Anatomy en physiology

part 2

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• **Anatomy**: the study of the body **structure** and the relationships among body parts

• **Physiology**: the study of the body **function**, or how the body works
The power of repetition!
Skeletal system

• Bone: main supporting tissue of the body
  • Support, Protection, Transmission of forces / movement,
  • (Hematopoiesis), (Storage and release of minerals (Ca, P)

• Form and shape reflects its function
  • Long bones: Leverage
  • Flat bones: Protection
  • Short bones: Weight bearing
Movements anatomical planes

- (Mid)sagittal plane
  - (flexion, extension)
- Transverse plane
  - (rotation, pronation, supination)
- Coronal plane
  - (abduction, adduction, lateral flexion)
Anatomical directions

- Medial
- Lateral
- Proximal
- Distal
- Anterior
- Posterior
- Superior
- Inferior
- Ventral
- Dorsal
- Craniaal
- Caudaal
Muscular system

• Skeletal or striated
  – Voluntary
    • Isometric
    • Concentric
    • Eccentric

• Cardiac
  – Involuntary

• Smooth
  – Involuntary
Origin and insertion

- **Origin**
  - Bone
  - Proximal
  - Stable

- **Insertion**
  - Bone/tendon
  - Structure it attaches to
  - Distal
  - Less mass
  - Greater motion
Fascia

• ‘All the collagenous-based-soft-tissues in the body, including the cells that create and maintain the extracellular matrix’

• (Some prefer “wider” view: also cartilage and bone)

• All one connected system

• System of biomechanical regulation

• Fascia = ECM + all the cells within

• Connective tissue (old nomenclature)
Fascia

- Fascia is an uninterrupted viscoelastic tissue which forms a functional 3-dimensional collagen matrix.

- It surrounds and penetrates all structures of the body extending from head to toe, thus making it difficult to isolate and develop its nomenclature.
Fascia

- Superficial / Deep (old nomenclature)
- Recently:
  - Linking fascia
  - Fascicular fascia
  - Compression fascia (crural fascia lower leg)
  - Separating fascia
- Tensional fluid system (sponge)
- It’s all connected
- Largest, richest sensory organ of the body
- (proprioception)
Fascia

The Endless Web of Fascia
Fascia

- Makes muscles “slide”
- 30% of the mass of our muscle
- Muscle = myofascia
- Tubes, within tubes, within tubes.......
The nervous system
Nervous system NS

- Maintains homeostasis together with endocrine system
- Regardless of most changes in external environment
- Enables us to survive and to thrive
- It coordinates our movements, regulates our emotions, and controls most of the body's functions.
- **Most complex system!**
Nervous system

• Reception

• Transmission (conduction)

• Integration (appropriate respons)

• Respons (muscles and glands)
Nervous system

• Central nervous system
  – Brain
  – Spinal cord

• Peripheral nervous system
  – Peripheral nerves
neuron
Nervous system

Central

Peripheral

somatic

autonomic

sensory

motor

sympathetic

parasympathetic
The central nervous system (CNS)

- **Brain**
- **Spinal cord**
  - Integrates information it receives
  - Coordinates/influences activity of the body
Central Nervous system CNS

- Cerebrospinal fluid

- Meninges
  - Pia mater (inner)
  - Arachnoid
  - Dura mater (outer)
Central nervous system

- Brain
  - Brainstem
  - Thalamus
  - Hypothalamus
  - Cerebellum
  - Cerebrum
The central nervous system (CNS)

- **Brain stem**
  - **Medulla**
    - extension of spinal cord
    - neuron cell bodies in the medulla control respiration, heartbeat, and blood pressure
  - **Pons**
    - connects neuronal pathways from the spinal cord, cerebrum, and cerebellum.
  - **Midbrain**
    - receives incoming sensory messages, integrates them, and transmits decisions to the appropriate motor nerves
Central nervous system

- Frontal lobe
- Central sulcus
- Parietal lobe
- Parieto-occipital sulcus
- Occipital lobe
- Pineal gland
- Corpora quadrigemina
- Mesencephalic aqueduct
- Fourth ventricle
- Cerebellum
- Temporal lobe
- Thalamus
- Hypothalamus
- Mesencephalon
- Corpus callosum
- Interthalamic adhesion
- Pons
- Medulla oblongata
- Spinal cord

(c) Midsagittal view
The central nervous system (CNS)

- **Thalamus**
  - Relay station (spinal cord → sensory cortex)
  - Emotion, arousal, attention

- **Hypothalamus**
  - It supplies input to areas in the medulla and spinal cord that control activities such as
    - heart rate, respiration, body temperature, water balance
  - Bridge between nervous and endocrine system; It produces various hormones and regulates the pituitary gland
The central nervous system (CNS)

