Dynamic rehabilitative ultrasound for pelvic floor disorders – Introduction in techniques and hands-on-workshop
Workshop 8
Monday 23 August 2010, 09:00 – 12:00

Chairs: Bärbel Junginger (Germany) & Kaven Baessler (Germany)

Time	Time	Topic	Speaker
9:00	9:10	Welcome and Objectives	Bärbel Junginger
9:10	9:25	Scientific background of pelvic floor motor control, coordination training and specific stabilisation of the pelvic floor	Kaven Baessler
9:25	9:55	Development of an individual and specific rehabilitation programs employing ultrasound.	Bärbel Junginger
9:55	10:10	Different ultrasound applications in the assessment and rehabilitation of stress, urge and faecal incontinence Technical instructions and information regarding the selection of adequate equipment.	Kaven Baessler
10:10	10:30	Hands-on: Abdominal muscle ultrasound to assess the transversus, external and internal oblique muscles, transversus-pelvic floor co-contractions and adverse external oblique contractions	Bärbel Junginger / Kaven Baessler
10:30	11:00	Break	
11:00	11:15	Hands-on: Supra-pubic (abdominal) ultrasound to assess movements of the bladder base during pelvic floor contraction, straining and coughing	Bärbel Junginger / Kaven Baessler
11:15	11:45	Hands-on: Perineal (translabial) ultrasound to evaluate the bladder neck movements during maximal and submaximal pelvic floor contraction, straining, coughing and other functional tasks	Bärbel Junginger / Kaven Baessler
11:45	12:00	Results of a specific rehabilitation program employing ultrasound	Bärbel Junginger

Aims of workshop

The aim of this workshop is to familiarize participating physiotherapists and other interested health care professionals treating women with pelvic floor disorders with techniques of dynamic rehabilitative ultrasound and the appropriate equipment.
Different ultrasound applications to assess pelvic floor function will be practiced amongst participants.

Educational Objectives

Ultrasound is a medium for pelvic floor rehabilitation for physiotherapists and other health care professionals treating women with pelvic floor disorders. Dynamic rehabilitative ultrasound is used to image function and dysfunction of musculo-skeletal and pelvic floor

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disorders. The aim is to directly evaluate the effect of muscle contraction and relaxation, e.g. bladder neck elevation and descent. Workshop participants will practice amongst each other abdominal muscle ultrasound to assess the transversus, external and internal oblique muscles as well as perineal and supra-pubic ultrasound to evaluate the bladder movements during pelvic floor contraction, straining, coughing and other functional tasks

Motor control and pelvic floor awareness are essential parts of pelvic floor rehabilitation. For the maintenance of continence, pelvic floor muscle contraction is required to stabilise the bladder neck and to compress the distal urethra during increased intraabdominal pressure. While contraction of pelvic floor muscles leads to an elevation of the bladder neck, intra-abdominal pressure raise may result in bladder neck descent. The intraabdominal pressure however is increased during voluntary maximal contractions of the PFM. During a head lift or brace bladder neck elevation is only apparent when IAP and PF muscle activity were appropriately matched. Bladder neck elevation also occurs during the TrA contraction.
The pelvic floor muscle is part of the abdominal capsule, a tonic muscle system with predominantly slow-twitch-fibres. As all muscles surrounding the abdominal cavity have the potential to increase IAP, and increased IAP causes descent of the bladder neck, activation of the PFM is critical to maintain the position of the bladder neck during tasks that involve abdominal and diaphragm muscle contraction. If PF muscle activity is insufficient or abdominal muscle activity (and the associated increase in IAP) is increased, bladder neck descent may occur during functional tasks. Such descent of the bladder neck has been argued to be associated with urine loss.

Findings of normal and pathological pelvic floor function during pelvic floor contraction, coughing, lifting and other activities of daily life will be discussed.
The hands-on-part will give participants the possibility to perform three different ultrasound techniques that are useful for evaluation and treatment of pelvic floor disorders.

PD Dr Kaven Baessler is a trained urogynaecologist (DU, RANZCOG) and currently working as director of the Pelvic Floor Centre Charité, University Hospital Berlin.

Bärbel Junginger (PT MT (OMT)) is a physiotherapist with a special interest in pelvic floor rehabilitation. She is currently working with Dr Baessler in Berlin/ Germany and is a MPhil student to Prof Paul Hodges, University of Queensland Brisbane/ Australia.

Dynamic rehabilitative ultrasound for pelvic floor disorders

Introduction in techniques and hands-on-workshop

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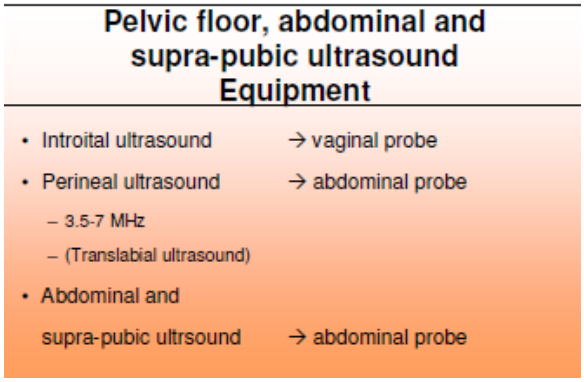
1. Introduction:

- Ultrasound is a medium for pelvic floor rehabilitation for physiotherapists and other health care professionals treating women with pelvic floor disorders.
- Dynamic rehabilitative ultrasound (DRUS) is used to image function and dysfunction of musculo-skeletal and pelvic floor disorders.
- For pelvic floor rehabilitation several muscles are of interest:
  - abdominal muscles: abdominal ultrasound probe
  - pelvic floor muscles: abdominal or endovaginal ultrasound probe

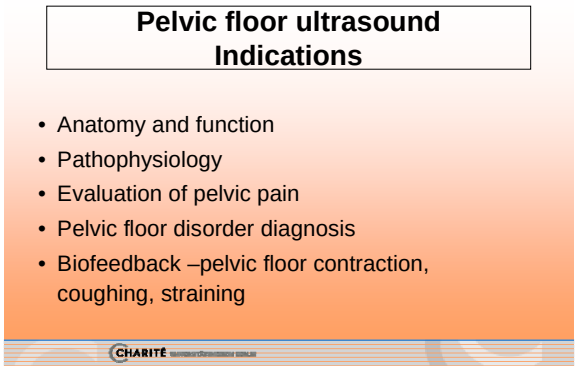
Ultrasound can be used as an instrument for evaluation of physiological and pathophysiological movements of the bladder. It can also be used as a biofeedback instrument, for example via perineal ultrasound, to enhance the understanding of normal pelvic floor function during coughing e.g. The physiological pre-contraction of the pelvic floor can be taught, known as the "Knack", a pelvic floor contraction that is generated before coughing or sneezing to prevent urinary leakage [1, 2]. The Knack has been confirmed to improve the stability of the bladder neck during coughing. A loss of pre-contraction has been shown in incontinent women during a daily function (rapid arm movement) [3]. In conjunction with abdominal ultrasound, perineal ultrasound is a valuable instrument to assess the synergy of the pelvic floor and deep abdominal muscles. It can be used for pelvic floor re-education especially for retraining of functional tasks that result in urinary leakage in the individual subject [4]. Recent studies have shown that motor learning with selective muscle contraction under US-guidance leads to faster and better outcomes (performance, strength, repeatability). In Van et. Al' study [5] patients increased their strength within 2 weeks after teaching selective multifidus muscle activation with US. At this early stage an increase in strength is a sign for better coordination and better performance of the exercise because "real" muscle strength cannot occur in such a short time. In the field of PFM and trunk muscle rehabilitation US biofeedback is also commonly used [6-8].

