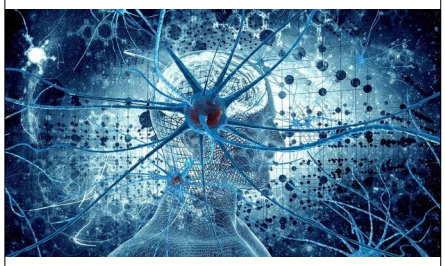
The NeuroDevelopmental Sequence -NDS-

- Universal progression of human development
- Relatively* unchanged in written human history
- No options



1

The NeuroDevelopmental Sequence -NDS-

- Why does it matter in Rehab?
  - The origin of movement acquisition
  - Hardwired blueprint
  - How do you restore
    - Knee extension
    - Hip flexion
    - A squat
    - A deadlift
    - "Gait Training"
    - Running

2-1

The NeuroDevelopmental Sequence -NDS-

- Why do in Reha
  - nt
  - A

2-2

The NeuroDevelopmental Sequence -NDS-

Movemen and the

develop together

3

The NeuroDevelopmental Sequence -NDS-

- Supine
- Prone
- Quadruped
- Sitting
- Kneeling
- Vertical Stance

4

The NeuroDevelopmental Sequence -Sensory info-

- Vision - limited
- Hearing - fully developed
- Smell - fully developed
- Taste - sweet
- Touch - deep pressure

5

The NeuroDevelopmental Sequence -Supine-

- Systemic flexion
  - Spinal
  - Hip, knee, DF, toes
  - Shoulder, elbow, wrist, fingers
- Reflexes drive survival

6

The NeuroDevelopmental Sequence -Supine-

		In	Out
Rooting	Cheek	B	3mo
Sucking	Mouth	B	2-5mo
Moro	Neck	B	4mo
As. Tonic Neck	Neck	B	4mo
Palmar Grasp	Hand	B	4-6mo
Plantar Grasp	Foot	B	9mo
Babinski	Foot	B	12mo
Stepping	LE	B	2mo

7

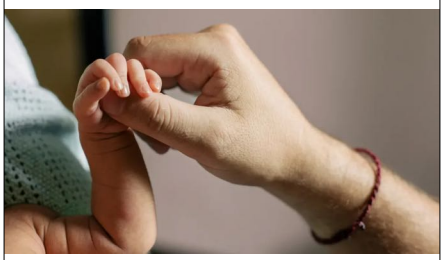
The NeuroDevelopmental Sequence -Moro-

8

The NeuroDevelopmental Sequence -ATN-

9

The NeuroDevelopmental Sequence -Palmar Grasp-



10

The NeuroDevelopmental Sequence -Plantar Grasp-

11

The NeuroDevelopmental Sequence -Babinski-

12

The NeuroDevelopmental Sequence -Stepping-

13

The NeuroDevelopmental Sequence -Prone-

- Develop Extension
  - Cervical
  - Hip
  - Knee
  - Ankle
  - Shoulder
  - Elbow
- Develops SBL > Elongates SFL

14

The NeuroDevelopmental Sequence -Prone-

- First PURPOSEFUL expression of strength…
- Foundation of head, neck, jaw musculature….
- Pushing belly into ground, further develop diaphragm

15

The NeuroDevelopmental Sequence -Quadruped-

- First exposure of the spine off the ground…
- Develops
  - shoulder girdle force production, endurance
  - Hip force production, endurance
  - BTE, loaded DF, loaded wrist EXT

16

The NeuroDevelopmental Sequence -Quad-

- Need enough strength…
- Cross lateralization is critical/allows locomotion to develop
- First efficient form of locomotion…
- Head is even higher…

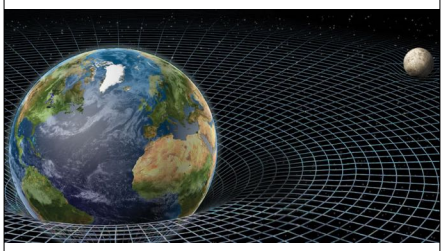
17

The NeuroDevelopmental Sequence 2 Constants

18-1

The NeuroDevelopmental Sequence 2 Constants

1. **Gravity**



2. **The Ground**

18-2

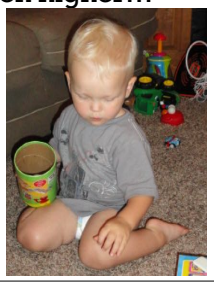
The NeuroDevelopmental Sequence -Sitting-

- First expression of a vertical spine…
- Progression
  - Propped
  - Supported > unsupported
  - Large BOS >Smaller BOS
- Ischial Tuberosities

19

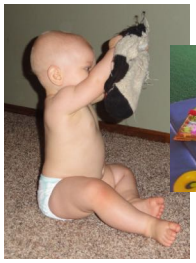
The NeuroDevelopmental Sequence -Sitting-

- Free the hands…
- Head is even higher…
- W-sit…



20

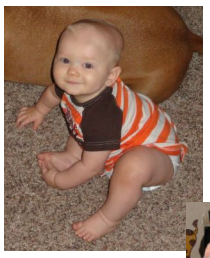
The NeuroDevelopmental Sequence -Sitting-