- Cerebellum
  - Coordination
  - Refinement of movement
  - (proprioception)
The central nervous system (CNS)

- Cerebrum
  - Frontal lobe
  - Parietal lobe
  - Temporal lobe
  - Occipital lobe
The central nervous system (CNS)

• Cerebrum
  – cerebral cortex
    • outer gray matter, neuron-cells
  – white matter
    • axons, myelin
The central nervous system (CNS)

- Cerebral cortex
  - Motor cortex
    - Controls movement
  - Sensory cortex
    - Receives incoming information
      - (visual, hearing, pressure, touch, and so on.)
  - Association cortex
    - Interprets incoming sensory information
    - Site of intellect, memory, language, emotion
Central nervous system

• Spinal cord
  – Inferior extension of the brain
  – Controls reflex activities
  – Transmits information back and forth from peripheral nerves to the brain
  – Ascending and descending tracts
reflex
Central nervous system

• Spinal cord
  – Caudal it narrows to a sharp tip
    • Conus medullaris
  – Lower part: cauda equina

• 31 pairs of spinal nerves
  – Named region vertebral collum
    • (C1-8, Th1-12, L1-5, S1-5, Coccyx 1)

  • Afferent (sensory information)
  • Efferent (motor information)
Homunculus
Homunculus

Een homunculus is een representatie van lichaamsdelen in de motorische en somatosensorische cortex van de hersenen. Door middel van deze representaties is het mogelijk om onderscheid te maken tussen de verschillende hersendelen, bijvoorbeeld zodat je alle vingers los kunt aansturen, of zodat je weet dat je voeten op de grond staan.

Het gedeelte van de cortex dat wordt toegewezen aan een bepaalt lichaamsdeel is afhankelijk van de mate waarin dit deel gebruikt wordt. Zo zijn de vingertoppen in de somatosensorische gebieden veel groter dan de armen, omdat ze vaak worden gebruikt om kleine details te voelen. Je kunt je wel voorstellen dat deze gebieden bij mensen die braille lezen nog groter zijn. In de motorische cortex is eenzelfde soort verdeling te zien, maar dan zijn er overrepresentaties van andere gebieden. Je kunt hierbij denken aan de representatie van de benen, die we gebruiken om ons te verplaatsen, zowel lopend als fietsend.

Opmerkelijk aan de homunculus is dat gebieden die dicht bij elkaar liggen op het lichaam ook dicht bij elkaar liggen in de homunculus. De representaties van de vingers liggen dus naast de representaties van de handen. Daarnaast is een homunculus eigenlijk een omgekeerd plaatje van het lichaam, want de voeten zijn in het dorsale gedeelte gerepresenteerd, en het gezicht juist in het ventrale gedeelte. Bovendien bevat een homunculus slechts representaties van de helft van het lichaam, zoals we vaak zien in de hersenen. Een homunculus in de linker hemisfeer heeft dus alleen representaties van rechter lichaamsdelen.
Nervous system

Central

Peripheral

somatic

autonomic

sensory

motor

sympathetic

parasympathetic
Nervous system

- Peripheral nervous system PNS:
  - 31 pairs of spinal nerves
  - 12 pairs of cranial nerves

- Somatic (changes in the external world)
  - Sensory receptors
  - Motor neurons

- Autonomic (regulation of the internal world)
  - Sympathetic nerves
    - Stimulate organs, mobilize energy, respond to stress
    - Heart rate ↑, breathing ↑
  - Parasympathetic nerves
    - Conserve and restore energy
    - Heart rate ↓, breathing ↓
Peripheral nervous system

• 12 cranial nerves
  – 10 brainstem
  – 1 cerebellum
  – 1 thalamus

• Sensory and motor neurons

• Smell, vision, eye movement, touch, facial expression, hearing, taste, swallowing, neck and shoulder muscles....
Cranial nerves

I. Olfactory
II. Optic
III. Oculomotor
IV. Trochlear
VI. Abducens
V. Trigeminal
XII. Hypoglossal
XI. Spinal accessory
X. Vagus
VII. Facial
VIII. Vestibulocochlear
IX. Glossopharyngeal
Peripheral nervous system

- **Nervus vagus (CNX),**
  - 10th cranial nerve
  - Emerges from medulla
- **Mixed functions:**
  - Sensory: pharynx, larynx, trachea, esophagus, heart, abdominal viscera
  - Motory: pharynx
- viscerál parasympathetic system
  - Smooth muscles:
    - tr.circulatorius, tr.respiratorius, tr.digestivus
Peripheral nervous system