2. Equipment

- Ultrasound machine – simple, no colours or Doppler or 3/D facilities required
- Abdominal ultrasound probe or (endovaginal ultrasound probe)



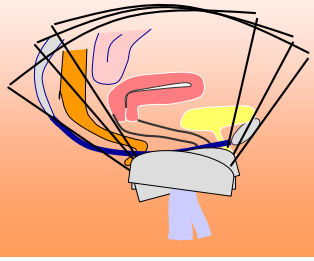
3. Indications of pelvic floor ultrasound



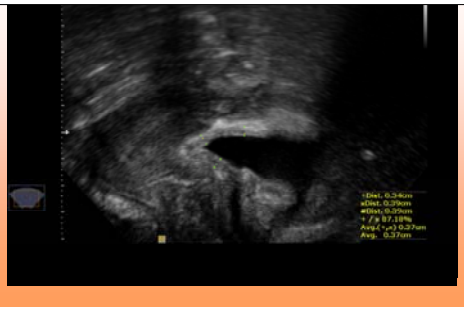
4. Perineal ultrasound: application and normal anatomy and function

Pelvic floor ultrasound
Normal Anatomy

- Urethra, bladder
- Rectum
- (Vagina)
- Anal sphincter
- Uterus



Perineal ultrasound with normal position of uterus



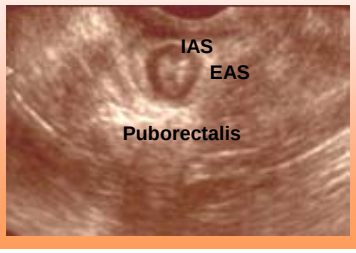
Perineal or introital ultrasound

Bladder wall thickness

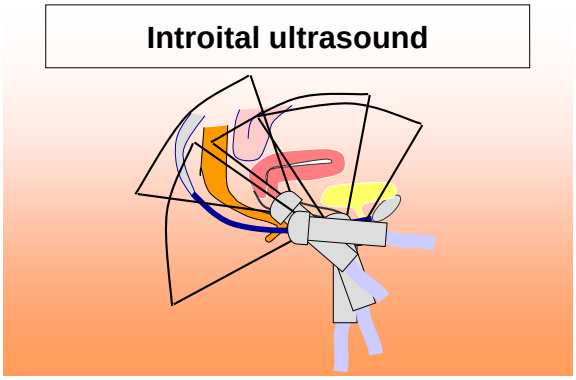
- Normal: <5mm
- 3 measurements >5.5mm: detrusor overactivity

Pelvic floor ultrasound

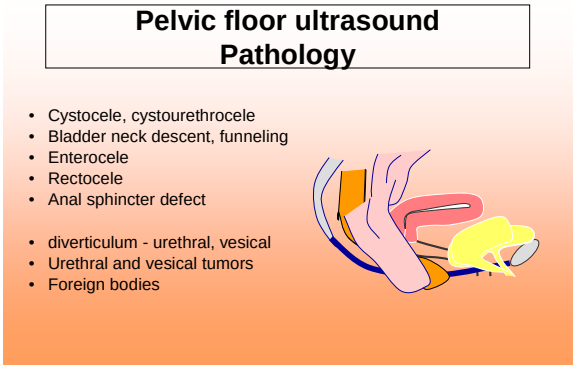
Anal sphincter



5. Application of introital ultrasound

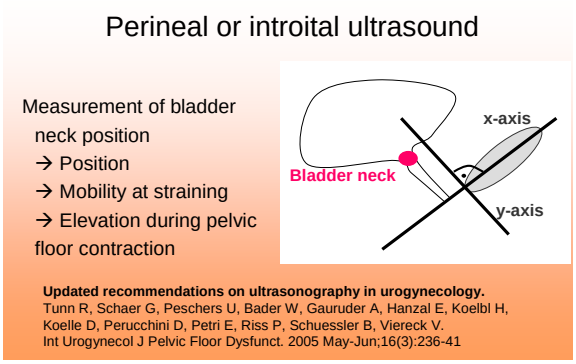


6. Pelvic floor ultrasound: pathology



7. Measurement of bladder neck position

- For pre-post assessment e.g.
- Mainly for scientific evaluation

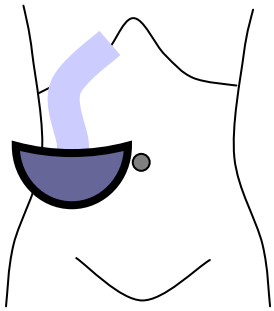


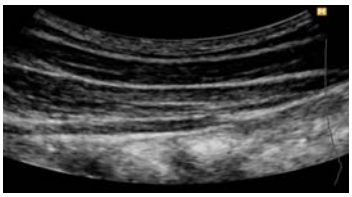
8. Aims of dynamic rehabilitative ultrasound

- Evaluation of the effect of pelvic floor muscle contraction and relaxation
  - bladder neck elevation
  - bladder neck descent.
  - Movement of the puborectalis muscle and rectum
- To directly evaluate the changes in abdominal muscle thickness and muscle sliding

9. Techniques used in pelvic floor rehabilitation

- Technique of ultrasound application for assessment of transverse, external and internal abdominal oblique muscles





- Perineal (females) and supra-pubic ultrasound (females and males).
    - Evaluation of bladder neck and puborectalis muscle movements.
- Measurements should be performed during pelvic floor contraction/ relaxation, straining, coughing and other functional tasks.

10. Findings of normal and pathological pelvic floor function (video examples)

- during pelvic floor contraction
- coughing
- lifting and other activities of daily life

11. Description of a rehabilitation program employing DRUS, palpation and functional teaching:

The main goal is to teach a bladder neck-effective pelvic floor contraction in women with stress and urge incontinence. Bladder neck effective means a cranio-ventral movement with an elevation of the bladder neck which can be maintained during breathing and coughing e.g. The co-activation of the transverse abdominal muscle (TrA) and the elimination of internal and external oblique muscle contraction is of further importance.

Evaluation includes bladder neck elevation, pre-contraction, voluntary pelvic floor contraction at maximal strength and with submaximal effort, hold during breathing and coughing, stabilization of the urethra, hold of bladder neck position during coughing or abdominal manoeuvres and typical physical exercises.

Ultrasound is the method of choice to visualize the bladder neck. Palpation and ultrasound are both employed to teach pelvic floor contractions. Palpation of PFM leads to a better perception and awareness whereas ultrasound shows the patient that the performed contraction is sufficient, insufficient or even not effective. Both, the visual and the tactile biofeedback are utilized to teach how to perform a sufficient and bladder neck effective PFM contraction.

The assessment of the bladder neck elevation seems important given that during typical so-called pelvic floor gymnastic exercises the bladder neck is not necessarily elevated or even supported (Posterpresentation IUGA 2010 Baessler&Junginger).

First comes awareness and subsequently individual dysfunctions of the PFM and the TrA will guide next steps of the program. At the end, functional integration into daily life and the patient's incontinence patterns is instructed. This is considered essential to guarantee life long implementation of the pelvic floor instead of life long training and exercises. It also serves the autonomy of the patient.

12. Case reports and interactive discussion about training strategies, modalities and experiences:

Case 1: Woman with stress urinary incontinence (SUI): descent of the bladder base during coughing on ultrasound.

Slight anterior vaginal wall prolapse
Palpation Oxford: 2, problems with endurance, no problems with fast contractions, breathing during contraction but loss of contraction
Bother scale: greatly bothered of SUI – Australian pelvic floor questionnaire/ German version [9]
Previous physiotherapy: 12 supervised group training sessions

Therapy:

Case 2: Woman with OAB and SUI showing bad coordination and co-contraction of all abdominal muscles during PFM contraction.