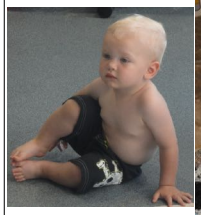


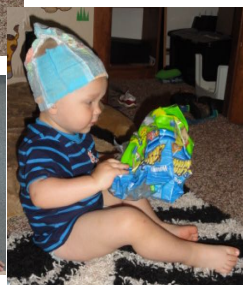
- A LOT of variations
- All follow same progression

21

The NeuroDevelopmental Sequence -Sitting-







- A LOT of variations
- All follow same progression

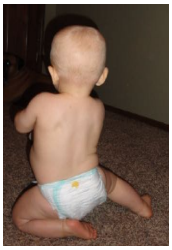
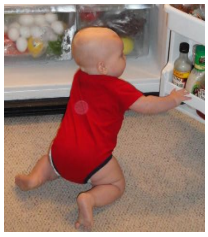
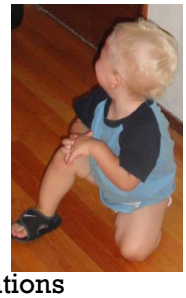
22

The NeuroDevelopmental Sequence -Kneeling-


- First vertically loaded and compressed hips/pelvis and spine
- Progression
  - Supported > unsupported
  - Large BOS >Smaller BOS
- Higher Perspective

23

The NeuroDevelopmental Sequence -Kneeling-

- A LOT of variations
- All follow same progression

24

The NeuroDevelopmental Sequence -Vertical Stance-


- First vertically loaded knees/ankles
- Progression
  - Supported > unsupported
  - Large BOS >Smaller BOS
- Highest Perspective

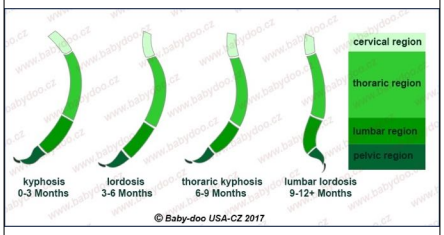
25

The NeuroDevelopmental Sequence -Vertical Stance-

- A LOT of variations
- All follow same progression

26

The NeuroDevelopmental Sequence -Spine Development-



- Systemic flexion>>>mature spinal curves
- Why systemic flexion?

27

The NeuroDevelopmental Sequence -Firsts-

SUPine	PROne
C-flex	C-Ext
C-Rot	Scap Retraction
Shoulder Flex	Shoulder Ext
Elbow Flex	Hip Ext >0
Hip Ext to 0	Resisted Breathing
Hip flexion	L-EXT
Shoulder ABD	Knee EXT +Hip Ext
Knee flexion	Comp/WB wrist,elbow, shoulder
	BTE

28

The NeuroDevelopmental Sequence -Firsts-

QUADruped	SITting
Suspended spine	Vert trunk + free hands
Comp/WB hips	Comp/WB trunk
WB Foot, Ankle	Comp/WB Pelvis
WB/Comp Big toe	Vertical Pelvic Floor
C-hyper ext	WB hip Rotations
Cross-lateralization	Vertical Neutral Spine
Comp/WB Hip flexion	WB/Distracted UE
DF	
WB knee Flexion	

29

The NeuroDevelopmental Sequence -Firsts-

KNEELing	Vertical Stance
Vertical WB/Comp hips	WB/Comp knees, ankles
Beginning Vertical, integrated pelvic floor	WB/Comp Integration of Trunk/spine
WB end range knee flexion	Finished Vertical, integrated pelvic floor
WB Plantarflexion OP	

30

The NeuroDevelopmental Sequence -NDS-

- Breathing
- Head Control
- Pushing Down
- Weight Shifting
- Perturbations
- Dissociation

31

TO BE CLEAR:

THIS PROGRESSION OF PATTERNS IS THE SOLUTION TO EVERY "STABILITY" or "MOTOR CONTROL" PROBLEM IN EXISTENCE.

32

TO BE CLEAR:

THIS PROGRESSION OF PATTERNS IS THE SOLUTION TO EVERY "STABILITY" or "MOTOR CONTROL" PROBLEM IN EXISTENCE.

HOW:

- Sequential progression to establish control from midline out
- Sequential progression to establish control from the head down.
- Increases complexity
- Struggle/overcome adversity
- Progresses external control to internal control with "enough" strength IFF……

33

The NeuroDevelopmental Sequence -BREATHING-

1. Write down everything you know about breathing.

34

The NeuroDevelopmental Sequence -BREATHING-

- The only function of the brainstem that we have conscious control over.
- Allows us to access the F3 response

35

The NeuroDevelopmental Sequence -BREATHING-

- SCM
- Scalenes x 3
- Pec Mj
- Pec mn
- Serratus Ant
- Latissimus dorsi
- Serratus Post sup
- Iliocostalis cervici

Technically any muscle attached to the upper limb and the thoracic cage can act as an accessory muscle of inspiration through reverse muscle action

36

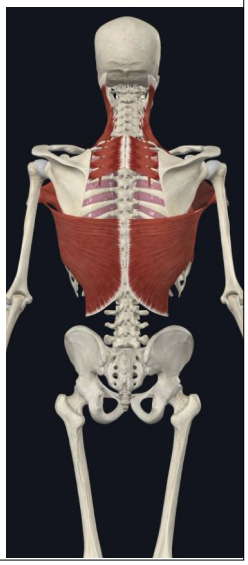
The NeuroDevelopmental Sequence -BREATHING-