- Nervus vagus
  - Abdomen → diaphragm → thorax → larynx → medulla → brain
- Connection “body and mind”

- (Ujjayi) breathing stimulates nervus vagus
- Stimulates parasympaticus
- “slows down”
- “happy” feeling
- 75% of all parasympatic fibers
Nervus vagus (X)
Nervus vagus stimulation

- Turn on neurogenesis, helping our brains sprout new brain cells.
- Rapidly turn off the stress, hyper-arousal, and fight/flight via the relaxation response.
- Sharpen our memories.
- Fight inflammatory disease.
- Help you resist high blood pressure.
- Block the hormone cortisol and other oxidizing agents that age and deteriorate the brain and body.
- Block systemic (body-wide) inflammation – a major factor behind aging and poor health.
- Lower chances of getting stress and tension headaches.
- Help spare and grow our mitochondria - this is a key to maintaining optimal energy levels and not harming our DNA and RNA.
- Affect our overall ability to live longer, healthier, and more energetic lives.
- Help us overcome depression and anxiety.
- Help us sleep better.
- Raise levels of human growth hormone.
- Help us overcome insulin resistance.
- Turn down allergic responses.
Nervous system

Central  Peripheral

somatic  autonomic

sensory  motor  sympathetic  parasympathetic
Peripheral nervous system

- **Somatic**
  - Voluntary (skeletal muscles)

- **Afferent**
  - Sensory

- **Efferent**
  - Motor
Peripheral nervous system

- Autonomic
  - Involuntary (smooth muscles)

- Sympathetic
  - ‘fight or flight’
  - Thoracal and lumbal regions

- Parasympathetic
  - ‘rest and digest’
  - Cranial and sacral regions
  - Nervus vagus (X)
Autonomic nervous system
CNS and PNS

- Brain and spinal cord
  - Central nervous system
    - Autonomic nervous system
      - Sympathetic
      - Parasympathetic
      - Thoracic and lumbar autonomic nerves
      - Sacral autonomic nerves and cranial nerves
    - Somatic nervous system
      - Spinal and cranial nerves
        - Motor nerves
        - Sensory nerves
  - Peripheral nervous system
    - Internal environment: Smooth muscle, cardiac muscle, glands, organs
    - Skeletal muscles
    - External environment and body senses

- Internal environment: Smooth muscle, cardiac muscle, glands, organs
- Skeletal muscles
- External environment and body senses
KEEP
CALM
AND
JUST
BREATHE
STRESS
What is “stress”??

Positive effects?

Negative effects?
Stress

• Effects 3 endocrine glands
  – Hypothalamus
  – Pituitary gland
  – Adrenal glands

• HPA axis
Stress

• Fight-or-Flight respons

• Acute stress respons

• This respons is the first stage of a “general adaptation syndrome” (GAS)

• The initial response and subsequent reactions are triggered in an effort to create a boost of energy

• The physiological changes that occur during the fight or flight response are activated in order to give the body increased strength and speed in anticipation of fighting or running
Stress

stressor → hypothalamus

hypothalamus → CRF (Corticotropin Release Factor)

CRF → pituitary gland releases "ACTH" (Adrenocorticotrophic Hormone)

ACTH → adrenal cortex secretes various stress hormones (e.g., cortisol)

Adrenal cortex secretes various stress hormones (e.g., cortisol) → stress hormones (30 varieties) travel in bloodstream to relevant organs (e.g., glands, heart, intestines)

Stress hormones activate various smooth muscles and glands (e.g., pupils dilate) → flight or fight response

Nerve endings activates various smooth muscles and glands (e.g., pupils dilate)
General Adaptation Syndrome

Stages of GAS

Stressor

Mild and controllable

Alarm reaction → Adaptation → Exhaustion

Hyperactive or uncontrollable

Relaxation

Homeostasis

If the stress response is hypoactive, the situation may also be harmful to health, the person become more susceptible to disease associate with dysfunction of immune system, or emotional and mental deficiency.
Stress

• prolonged increases in stress can cause a variety of negative effects

  – Physiological
    • Headaches, muscle tension/pain, chest pain, fatigue, changes in sex drive, upset stomach, problems with sleeping, urinary problems.....
  – Psychological
    • Headaches,
    • Anxiety, restlessness, lack of motivation/focus, irritability or anger, depression
  – Behavioral
    • Overeating / undereating
    • Drug / alcohol abuse
    • Social withdrawal

  – Chronic suppression immune system
Stress

Stress Curve

Performance

- too little stress (underload)
- optimum stress
- too much stress (overload)
- burn-out

Stress Level

- laid back
- inactive
- fatigue
- exhaustion
- anxiety/panic/anger
- breakdown
How can (yin)yoga relief (too much) stress???
Pregnancy and Yoga
Why?