Palpation Oxford: 4, no problem with endurance, no problem with fast contractions, no breathing during contraction
Bother scale: moderately bothered of SUI - Australian pelvic floor questionnaire/ German version [9]
No supervised previous physiotherapy

Therapy:

Case 3: Woman with no contraction at all, no visible effect during contraction, no perception, no PF awareness.

Palpation Oxford: 0
Bother scale: moderately bothered of SUI, occasionally flatus incontinence but greatly bothered of it - Australian pelvic floor questionnaire/ German version [9]
No supervised previous physiotherapy

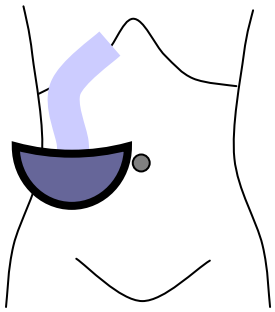
Therapy:

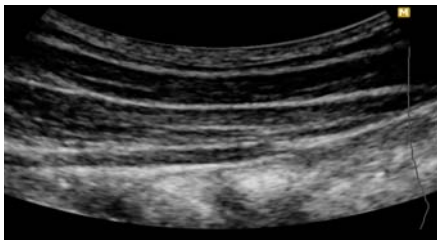
Practical Session:

1. Abdominal muscle ultrasound:

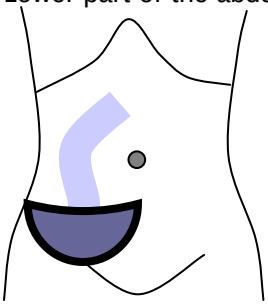
Transversus, external and internal abdominal oblique muscles, transversus-pelvic floor co-contractions and adverse external oblique contractions [10].

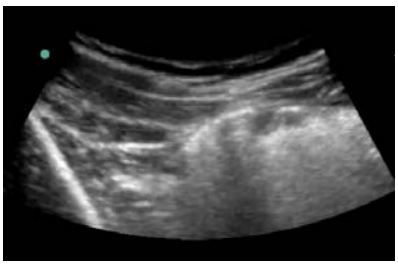
Upper and middle part of the abdominal muscles [11]





Lower part of the abdominal muscles [11]

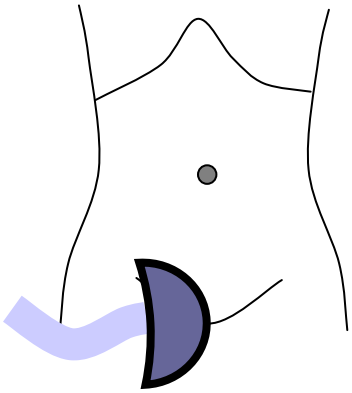


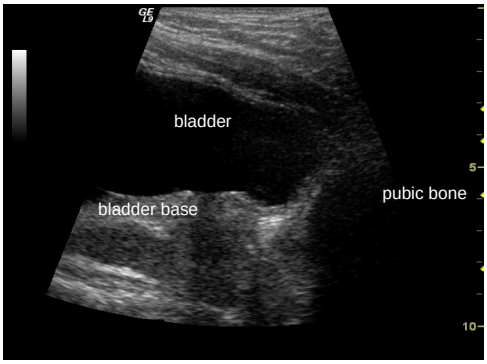


2. Supra-pubic (abdominal) ultrasound.

Assessment of movements of the bladder base during pelvic floor contraction, straining and coughing

This method is applicable in female and in male.

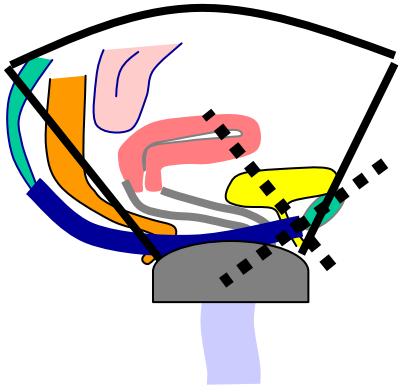




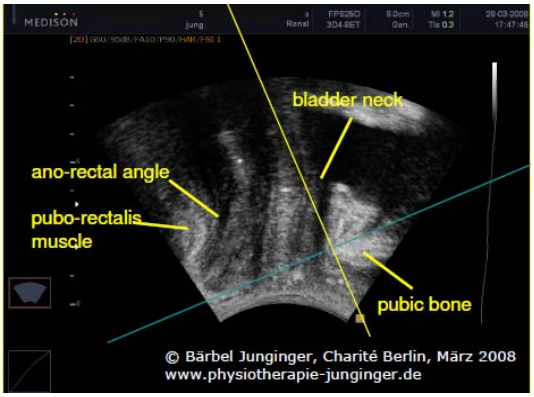
3. Perineal (translabial) ultrasound

In females to evaluate the bladder neck and the puborectalis muscle movements during pelvic floor contraction, straining, coughing and other functional tasks.

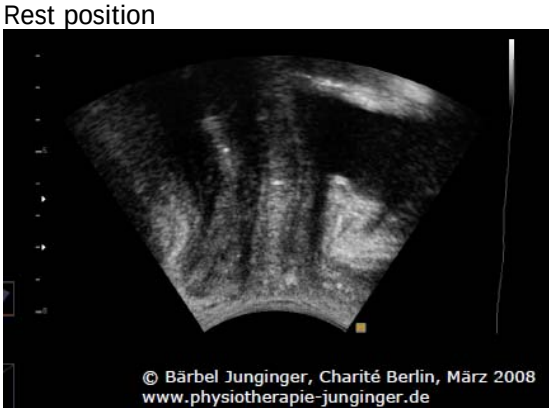
Perineal probe and application:



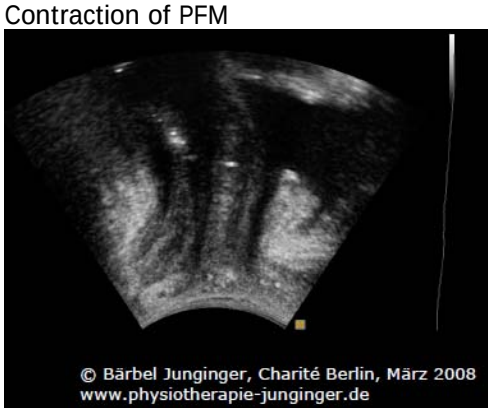
Landmarks for perineal ultrasound



Rest position



Contraction of PFM



Prospective follow – up investigation of a specific pelvic floor rehabilitation program with focus on coordination using a validated Pelvic Floor Questionnaire

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Introduction

Traditional pelvic floor muscle strength training has resulted in disappointing long term continence rates (1). In contrast, simple pelvic floor pre-contraction before coughing has been described to be effective (2) and co-contraction of the transverse abdominis muscle as physiologic (3).

Aims

The aim of this study was to prospectively evaluate the effectiveness of a pelvic floor rehabilitation program employing pre-contraction and coordination of the pelvic floor and transverse abdominis muscles and addressing individual functional deficiencies identified on history, vaginal palpation and perineal ultrasound.