- SCM
- Scalenes x 3
- Pec Mj
- Pec mn
- Serratus Ant
- Latissimus dorsi
- Serratus Post sup
- Iliocostalis cervici

37

The NeuroDevelopmental Sequence -BREATHING-

- SCM
- Scalenes x 3
- Pec Mj
- Pec mn
- Serratus Ant
- Latissimus dorsi
- Serratus Post sup
- Iliocostalis cervici



38

The NeuroDevelopmental Sequence -BREATHING-

39-1

The NeuroDevelopmental Sequence -BREATHING-

39-2

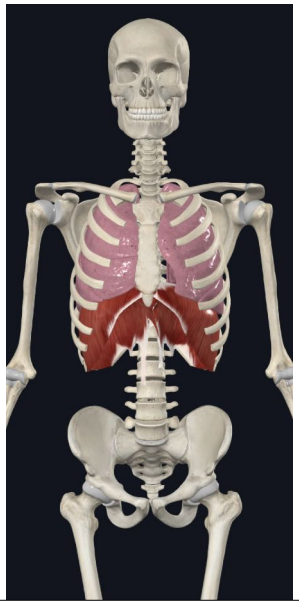
The NeuroDevelopmental Sequence -BREATHING-

40-1

The NeuroDevelopmental Sequence -BREATHING-

40-2

The NeuroDevelopmental Sequence -BREATHING-



41

The NeuroDevelopmental Sequence -BREATHING-

- **Supine** - only resistance is gravity
- **Prone** - bw becomes resistance
- **Quad** - "other" muscles to support body, Diaphragm to breath
- **Verticals** - weight of the ribcage + gravity

42

WHAT MARKS the beginning of life?

43-1

WHAT MARKS the beginning of life?

The first inhale

43-2

WHAT MARKS the beginning of life?

The first inhale

But, what comes before that first inhale?

43-3

WHAT MARKS the beginning of life?

The first inhale

But, what comes before that first inhale?

The Pause…..

43-4

The NeuroDevelopmental Sequence -THE LUNGS-

- **In utero:**
  - Oxygen supplied by umbilical cord
  - Lungs don't provide oxygen
    - ***Fluid filled, collapsed***
    - foramen ovale - lt atria>rt atria
  - Right side of the heart is the dominant side.
- **The Pause (~10sec)**
  - Lungs immediately transition to be filled with air
    - Absorb fluid
- **At Birth:**
  - Once lungs are filled: lowered pressure/resistance to blood flow- helps reroute blood flow to lungs
  - Left side of the heart pumps blood to body
  - Right side of the heart pumps blood to the lungs
  - Lungs provide all oxygen to blood supply

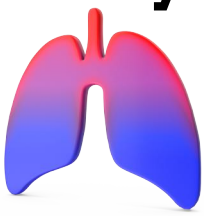
44

Understanding what is happening during the breath cycle…

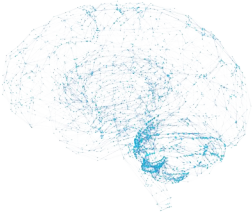
Inhale	Expanding lungs - O2 in	Freeze/ Fight/Flight
HOLD	Lungs expanded - Hold O2 in	*Freeze/ fight/Flight*
Exhale	Collapsing lungs - CO2 out	Rest/ Digest/ Recover
PAUSE	Collapsed lungs - not filled with O2	Freeze/ Fight/Flight

45

When you control your

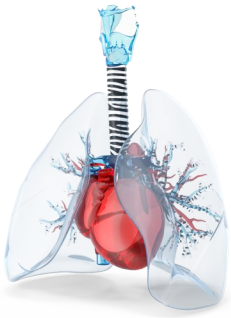


you control your

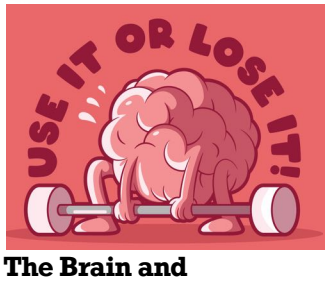


46

Remember



The heart and the lungs function together…



The Brain and Movement function together….

47

Remember

Performance

Focus

48

Breathing BONUS

REDUCE ANXIETY WITH SIGHS

HUBERMAN LAB

QUANTAL CLIPS

49-1

Breathing BONUS

REDUCE ANXIETY WITH SIGHS

HUBERMAN LAB

QUANTAL CLIPS

49-2

The NeuroDevelopmental Sequence -NDB-

If the Patterns are the framework to develop stability (control), how does NDB contribute?

50-1

The NeuroDevelopmental Sequence -NDB-

If the Patterns are the framework to develop stability (control), how does NDB contribute?

Inhale > increase IAB
Hold> maintain IAB
HOLD +> increase IAB
Exhale> lower IAB
Pause > maintain

50-2

IFF…

- Progresses external control to internal control with "enough" strength IFF……

51-1

IFF….

- Progresses external control to internal control with "enough" strength IFF……

How do you control the breath during movement?

51-2

IFF….