“Do no harm”

“Give a positive (yoga) experience within the boundaries of a person’s possibilities”

guide a person save through a practice
• Today I’ll give you guidelines to guide a pregnant woman through a “regular” **yang-style** class

• Today I’ll give you guidelines to guide a pregnant woman through a “regular” **yin-style** class

• This is **not** a workshop prenatal yoga!
Pregnancy

• 40 weeks (38 wks after conception)

• 37-42 weeks “a-terme”

• 1st, 2nd, 3rd trimester
Stages of pregnancy
Yoga and pregnancy

• Pregnancy is not the time to “start” a regular yoga class

• If used to yoga-practice it’s safe to continue
  – If under the guidance of a teacher who knows what to do!!!
  – Use of “options” and “adaptations”
Yoga and pregnancy

• If pregnant and never done yoga before → advice to go to a prenatal yoga class

• Yin class is ok, if the teacher is capable of guiding pregnant women through a yin-class
First trimester

• 1-13 weeks
• Emotional changes

• Physical changes
  – Morning sickness
  – Nausea
  – Tender/swollen breasts
  – Increased urination
  – Fatigue
  – Food aversions or cravings
  – Dizziness
  – Heartburn
  – Constipation
First trimester

• Hormonal changes
  
  – B-hcg
    • placenta
  
  – Oestrogen, Progesteron
    • Ovaria
  
  – Relaxin
    • Corpus luteum / placenta
  
  – (Prolactin)
    • Anterior hypophysis
  
  – (oxytocin)
    • Posterior hypophysis
First trimester

• Cardiovascular changes
  
  • Blood pressure ↓ (dilatation of blood vessels)
  
  • Heart rate ↑
  
  • Blood volume ↑ (↑ plasma volume)
  
  • Cardiac output ↑ (to meet growing demand)
    – Volume of blood pumped by the heart in 1 minute
    – CO= stroke volume x heart rate
  
  • Anemia
    – (due to ↑ plasma volume)
  
• Tired, out of breath, dizzy due to low blood-pressure, palpitations
First trimester

• Easy, slow, sweet, nice vinyasa practice

• Carefull with quick transitions up and down

• No intense/deep twists
  • No Parivrrta parsvakonasana
  • No ardha matsyendrasana
  • No parivvrta utkatasana

• Easy “open” twists are ok
  • Yes uth. Parsvakonasana
  • Yes adaptation parivrrta parsvakonasana
  • Yes parivvrta sukhasana
  • Yes gentle lying spinal twist

• Twists of upper spine to open chest are ok

• Yin practice is ok, same guidelines as before, not to “deep” in the posture
First trimester

- What about abs?
  - No problem

- What about lying on your belly?
  - No problem

- What about inversions?
  - Some teachers avoid it
  - I think it’s ok if it feels good
  - If the woman never did an inversion before, now is NOT the time
  - Options and alternatives for “easy” inversions
Second trimester

- 14-27 weeks
- Less tired, less nauseous
- Fetal movement
- Hormonal changes
  - Relaxin
- Physical changes
  - Growing belly
  - Breast changes
    (growth/enlargement/tenderness)
  - Heartburn
  - Constipation
  - Increased urination
Second trimester

- Cardiovascular “stable” period
- Cardiovascular changes already have taken place
- Growing belly
- +/- navel
Second trimester

• Relaxin

  – Produced by corpus luteum (beginning) and placenta

  – Peak around 14 weeks and at delivery
    • 1st and 3rd trimester

  – It mediates hemodynamic changes
    • ↑ cardiac output, ↑ renal blood flow, ↑ arterial compliance

  – It relaxes (pelvic) ligaments (symphysis)

  – (heartburn)
Second trimester

• Complaints
  – Wobbly walk
    • Shifted centre of gravity
    • Relaxin and loose ligaments
  – Pain
    • Back, pubic bone
  – Heartburn

• Carefull with
  • “split postures”
Pelvis
Ligaments

• Fibrous connective tissue

• Links bone to bone at the joint

• Stabilize / Allow mobility

• Relaxin!!!