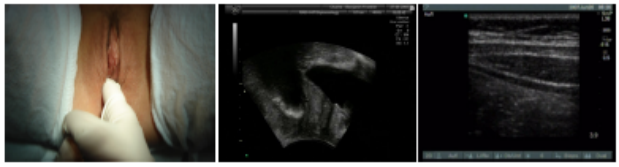
Methods

Subjects
- 55 consecutive women aged 34-83 years (median 52 years) with urinary incontinence
- Parity 0-4 (median 2); two nulliparas
- Body mass index: 16.9 - 32.0 (median 23.5)

Symptoms:
- Pure stress urinary incontinence (SUI; n=9)
- Pure overactive bladder symptoms (OAB; n=9)
- Mixed OAB-SUI (MUI; n=37).
- Wind incontinence (WI; n=39), faecal incontinence (FI; n=14)

Outcome measures:
- Validated self-administered pelvic floor questionnaire for bladder, bowel, prolapse and sexual symptoms (4).
- Improvement scales (much better, a little better, no change, a little worse, much worse) for bladder, bowel, prolapse and sexuality domains
- Satisfaction with treatment and care assessed by a 10-cm visual analogue scale (VAS; 0 = not at all satisfied, 100 = very satisfied)
- Questions regarding coordination and pre-contraction
- Follow-up assessment by an independent health care provider

Assessment and rehabilitation related to findings:
- Vaginal palpation, perineal ultrasound and abdominal muscle ultrasound at rest and function (e.g. coughing, nose blow etc.)



Important components of rehabilitation employing observation, vaginal palpation, perineal and abdominal ultrasound as biofeedback methods:
- Control for accurate, timely and lasting contractions
- Coordination with transverse abdominis muscle (3, 5)
- Elimination of undue internal and external oblique muscle activity (5)
- Maintenance of contraction during breathing, coughing, lifting, at urgency etc.
- Integration of these components into daily life and into sport (fotos)

Results

- Number of treatment sessions: 1-6 (median 2, mean 2.4)
- Duration initial session: ≥ 60 min, following sessions: 15 - 90 min
- Total treatment time: 60 – 240 min; median 120 min; mean 133 min
- Follow-up time: 1-18 months (median 7; mean 8.3)

Results pelvic floor function
- 50 / 55 (91%) improvement bladder function
  - a little better: n=22 / much better: n=28
- 15 / 39 (39%) improvement bowel function
- 31 / 46 women with SUI symptoms cured/ improved (67%)
- 36 / 46 women with OAB symptoms cured / improved (78%)
- Bladder, bowel and sexual dysfunction scores on the Pelvic Floor Questionnaire decreased significantly (Table 1)
- No association between length of follow up and treatment success

Table 1: Results of the pelvic floor questionnaire. Bladder, bowel and sexual function domain scores improved significantly (max. domain score=10).

	Before treatment	After treatment	P
Bladder function	2.6	1.3	<0.001
Bowel function	1.8	1.2	<0.001
Prolapse symptoms	0.9	0.7	0.072
Sexual function	1.2	0.7	0.006
Global PF dysfunction score	6.5	3.9	<0.001

Patients satisfaction (10 cm - VAS scale):
- **With treatment**: 15 – 100 (median 80), **with care**: 40 – 100 (median 90)
- Significant difference between satisfaction with treatment and care

Pelvic floor pre-contraction (before coughing, lifting, etc.):
- Performed by 50 / 55 women (91%)
- *Regularly* performed by 39/55 women (71%)
- Women who performed pre-contractions were more likely to report fewer urinary incontinence (Chi-square; p=0.021)
- Significant correlation between frequency of pre-contractions and patient satisfaction with treatment (Spearman -0.36; p=0.006)

Conclusions

This study showed that the individual dysfunction-related pelvic floor rehabilitation after evaluation of specific muscle and functional deficiencies is effective for SUI and OAB with improvement/cures rates of 67% and 78%, respectively. These results are comparable with strength programs in the literature. The main advantages are that treatment goals can be achieved early and maintained for more than 12 months without the need for further supervised physiotherapy, especially when pre-contractions are performed routinely.
Important components of the treatment are perception, the coordination of sustained pre-contractions and their routine integration into daily life, sports activities and urge episodes. Pe-contraction and coordination training of the pelvic floor with subsequent integration into daily life might be the key points in the treatment of pelvic floor disorders.
Obviously further studies are needed to prove the long term efficiency of this program.

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Scientific background of pelvic motor control, coordination training and specific stabilisation of the pelvic floor

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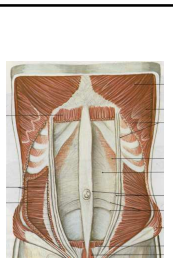
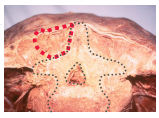


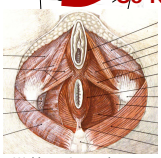
Waldeyer Anatomie



Joint Stability Group

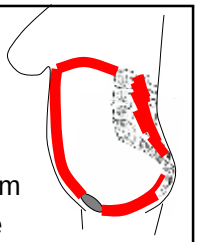
Co-Kontraktion

Sapsford et al. 2001



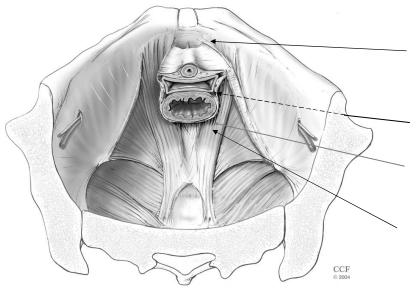
Waldeyer Anatomie

Pelvic floor muscle



- Part of the tonic muscle system
- Part of the abdominal capsule
- Predominantly slow-twitch-fibres

Type I – slow twitch fibres in the pelvic floor



Periurethral Levator ani 95%

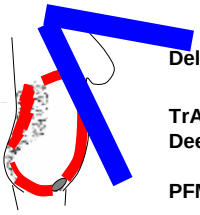
External anal sphincter 78%

Puborectalis 75%

Pubococcygeus anterior 67% posterior 76%

Gilpin 1989, Swash 1992, Gosling 1981

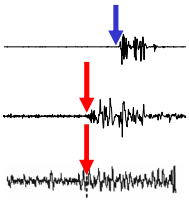
physiological reactions: „pre-programming“



Deltoid muscle

TrA
Deep multifidus

PFM



Hides et al. 1996, Hodges et al. 1996-2005, Smith et al. 2006

Physiological and pathophysiological studies: an overview

- Hides et al. 1996: pain inhibition of deep multifidus muscle
- Hodges et al. 1996: Loss of pre-programming of transverse abdominis muscle
- Smith et al. 2006: Loss of pre-programming of pelvic floor muscles
- Hungerford et al. 2003: EMG-onset of multifidus muscle delayed in SIJ- pain-patients
- Hodges et al. 2003: Immediate loss of pre-programming after experimentally induced pain

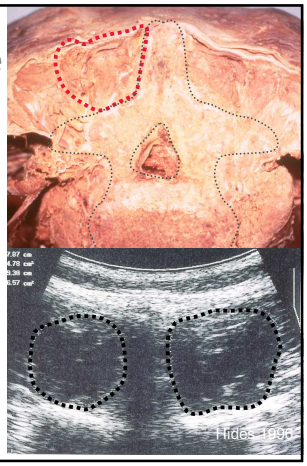
Multifidus muscle

Patients
- First episode of low back pain (unilateral); n=41

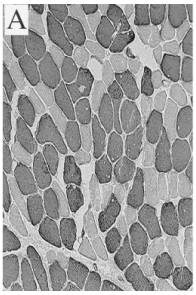
Control group:
- no back pain

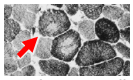
Outcome measures
- cross sectional area in ultrasound and MRI

Results:
- Muscle atrophy within 24 h
- Cross sectional area symmetrical in controls
- US correlates with MRI measures

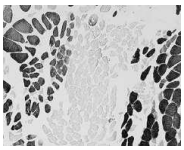


Morphological changes





moth-eaten cells



large group atrophy of multifidus

Normal (A) and diseased side (B) of multifidus muscle

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Specific rehabilitation of TrA

