimulation of pudendal nerve (prolonged pudendal nerve conduction velocity in 97% SUI) is effective in 62% with SUI and 20% were dry
- Electromagnetic stimulation

Multiple purposes Electrostimulator and Biofeedback

Patient visualization & biofeedback

Clinical effect

- Magnus et al:
  interstitial cystitis,
  54% benefit from suprapubic TENS
- Park et al:
  Prostatodynia, 20Hz, anal plug,
  ↓ pain and ↓ muscle spasm in 18 sessions
- Walsh et al:
  irritative voiding syndrome, 1 week
  ↓ urinary symptom temporally
  100% relapse within 6 months
- Effectiveness depend on frequent, ongoing treatment

Electrogalvanic stimulation for levator ani spasm

- A high voltage direct current (80-120Hz)
- Possible mechanism

  high frequency nerve stimulation

  induce tentanic and fatique of levator ani

  break the spasm-pain

Clinical result:

- Rectal probe, high voltage galvanic stimulation, 80 or 120 cps, 1 h
- 90% relieve symptoms
- high relapse rate in 6 months

Combination therapy

- **Behavioral modification**
- **Manual technique**
- **Biofeedback**
- **Electrical stimulation**
- **Pharmacotherapy**

Electrostimulation and electromodulation for NVD

- Detrusor contractility reduces during electrostimulation of pelvic floor
- Detrusor overactivity –

  Sacral neuromodulation,

  Surface sacral electromagnetic current stimulation
- Detrusor underactivity – Sacral nerve or

  Intravesical neurostimulation

Electrical stimulation

- **5-20Hz, 210μs, low level intensity**
- **Intravaginal/ intranal electrode**

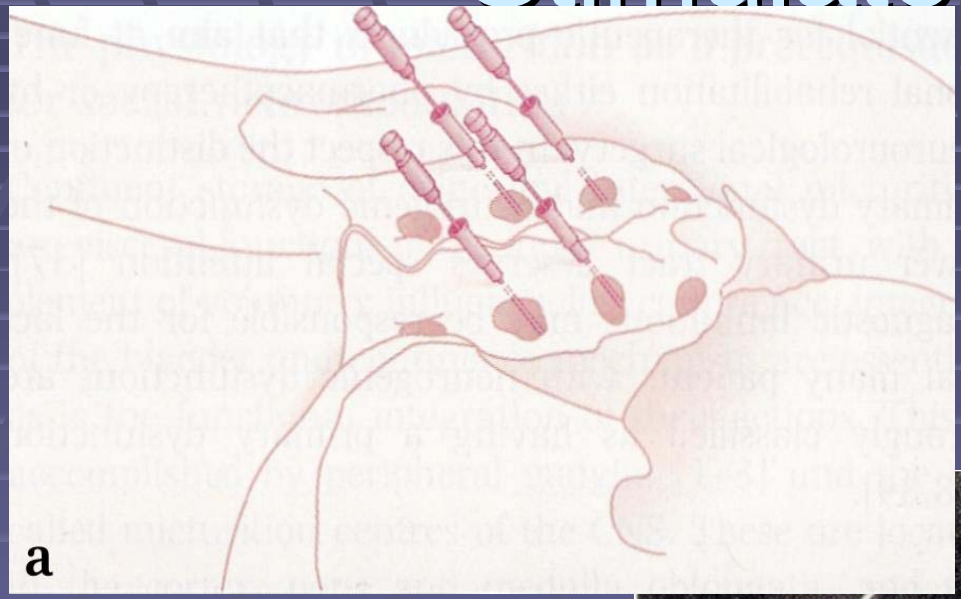
  transcutaneous electrodes: sacral dermatome:

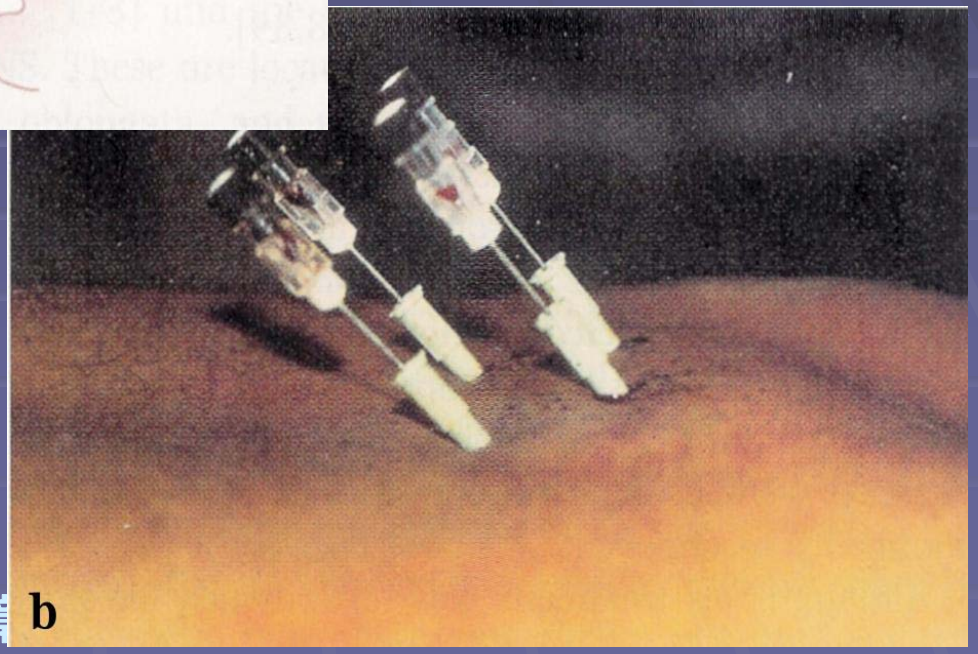
  - sacral, suprapubic, common peroneal, posterior tibial nerves

mechanism of action

- Large skin afferents suppress spontaneous reflex activity within the dermatome

Implantation of Sacral Stimulator





Correct placement of electrode on Sacral nerves