• (Pain SI joint, pain pubic bone, low back pain)
Second trimester

- Easy, slow, sweet, nice vinyasa practice
- Careful with quick transitions up and down
- No intense/deep twists
- Easy “open” twists are ok
- Twists of upper spine to open chest are ok
- Physical limitations in asana due to growing belly
  - Uttanasana
  - Passchimotanasana
  - Janusirsasana
  - Cobra / urdhva mukha svanasana
  - Sun salutations?
Second trimester

• What about abs?
  • Obliques no problem
  • Don’t use rectus abdominis

• What about lying on your belly?
  • “No” or use props

• What about inversions?
  • Some teachers avoid it
  • I think it’s ok if it feels good
  • If the woman never did an inversion before, now is NOT the time
  • Options and alternatives for “easy” inversions
Second trimester

• What about backbends?
  • “baby backbends” are ok
  • Carefull on deep intense backbends, or even “NO”

• What about “jumping”
  • NO!
Second trimester

- Yin is ok
- But......

- Carefull (relaxin)

- Don’t go to far / to deep
  - Injuries, loose ligaments, pain sitting bones/hamstrings attachment, etc...

- Use extra props

- Physical limitations
  - Be creative and use props

- Careful on “split” postures

- Better to lie on the **left side** to avoid compression
Pelvic floor
Pelvic floor

- Hold and release pelvic floor
- Adductor exercises
- Back exercises
- Squat
Third trimester

- 28-40 weeks

- Growing cardiovascular demand
  - Bloodpressure ↑ (pre-pregnancy levels)
  - Heart rate ↑
  - Cardiac output ↑
  - Anemia
    - (due to ↑ plasma volume)

- Dyspnoe

- Palpitations

- Oedema

- Compression of abdominal vessels

- ↑ Relaxin
Third trimester

- “Discomfort” due to growing uterus
- Tired
- Oedema
- Bad nights
- Pain in back, symphysis, legs

Late Pregnancy

- The breasts and uterus grow, adding weight to the front of the body.
- Abdominal muscles stretch as the baby grows.
- Nerves may be pressed as the baby grows or shifts position.
- Pelvic ligaments and joints loosen and become strained.
Third trimester

- Maybe it’s time to gradually stop your “easy, slow, sweet, nice vinyasa practice”
- Carefull with quick transitions up and down
- No intense/deep twists, they are not even possible
- Easy “open” twists are ok
- Twists of upper spine to open chest are ok
- Careful on split asana’s or even stop split asana’s
- Careful on “opening hips” or even stop it
- Don’t lie on your back (compression!)
- Lie preferrebly on left side
Third trimester

• Yin practice is ok, but carefull (relaxin)
  – Don’t go to far / to deep: Injuries, loose ligaments, pain sitting bones/hamstrings attachment, etc...

• Use extra props

• Physical limitations
  – Be creative and use props

• Careful on “split” postures

• Same guidelines as before:
  – No intense/deep twists
  – Easy “open” twists are ok

• Twists of upper spine to open chest are ok

• Better to lie on the left side to avoid compression
Third trimester

- What about abs?
  - Only obliques

- What about lying on your belly?
  - No

- What about inversions?
  - Some teachers avoid it
  - I think it’s ok if it feels good
  - If the woman never did an inversion before, now is NOT the time
  - Options and alternatives for “easy” inversions
  - “Easy” inversions feel soooooo good (feeling of relief)
Yoga and pregnancy

- Pregnancy is not the time to “start” a regular yoga class.
- If used to yoga-practice it’s safe to continue.
- If under the guidance of a teacher who knows what to do.
- Use of “options” and “adaptations”
- Stop when there are “pregnancy-complications”
- You as a teacher should feel comfortable having a pregnant woman in your class, if not: tell her and refer her to another teacher or a prenatal class.
What do you think?

- Uttanasana / padangusthasana/ padahasthasana
- Utkatasana
- Trikonasana
- Uth. Parsvakonasana
- Virabhadrasana I, II, III, viparita
- Ardha chandrasana
- Prasarita padottanasana
- Parsvottanasana
- Parivvrta trikonasana
- Parivvrta parsvakonasana
- Balance???? Vrksasana
- Dandasana
- Passchimottanasana
- Purvottanasana
- Janusirsasana
- Marichyasana I
- Navasana????

- Vasisthasana
- Bakasana?
- Baddha konasana
- Ardha bhekasana
- Eka pada raja kapottasana (PREP and full pose)
- Virasana
- Shalambasana, bhujangasana
- Setu bandha sarvangasana
- Urdhva dhanurasana
- Adho mukha svanasana
- Supta padangusthasana
- Parivvrta sukhasana
- Ardha matsyendrasana
- Salamba sarvangasana
- Halasana
What do you think?

- Catterpillar
- Butterfly
- Frog
- Dragonfly / straddle
- Sphinx / seal
- Saddle
- Deer, shoelace, int/ext rotation femur
- Savasana
Namasté