- RCT: versus standard treatment in patients with radiological diagnosed spondylolysis or spondylolisthesis
- follow-up at 3, 6, 30 months
- Results:
  - Statistic significant reduction in pain and function; maintained after 30 months[1]
  - Significant reduction in recurrence of back pain in the specific training group compared with the control group at 1 and 3 years follow-up **after** specific rehab and without recommendation of specific ongoing exercises[2]

	Specific training	control
1 year follow-up	30	84
3 years follow-up	32	78

1. O´Sullivan, 1997; 2. Hides, 2001

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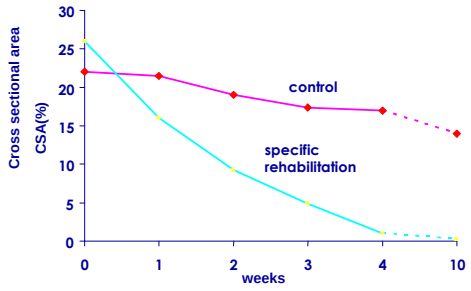
Cross sectional area after treatment



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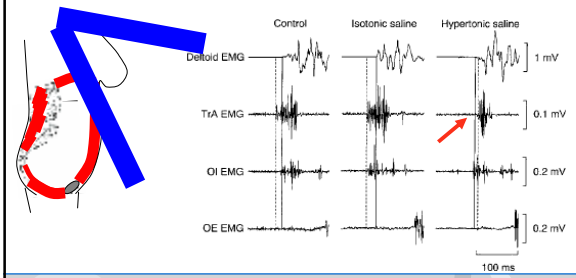
Induced pain

Hodges et al. 2003:

loss of pre-programming of TrA immediately after injection of hypertonic saline into longissimus muscle



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Motor control

- Emotional components like anticipation of pain are responsible for changes in strategy of muscle control (delayed onset of deep muscles, hyperactivity of superficial muscles)[1]
- Isometric leg contractions: patients show a significant smaller increase in TrA thickness compared with healthy controls, but no difference in IO/EO [2]

1. Moseley, 2004; 2. Ferreira, 2004

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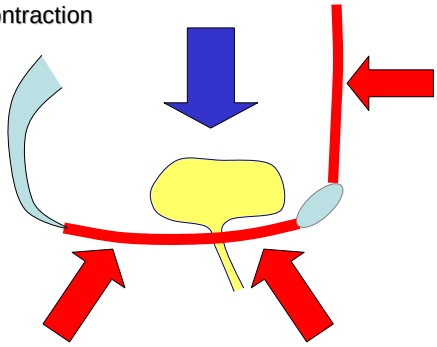
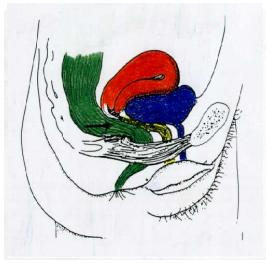
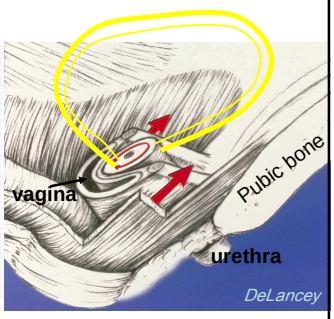
Pre-programming:

- co-contraction of PFM + transverse abdominis (TrA)
- pre-contraction



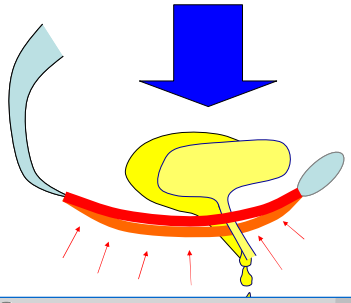




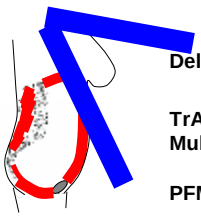
Baessler et al.,edts., Pelvic floor reeducation

Stress urinary incontinence

Involuntary loss of urine at physical exertion



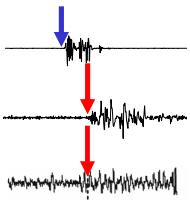
Dysfunction in stress incontinent patients: loss of pre-programming



Deltoid muscle

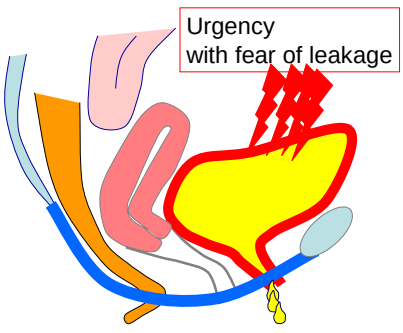
TrA
Multifidus

PFM



Hides et al. 1996, Hodges et al. 1996-2005, Smith et al. 2006

Urge incontinence



Continence during increases in abdominal pressure

1. Pre-contraction
2. Bladder neck elevation and support
   → maintained during "stress"
   → with sufficient increase in intraurethral pressure
3. Correct coordination

Incontinence

1. Loss of Pre-contraction
2. Delayed “Pre”-contraction
3. Loss of bladder neck support or failed bladder neck elevation
4. Incorrect coordination (e.g. loss of pelvic floor contraction during breathing)
5. Loss of supportive pelvic floor contraction e.g. while standing up
6. Pelvic floor contraction that does not result in an elevation of an unsupported bladder neck

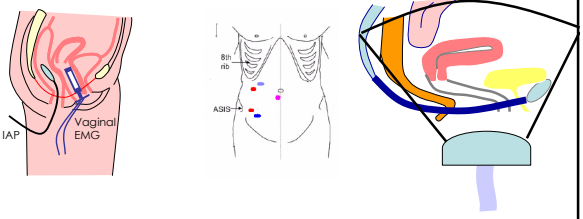
Needle EMG and intravaginal surface EMG reveal the relationship between contractions of abdominal and pelvic floor muscles, bladder neck elevation and intra-abdominal pressure in healthy women

Junginger B[1,2], Baessler K [2], Sapsford R[1], Smith M[1], Hodges PW[1]

1. Division of Physiotherapy The University of Queensland Brisbane Australia, 2. Charité University Hospital Berlin Germany

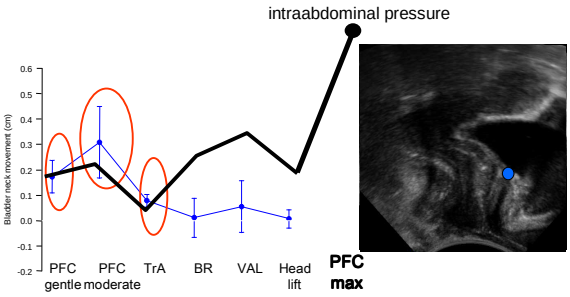
Junginger, Baessler, Sapsford, Hodges, 2009, IUJ

Methods



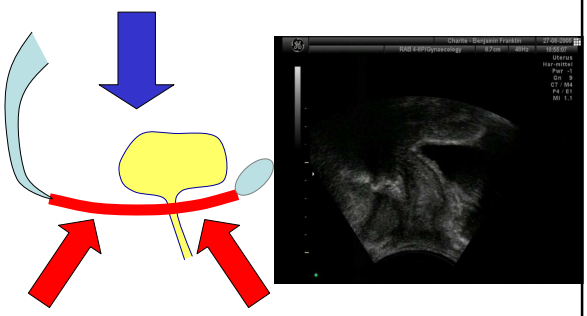
ccre spine centre of clinical research excellence — Spinal Pain, Injury & Health — NHMRC funded centre

Results

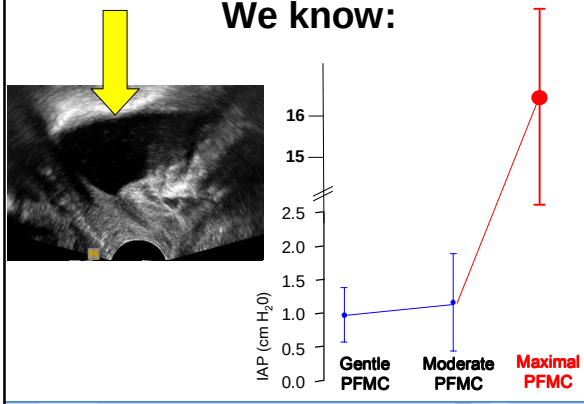


Pelvic-floor rehabilitation:

pre – contraction before coughing, sneezing, etc.