- Progresses external control to internal control with "enough" strength IFF……

How do you control the breath during movement?

"Hold" when things get tough

Controlled exhale through the sticking point.

51-3

IFF….

- Progresses external control to internal control with "enough" strength IFF……

52-1

IFF….

- Progresses external control to internal control with "enough" strength IFF……

Integrate NDB into your interventions:

1. **Manual work** > exhale on trigger point
2. **Wall ASLR progression** > 10 NDB
3. **Couch Stretch** > inhale into stretch, hold in the stretch, exhale out of the stretch, pause btn reps
4. **Deadlift** > Inhale on eccentric, exhale on concentric

52-2

The NeuroDevelopmental Sequence -HEAD CONTROL-

1. Write down everything you know about head control.

53

The NeuroDevelopmental Sequence -HEAD CONROL-

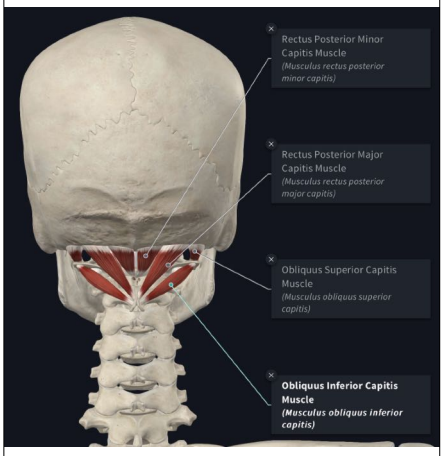
- Control ≠ Cervical ROM
- Prevent movement before creating movement

- Sensory information
  - Hear > see > orient
  - Maintain horizon
- Where the head goes, the body follows….

54

The NeuroDevelopmental Sequence -HEAD CONROL-

- The eyes and head control



- Where the eyes go, the head follows….

55

The NeuroDevelopmental Sequence -HEAD CONTROL-

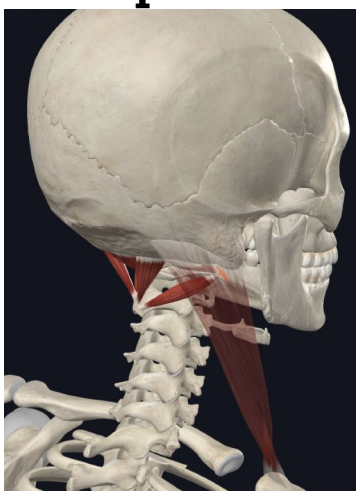
Quiz :

List all of the motions of the neck

56

AT Basic Skillz Test:

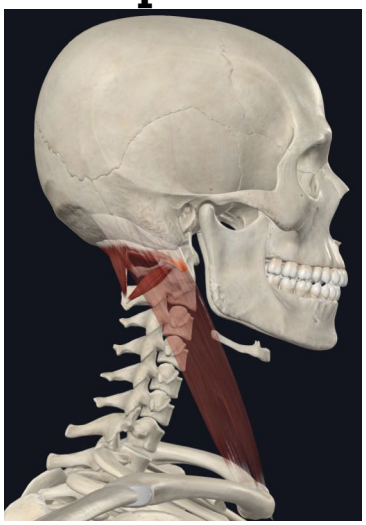
Palpate C1



57

AT Basic Skillz Test:

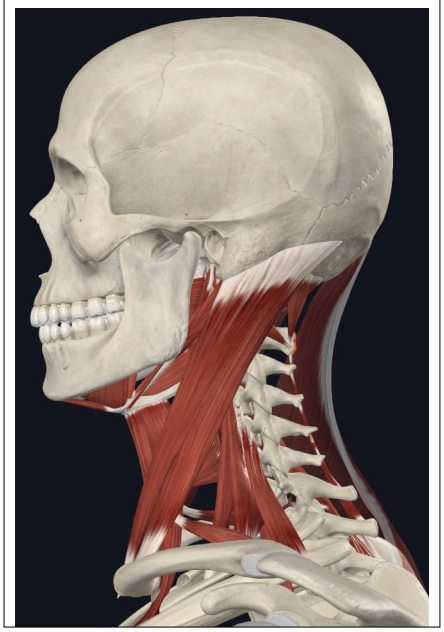
Palpate C1



58

AT Basic Skillz Test:

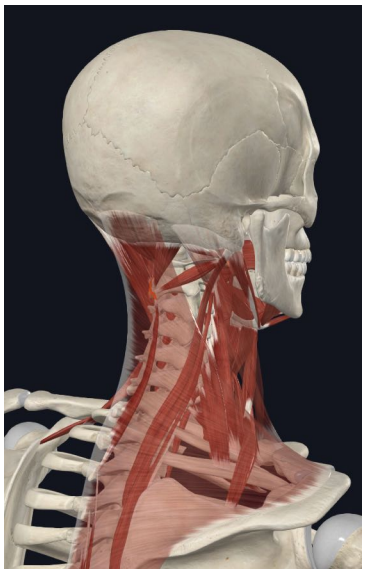
Palpate C2



59

AT Basic Skillz Test:

Palpate C2



60

The NeuroDevelopmental Sequence -HEAD CONROL-

Step 1 - prevent movement

- **Supine** > prevent EXT, RETRACTION
- **Prone** > Prevent FLEX, PROTRACTION
- **Sidelying** > Prevent LAT FLEX
- **Vertical Postures**> Integrates the rest of the spine with a static neck

61

The NeuroDevelopmental Sequence -HEAD CONROL-

Step 2 - Create movement

- **Supine** > Flexion, Protraction
- **Prone** > Extension, Retraction
- **Sidelying** > lat flexion
- **Vertical Postures**> Integrates the rest of the spine with a dynamic neck

62

The NeuroDevelopmental Sequence -HEAD CONROL-

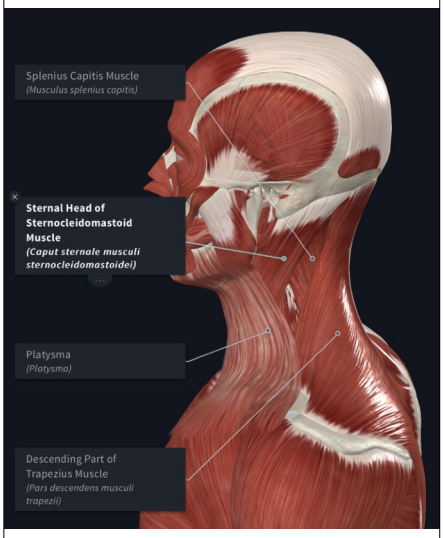
Every fascial line crosses the neck.

- Integrates head control with every shape
- Integrates head control with every movement

30 muscles directly affect the neck

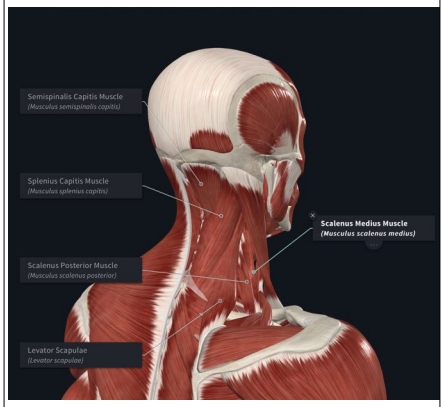
63

The NeuroDevelopmental Sequence -HEAD CONROL-



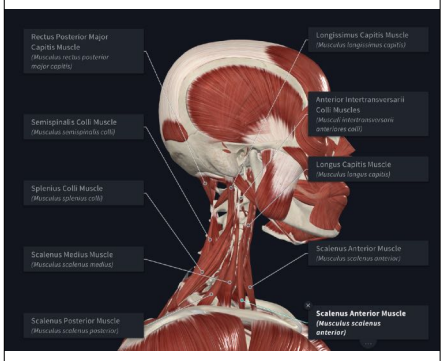
64

The NeuroDevelopmental Sequence -HEAD CONROL-



65

The NeuroDevelopmental Sequence -HEAD CONROL-



66

The NeuroDevelopmental Sequence -HEAD CONROL-

1.Interspinales colli
2.Longissimus colli
3.Posterior intertransersarii colli
4.Anterior intertransersarii colli
5.Splenius capitis
6.Semispinalis capitis
7.Splenius colli
8.Multifidus
9.Semispinalis colli
10.Spinalis colli
11.Longissimus capitis
12.Longissimus colli
13.Iliocostalis colli
14.Scalenes (ant, medius, post)
15.Rectus post minor
16.Rectus post major
17.Obliquus inf capitis
18.Obliquus sup capitis
19.Rectus lateralis capitis
20.Rectus ant capitis
21.Longus colli
22.Longus capitis
23.Sternohyoid
24.Levator scapulae
25.Omohyoid (sup/inf belly)
26.Sternohyoid
27.SCM
28.Digastric (ant/post belly)
29.Upper trapezius
30.Platysma

67

The NeuroDevelopmental Sequence -PUSHING DOWN-

1. Write down everything you know about pushing down.

68

The NeuroDevelopmental Sequence -PUSHING DOWN-

For every action (force) in nature there is an equal and opposite reaction.

Very little to see > pushing down ***creates*** internal tension/control/bracing

Push down, to get up.

69

The NeuroDevelopmental Sequence -PUSHING DOWN-

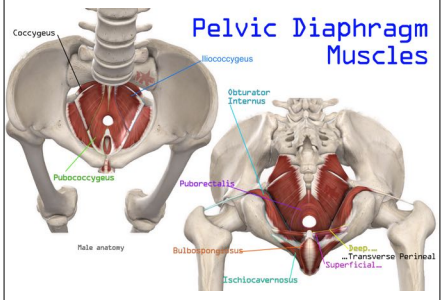
Develop The Strength and control needed to minimize /withstand the pressure of our own bodyweight pressing into the earth.