We know:



Bladder neck elevation with different levels of effort of pelvic floor muscle contraction

The **aim** of this study was to assess the effect of maximal and submaximal voluntary pelvic floor muscle contractions on the bladder neck, transverse abdominis and internal oblique muscles and on the intraabdominal pressure IAP

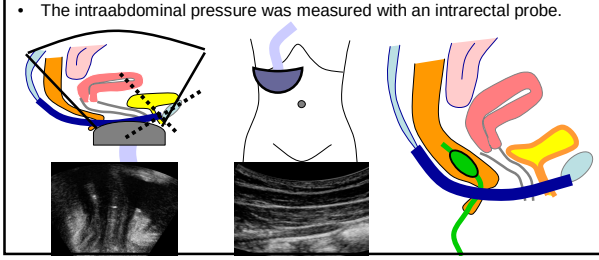
Kaven Baessler, Bärbel Junginger

CHARITÉ

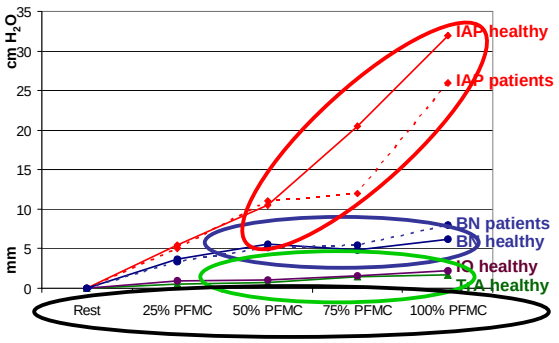
Charité Universitätsmedizin
Pelvic Floor Centre
Berlin, Germany

- Methods -

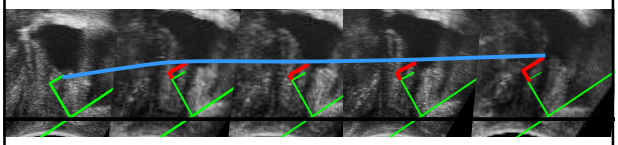
- 20 premenopausal nulliparous women without pelvic floor disorders
- 20 urogynaecological patients without pelvic organ prolapse beyond the hymen or previous PF surgery
- BN position was estimated with PUS using a coordinate system running through the pubic symphysis
- The thickness of the Tra and IO was measured simultaneously with an abdominal ultrasound probe using a previously validated method
- The intraabdominal pressure was measured with an intrarectal probe.



Results



Pelvic floor contraction, bladder neck elevation and intraabdominal pressure



Rest	25%	50%	75%	Max. PFMC
Intraabdominal pressure (cmH_2O):				
0	5	10	20	35

Conclusions

- Already 25% of a maximal pelvic floor contraction significantly elevates the bladder neck
- A maximal pelvic floor contraction does not further elevate the bladder neck after 50% of effort in pelvic floor-healthy women
- There is a considerable increase in intraabdominal pressure with maximal PFM contraction power similar to pressure increases during a nose blow and moderate coughing
- Maximal pelvic floor muscle contractions are not necessary to elevate the bladder neck and have the disadvantage of increasing the intraabdominal pressure undesirably due to co-contractions of the superficial abdominal muscles

Implications for specific pelvic floor rehabilitation

Re-education integrating physiology

- Pre-contraction
- Co-contraction
- Bladder neck support and elevation

Ensure bladder neck effective pelvic floor contraction

Avoid excessive increase in intraabdominal pressure

- No maximal PFM contraction
- Submaximal (25%-50%) pelvic floor contractions

Ensure maintenance of pelvic floor contraction during coughing or breathing e.g.

Pelvic floor rehabilitation program based on physiological motor control, applying ultrasound and palpation as tools to diagnose pelvic floor dysfunction and to give biofeedback and employing validated questionnaires to assess the efficacy

Bladder neck effective, controlled, integrative pelvic floor therapy

Specific PF rehabilitation programme

Dynamic rehabilitative ulstrasound (DRUS): assessment of pelvic floor function and application as a biofeedback instrument

Bärbel Junginger, PT, MT (OMT)
Kaven Baessler, MD

CHARITÉ ccre spine centre of clinical research excellence Spinal Pain, Injury & Health NHMRC funded centre The University Of Queensland AUSTRALIA

Specific pelvic floor rehabilitation programme

„Bladder neck effective, controlled, integrative pelvic floor therapy“

Assessment of individual symptoms

Evaluation of individual dysfunction

Explanation of individual pathophysiology

Teaching of bladder neck elevation

Training and integration of PFMC

Follow-up evaluation

- Individual symptoms
  - SUI
  - OAB
  - Mixed incontinence
  - (Voiding problems)
  - (Defaecation problems)
  - Prolapse symptoms

- Individual dysfunction
  - Lack of coordination
  - Reduced PFM contraction
  - Lack of PFM contraction
  - Delayed PFM contraction
  - No bladder neck elevation

Instruments to assess pelvic floor dysfunction for teaching, biofeedback and follow-up

- Abdominal ultrasound (abdominal muscles, bladder)
  - co-contraction TrA/ PFM
  - elimination of undue co-activation of IO
- Perineal ultrasound (bladder neck, puborectalis muscle)
  - Bladder neck elevation and support essential for continence
- Vaginal and rectal palpation
  - evaluation of quality and quantity of parts of a PFM contraction
  - Teaching of awareness and perception of PFMC
  - Localization of pain
- PF questionnaire
  - Validated assessment of symptoms
  - Pre and post therapy

Characteristics of the programme

- Evaluated programme (our study IUGA poster literature)
- Validated assessment instruments (questionnaire, ultrasound, palpation)
- Bladder neck effective PFM contraction and avoidance of maximal contractions
- (re-)education of pre-contractions
- Perineal ultrasound as a tool for diagnostic and didactic biofeedback and as a control instrument
- Follow-up part of the programme

Goals

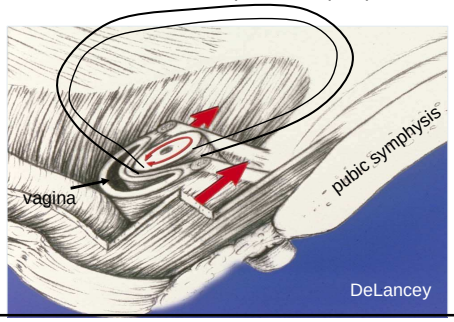
- bladder neck effective PFM contraction
- normal PFM-TrA-coordination during stress, urge, etc.
- Reduction of symptoms and increase of QoI
- integration of PFM into daily routine (in contrast to life-long-training)

Ultrasound - validated instrument for measurements in clinic and research

- Direct mesurement of muscle thickness and position (TrA, IO, EO; Hodges 2003)
- Imaging of blader movement via suprapubical ultrasound (Sherburn, Murphy 2002)
- Validation of movement of the bladder base (perineal ultrasound) during PFM contraction and during straining (Schaer et al. 1995)

continence

For the maintenance of continence, pelvic floor muscle (PFM) contraction is required to stabilise the bladder neck and to compress the urethra during increased intra-abdominal pressure (IAP)



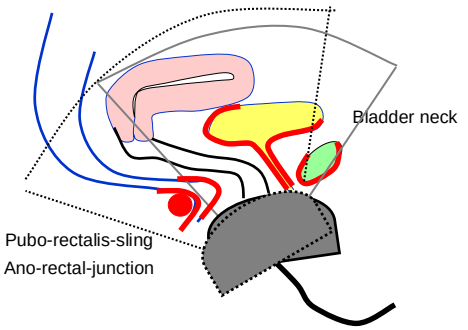
History of ultrasound for evaluation of BN position and movement

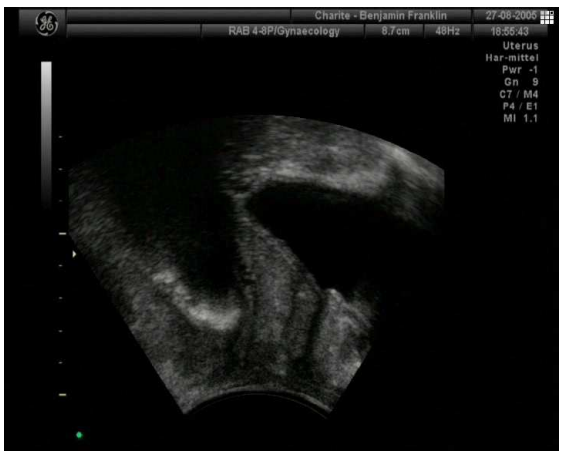
- 1958 Hodgkinson: Lateral bead chain cystography
- 1978 Hodgkinson and Green
- 1975: lateral chain urethrocystography
- 1992 Wise et al.: perineal sonography
- 1995 Schaer et al.: reproducibility, good inter-examiner agreement

Advantages of US

- Not dangerous
- Easy to apply for examiner
- easy to understand for patient
- Accepted (scientifically, clinically)
- No radiation – important for longer lasting during biofeedback procedures

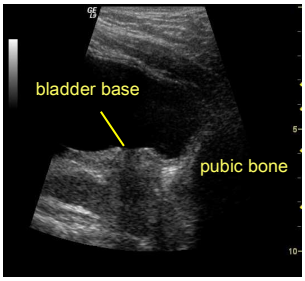
perineal ultrasound or translabial US: midline-sagittal view

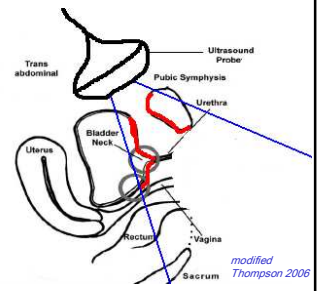




Alternative method of bladder movement assessment

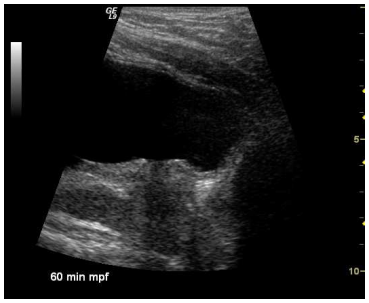
Abdominal supra-pubical ultrasound





modified Thompson 2006

Assessment of bladder movement



Assessment of bladder volume

Advantages of abdominal US

- Not invasive
- No undressing necessary
- **Also possible in male patients**

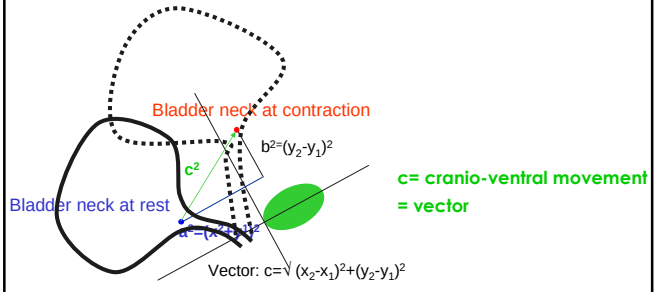
- Specialised physios are used to apply abdominal US for abdominal muscle assessment (TrA and IO; EO)

Assessment of abdominal muscles via abdominal US

Skin and sub-cut. tissue
EO
IO
TrA

Advantage of perineal ultrasound: validated assessment of BN movement

- Schaer et al. 1996
- Method with coordinate system through pubic symphysis



Normal values and hypermobility of BN movement

- **Normal**: 0-40 mm in young, nulliparous, continent women (Brandt, Peschers, Reed, Dietz)
- **Hypermobility**: a cut-off value between 5 mm [Reed, Reilly] and 14 mm [Lin, Meyer]
- Lower BN position in standing than in supine (Meyer)
- Women with joint hypermobility have a lower BN position at rest (King)
- Valsalva manoeuvre: important to distinguish functional testing with PFM contraction or evaluation of pelvic organ prolapse with relaxed pelvic floor (Örnö and Dietz 2007)

Ultrasound for biofeedback

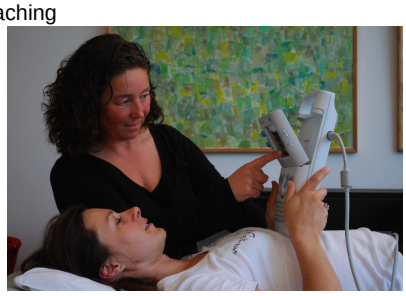
- Imaging of PF function
- Imaging of a region of the body that is normally not visible
- Application possible in different patient positions: lying, sitting, standing

- Application during functional tasks: sneezing, coughing and during urge symptoms (OAB)
- Application symptom-specific (e.g. bending over)

Terminology: Rehabilitative ultrasound imaging or DYNAMIC REHABILITATIVE US

Rehabilitative:

1. assessment
2. explanation/ teaching
3. training
4. re-assessment



The Use of Real-Time Ultrasound Imaging for Biofeedback of Lumbar multifidus Muscle Contraction in Healthy Subjects

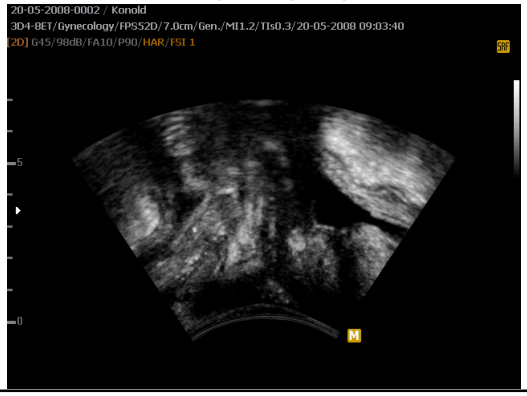
- 2 groups people: voluntary contractions of multifidus muscle with and without US biofeedback
- Follow-up time: 1 and 2 weeks
- results: US-group better results after 1 week, increase in muscle thickness (maintenance in week 2)

Van, Hides et al. 2006

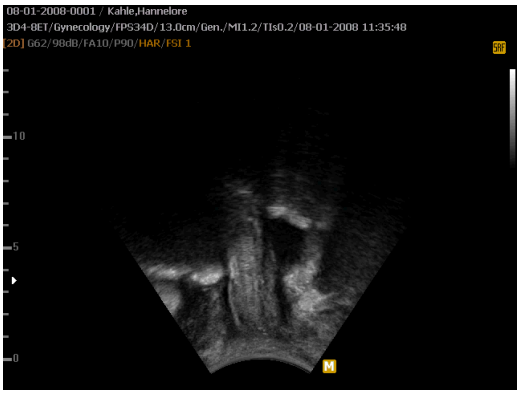
Normal function and findings in patients