Tissue Tolerance

Tissue adaptation

70

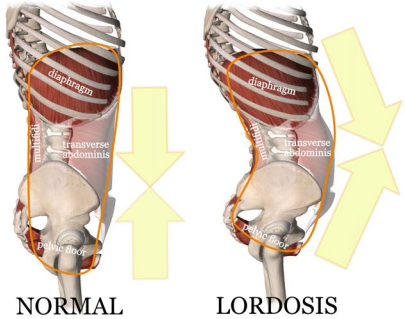
The NeuroDevelopmental Sequence -PUSHING DOWN-



The "Southern" Diaphragm
The Pelvic Floor
The Pelvic Diaphragm

71

The NeuroDevelopmental Sequence -PUSHING DOWN-



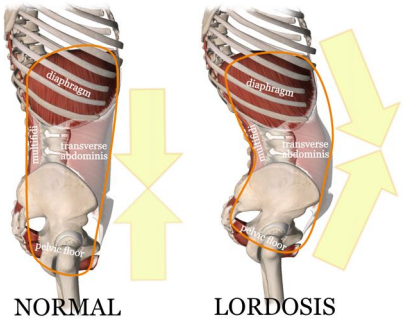
NORMAL LORDOSIS

"Internal" Pressurization

Push down into the ground to create midline/pelvis/LPHC control

72-1

The NeuroDevelopmental Sequence -PUSHING DOWN-



NORMAL LORDOSIS

"Internal" Pressurization

Push down into the ground to create midline/pelvis/LPHC control

72-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

Supine> feet, low back, elbows, back of head

Prone> belly, forehead, FA, palms, knees, big toe

Quadruped> palms, knees, toes/feet

73-1

The NeuroDevelopmental Sequence -PUSHING DOWN-

Supine> feet, low back, elbows, back of head

Prone> belly, forehead, FA, palms, knees, big toe

Quadruped> palms, knees, toes/feet

73-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

Supine> feet, low back, elbows, back of head

Prone> belly, face, FA, palms, knees, big toe

Quadruped> palms, knees, toes/feet

74-1

The NeuroDevelopmental Sequence -PUSHING DOWN-

Supine> feet, low back, elbows, back of head

Prone> belly, face, FA, palms, knees, big toe

Quadruped> palms, knees, toes/feet

74-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

Sitting> IT, legs, palms

Unsupported > palms at or above shoulder level

Kneeling> Knees, tops of feet, soles of feet, palms, shins

Unsupported > palms at or above shoulder level

75-1

The NeuroDevelopmental Sequence -PUSHING DOWN-

Sitting> IT, legs, palms

Unsupported > palms at or above shoulder level

Kneeling> Knees, tops of feet, soles of feet, palms, shins

Unsupported > palms at or above shoulder level

75-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

Vertical Stance> soles, palms

Unsupported > palms at or above shoulder level

76-1

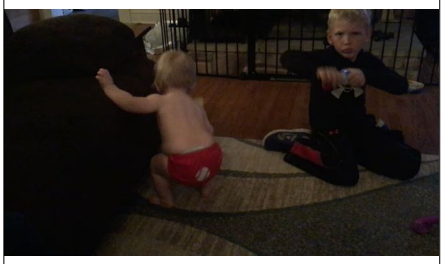
The NeuroDevelopmental Sequence -PUSHING DOWN-

Vertical Stance> soles, palms

Unsupported > palms at or above shoulder level

76-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

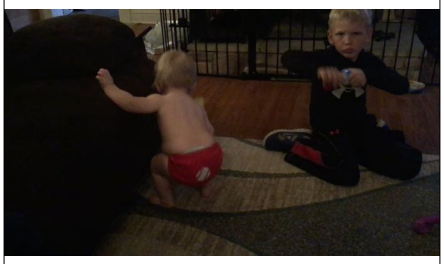


Vertical Stance> soles, palms

Unsupported > palms at or above shoulder level

77-1

The NeuroDevelopmental Sequence -PUSHING DOWN-



Vertical Stance> soles, palms

Unsupported > palms at or above shoulder level

77-2

The NeuroDevelopmental Sequence -PUSHING DOWN-

Marks the transition point of the patterns.

BR/HC > control head/ spine

WS,PERT/DISS > Point B, interact with environment

78

The NeuroDevelopmental Sequence -PUSHING DOWN-

NDB

HC

PD

WS

PERT

DISS

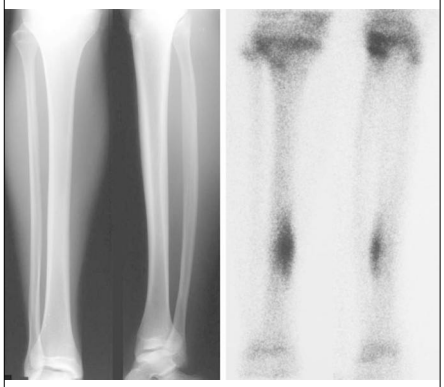
79

The NeuroDevelopmental Sequence -PUSHING DOWN-

1. Write down everything you know about weight shifting.

80

"Tissue Tolerance"



A tissues ability to appropriately respond to the stresses it has been exposed to.

81

The NeuroDevelopmental Sequence -Weight Shifting-

Adjusting the body weight over and WITHIN the base of support.

Progressively:

- Decreased BOS
- Increased length of lever arm

82-1

The NeuroDevelopmental Sequence -Weight Shifting-

82-2

The NeuroDevelopmental Sequence -Weight Shifting-

Test the limit of control.
Failure.
Test the limit of control.
Failure.

Slowly extends control within/over the BOS

83

The NeuroDevelopmental Sequence -Weight Shifting-

84-1

The NeuroDevelopmental Sequence -Weight Shifting-

84-2

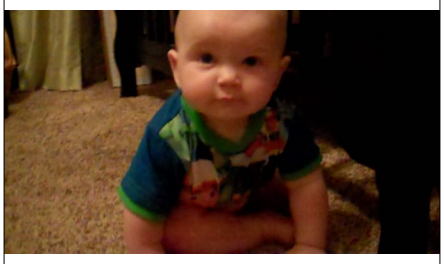
The NeuroDevelopmental Sequence -Weight Shifting-

85-1

The NeuroDevelopmental Sequence -Weight Shifting-

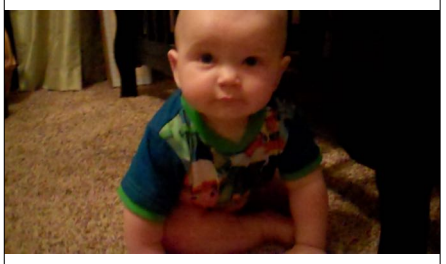
85-2

The NeuroDevelopmental Sequence -Weight Shifting-



86-1

The NeuroDevelopmental Sequence -Weight Shifting-



86-2

The NeuroDevelopmental Sequence -Weight Shifting-

87-1

The NeuroDevelopmental Sequence -Weight Shifting-

87-2

The NeuroDevelopmental Sequence -PERTURBATIONS-

1. Write down everything you know about perturbations.

88

The NeuroDevelopmental Sequence -Perturbations-

THE BULK OF CORRECTIVE EXERCISES:

- Pendulums
- Shoulder Series
- Hip Series
- Banded Shoulder Ex
- CW/CCW circles

89

The NeuroDevelopmental Sequence -Perturbations-

Extends the body weight outside and BEYOND the base of support.

Progressively:

- Decreased BOS
- Increased length of lever arm

Move the BOS

90

The NeuroDevelopmental Sequence -Perturbations-

Arms, legs, head (ROM)

Test the limit of control.
Failure.
Test the limit of control.
Failure.

Slowly extends control beyond the BOS, until…

91

The NeuroDevelopmental Sequence -Perturbations-

92-1

The NeuroDevelopmental Sequence -Perturbations-

92-2

The NeuroDevelopmental Sequence -Perturbations-

93-1

The NeuroDevelopmental Sequence -Perturbations-

93-2

The NeuroDevelopmental Sequence -Perturbations-

94-1

The NeuroDevelopmental Sequence -Perturbations-

94-2

The NeuroDevelopmental Sequence -DISSOCIATION-

1. Write down everything you know about dissociation.

95

The NeuroDevelopmental Sequence -Dissociation-

NOT ROTATION

Foundation of ALL efficient/effective Locomotion.

96

The NeuroDevelopmental Sequence -Dissociation-

TRADITIONAL PT PERCEPTION OF DISSOCIATION:

Dissociation for your body refers to our ability to move our head, mid back, low back, and hips separately from each other. For ex: When it comes to a golf swing, dissociation of the upper body from the lower body is essential.

97

The NeuroDevelopmental Sequence -Dissociation-

Separation of the visual/ VC/spatial orientation sensory input due to body orientation

Shoulders/Pelvis/Head in different orientation of the transverse plane

LARGER INTENT > locomotion

98-1

The NeuroDevelopmental Sequence -Dissociation-

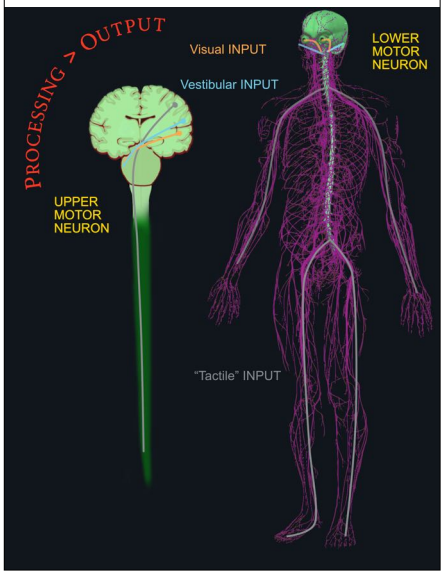
Separation of the visual/ VC/spatial orientation sensory input due to body orientation

Shoulders/Pelvis/Head in different orientation of the transverse plane

LARGER INTENT > locomotion

98-2

The NeuroDevelopmental Sequence -Dissociation-



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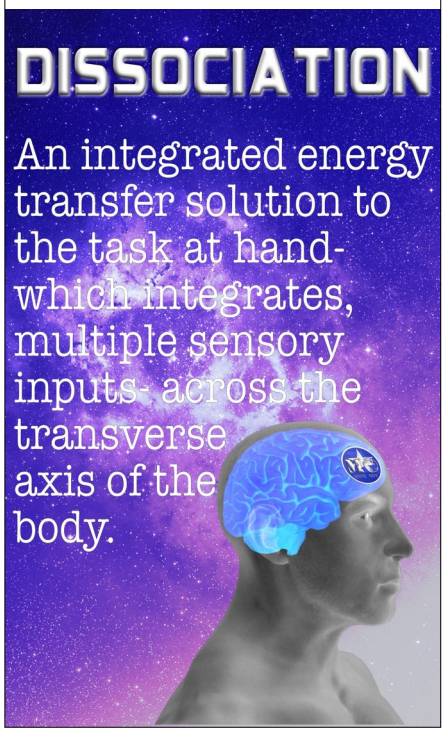