Healthy woman: function during coughing and laughing

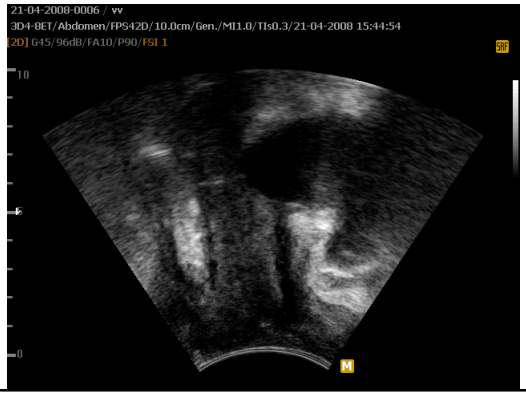
Patient with no pre-contraction and therefore:
BN-funneling and -hypermobility
during coughing



Patient with no pelvic floor awareness

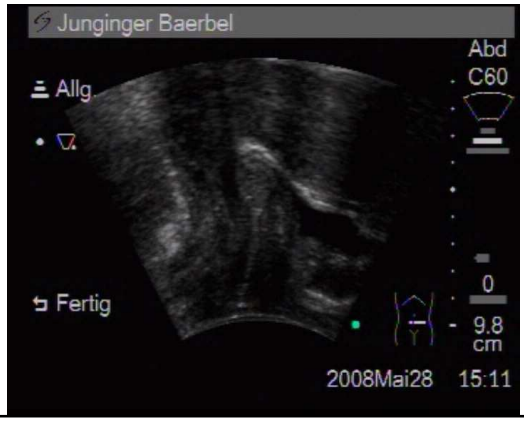


Patient with bad coordination;
co-contraction of all abdominal muscles

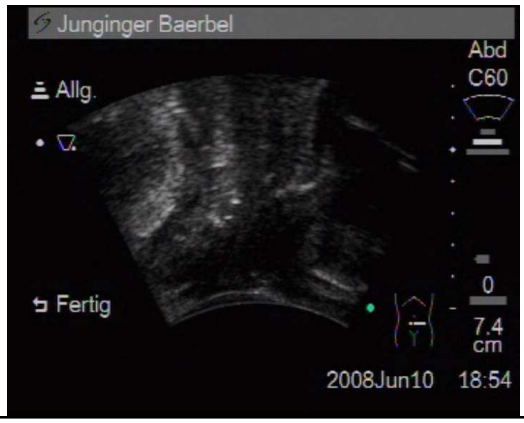


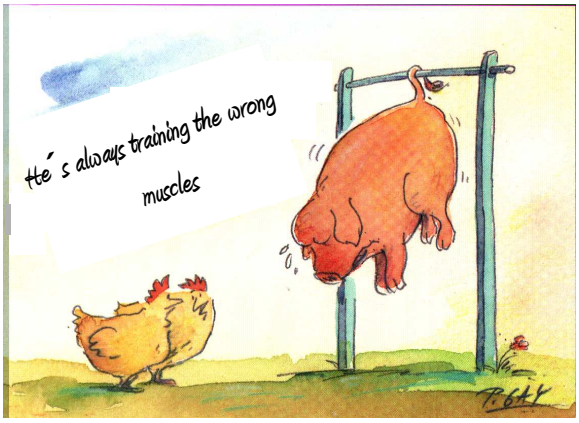
Same patient 3 days later after **one** biofeedback session and coordination training as a home programme

Insufficient perception; some activity of dorsal PFM but counter-activity of abdominal muscles **(IAP ↑)**

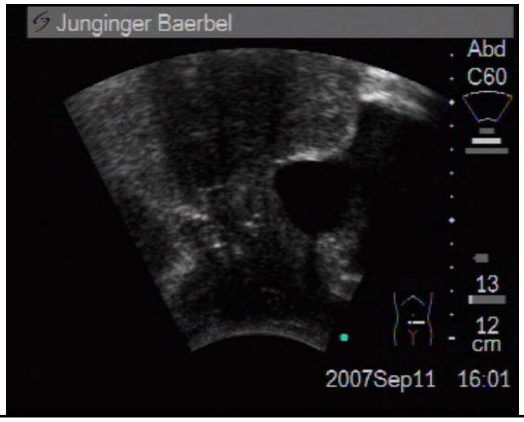


Better coordination 2 weeks later: no IAP ↑ but still insufficient elevation

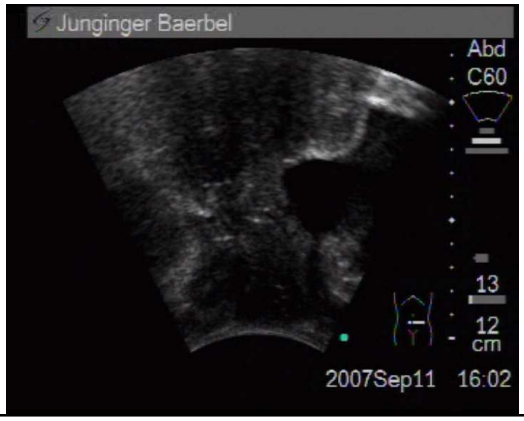




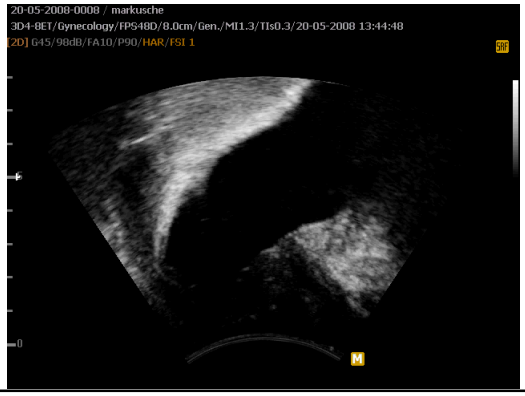
Patient with a good contraction but unable to hold during breathing



Same patient during coughing



Patient with a stage II cystocele: reposition possible but no hold because of structural defects



Follow up of a rehabilitation programm with focus on coordination using US

- n=55 women; 34-83 years (median 52 years)
- pure SUI n=9; pure OAB n=9, mixed OAB-SUI n=37
- Exclusion criteria: neurogenic bladder, previous pelvic floor surgery
- 0-4 children (median 2; four nulliparas)

- validated „German pelvic floor questionnaire“
- Visual analogue scale (VAS) for satisfaction with care and with treatment
- Improvement scale for bladder, bowel and sexual function (much better-a little better-no change-a little worse-much worse)

Junginger, Greiner, Baessler 2008

Results

- Follow-up time: median 7 (1-18) months
- Median treatment sessions: 2 (1-6)
- Duration of one session: 15 min - 90 min
- Initial treatment session: 60 min

Results pelvic floor function

- **91%** (50 / 55) improvement of **bladder function**
  - a little better: n=22 / much better: n=28
- Correlation between satisfaction with treatment and subjective improvement - 0.47, P< 0.001
- **67%** (31/ 46) women with **SUI** symptoms cured/improved
- **78%** (36/ 46) women with **OAB** symptoms cured/improved

- No association between length of follow up and treatment success/satisfaction with treatment

- ***Pre-contraction:*** Routinely performed by 71% (39/55 women)
- Women who performed pre-contractions were more likely to report fewer urinary incontinence (p=0.021)