100

The NeuroDevelopmental Sequence -Dissociation-

101

The NeuroDevelopmental Sequence -Dissociation-

102

The NeuroDevelopmental Sequence -Dissociation-

103

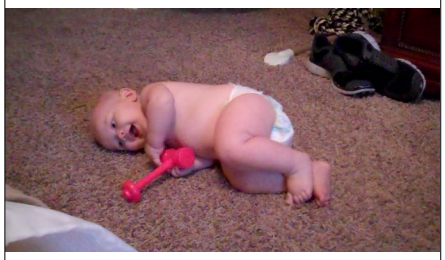
The NeuroDevelopmental Sequence -Dissociation-

104-1

The NeuroDevelopmental Sequence -Dissociation-

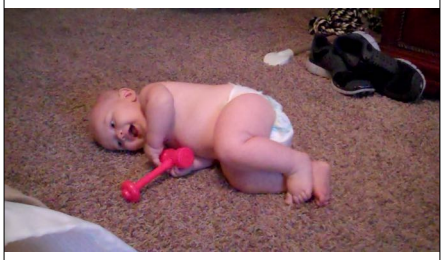
104-2

The NeuroDevelopmental Sequence -Dissociation-



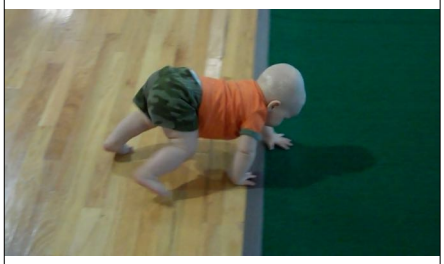
105-1

The NeuroDevelopmental Sequence -Dissociation-



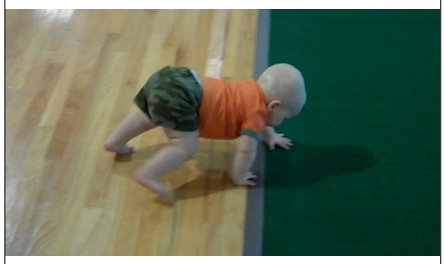
105-2

The NeuroDevelopmental Sequence -Dissociation-



106-1

The NeuroDevelopmental Sequence -Dissociation-



106-2

The NeuroDevelopmental Sequence -Dissociation-

107-1

The NeuroDevelopmental Sequence -Dissociation-

107-2

The NDS: Insights

When should you advance to a higher posture?

Dissociate in the lower posture AND NDB in the higher posture.

The NDS: Insights

How CAN I progress the "CHALLENGE" of any exercise?

1. Bigger BOS to smaller.
2. Shorter lever are to larger.

The NDS: Insights

How CAN I progress the "CHALLENGE" of any exercise?

3. More stability from the ground to more control from the body.
4. More External sensory input

The NDS: Insights

How CAN I progress the "CHALLENGE" of any exercise?

5. Same to opposite / ipsilateral to contralateral.
6. Less complex to more complex

The NeuroDevelopmental Sequence -Locomotion-

1. **Rolling**
   - 3mo - incidental/ ipsilateral
   - 4-6mo - purpose/ contralateral
   - 6mo purpose and intent > dissociation of head, shoulders, pelvis
2. **Crawling/Scooting**
   - 6-8mo
3. **Walking**
   - 12-18mo
   - Static> supported> unsupported
   - Hopping, skipping, jumping (18mo)

The NeuroDevelopmental Sequence -Locomotion-

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   - 3mo - incidental/ ipsilateral
   - 4-6mo - purpose/ contralateral
   - 6mo purpose and intent > dissociation of head, shoulders, pelvis
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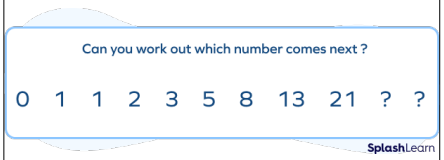
The NeuroDevelopmental Continuum -NDC-

- **Continuum:** *a coherent whole characterized as a collection, sequence, or progression of values or elements varying by minute degrees*
- **Sequence:** *continuity of progression; a particular order in which related events, movements, or things follow each other.*



114

The NeuroDevelopmental Continuum -NDC-

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115

The NeuroDevelopmental Continuum -NDC-

- NOTHING is consistent
- ALWAYS changing
- MANY options

116

The NeuroDevelopmental Continuum -NDC-

- NOTHING is consistent
- ALWAYS changing
- MANY options

117

The NeuroDevelopmental Continuum -NDC-

- NOTHING is consistent
- ALWAYS changing
- MANY options

118

The NeuroDevelopmental Continuum -NDC-

119

-NDC-
Your 'body' reflects your habits your choices and and your lifestyle.

120

-NDC-

- Completely different Nervous System
- Completely different skeleton
- Completely different muscular system
- Completely different hormonal system

121

-NDC-

What do adults bring?

- Strength imbalances
- Poor Strength:bodyweight ratio
- Mobility limitations
- Advanced problem solving ability (cheat)
- Habits
- Compensations
- Entitlement
- Education

122