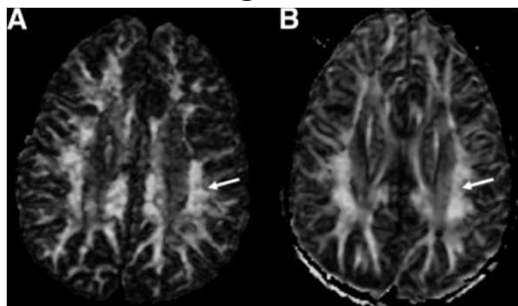


DTI shows absence of Arcuate Fasciculus—image B vs normal A



Slide 2

Primitive Reflexes In TBI Across All Ages

Presented by:
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For the
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Annual Conference

TBI E&M, Standard...then what?

- 5.3 Million Americans live with a long-term disability as a result of TBI.
- The annual incidence of TBI is 1.7M
- ABI (acquired brain injury) is 917K

Standard Medicine often does an excellent job saving lives and limiting the initial injury.

Then what?

Post-acute Assessment

- Level of consciousness & responsiveness to stimulation
 - Assessed depending on severity
- Alertness & attention
 - Responsiveness to stimulation
- Orientation
 - Person, place and time

- Memory
 - Visual memory (complex figure copy/drawing)
 - Prospective memory (memory to do things at specific times)
 - Retention Span (digit span)
 - Recall of new info (supraspan word lists)
 - Retrieval of info from remote memory (biographical memories)

- Language and communication
 - Written language/communication
 - Arithmetic processes
 - Reading Comprehension
- Abstract Thinking
 - Proverb Interpretations
 - Similarities and Differences

- Reasoning

- Logical Thinking

- a) Respond to questions - what would you do if you found a stamped and addressed unmailed letter?

- Appreciation of Relationships

- a) Draw conclusions based upon analysis of relationships - friend or foe

- Planning and Problem Solving

- Ability to think ahead

- Understanding future consequences

- Ability to weigh alternatives

- Ability to make appropriate choices

Traditional Treatment Approaches

- General Stimulation

- Theory-driven approach

- Functionally Oriented Treatment

- Cognitive Rehabilitation

- Behavior Therapy

- Generalize gains to other settings

- Advocate for accommodations

- Professionals often involved:
 - MD/DO's
 - Nurses
 - Neuropsychologists
 - Speech-language pathologists
 - OT's
 - PT's
 - Clinical psychologists
 - Social workers
 - Vocational rehab counselors

Why Monitor The Injured Brain?

- To facilitate early detection of potentially harmful events *before they have a chance to cause irreversible damage ...*

...thereby reducing the chances of secondary injuries...

(metabolic, immunologic, neurological diaschesis...NOT JUST FALLS)

...which represent both perpetuating variables and obstacles to the success of reasonable and important interventions.

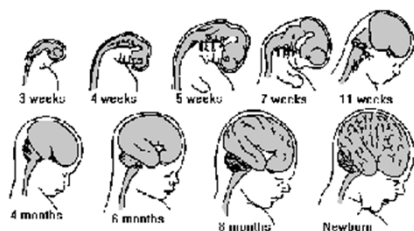
- To identify the process driving potentially harmful events, thus leaving time for effective intervention
- To enable and provide ongoing feedback to assist therapy and interventions directed at these threats

- Methods of monitoring the injured brain should be
 - non-invasive
 - relatively available
 - and cheapin order to be widely useful

- Current techniques used to monitor the injured brain include
 - a) Neurological observation
considered the most sensitive and specific indicator of brain function
 - b) EEG/EEG Spectral Array
sensitive in coma, seizures, even with muscle relaxers, useful in prognosis
 - c) Evoked Potentials
morbid predictor, indicator for focal deficits as well as prognosis

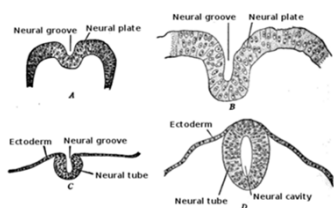
What could be missing?

- The human nervous system develops along very specific timeline.



- Currently Re-emergent primitive reflexes are rarely assessed, and then only during coma and semi coma
- However, it is well recognized that primitive reflexes often re-emerge in neurologic disease including neurodegeneration and trauma to the CNS rostral to the spinal cord (BRAIN).
- And, it's a cheap bedside diagnostic!!!

- Between day 19 and 20 we see the formation of the neural groove.



- By day 22 the neural tube has formed, figuratively bringing the outside world into the developing CNS establishing the foundation for the exquisite reality emulator which is the human brain.
- For this person's entire mental life, he/she will scan reality with the senses, analyze and evaluate, make predictions and plans and execute behavior...then learn to do better.

The human nervous system develops along very specific timeline.

- The areas of the CNS which regulate vital functions form first.
- Then sequentially the CNS matures from the most vital for survival leading to the most eloquent and responsive to the unique environment in which the person was born.

Survival versus Finesse

- The survival pathways are laid down first, thus they will always be found in the midline of the CNS.
- Neuroanatomically, in addition to midline, these pathways and structures are also found on the ventral surface of the brain

- Having these structures located in the deepest regions also confers a measure of protection from external threats.
- These pathways are the most genetically determined and are less dependent on sensory input for their maturity.

Finesse versus Survival

- The pathways which are most influenced by sensory input for their development are found more laterally and dorsally in the cord and brain.
- Within this division, first to develop are the primary sensory pathways, followed by association regions with the frontal processing areas last.

Beauty and the Beast

- This allows the last CNS areas to develop in humans to have an immense opportunity to adapt to unique territorial and social environments. Hence, the Beauty.
- In contrast, areas which develop first occur, in part, before declarative function and have an implicit character best characterized by "Childhood Amnesia" and can operate in stealth...
...the Beast

Primitive Reflexes in Stealth

- Primitive reflexes represent survival oriented motor responses
- They begin to form *in Utero*
 - Palmar & plantar grasp @ 11 weeks In utero
 - Moro @ 9-12 weeks in utero
 - TLR forward @ 12 wks in utero
 - ATNR @ 18 wks in utero
 - Spinal Galant and Perez @ 20 wks In utero

- These genetically hardwired reflexes play a part in the amazing waltz of postures and movements between the baby and mother during childbirth.
- Yes, innate reflexes cause the baby to “wiggle it’s way out” from presentation through the birth canal and companion reflexes cause the mother to push...pause...push... (Ferguson Reflex)

- WOW

- These reflexes do far more than make the baby squirm out.

As these reflexes fire they drive pathways that begin to develop the cerebellar and cerebral cortices.

Primitive reflexes initiate movements that form the building blocks for intentional movements.

- Eventually, primitive (A priori) perceptions of movements linked together with different outcomes form the basis upon which the cerebral cortex links cognitive percepts together to form ideas.

- Learning to process simple movements into volitional actions become the foundation upon which all cognition depends.

Delayed reflexes ALWAYS have cognitive concomitants!

- **As the reflexes fire synaptic stabilization occurs.**

The process of Synaptic Stabilization allows the nervous system to select for dominance the most efficient pathways and select for pruning the least effective pathways.

- Each sensory modality when activated inhibits competing sensory modalities.

For example, if you are watching something very carefully you may not hear someone speaking to you or vice versa.

- Each sensory modality has an optimal window for development. Each gets its turn on the center stage in an ideal sequence.

However, we live in a non-linear world!

- Baby's first sensory modality to take the stage is graviception and related motion.
- Hence,

the first systems to develop are the vestibular and proprioceptive systems.

The gentle sway of the mothers body as she moves about and the effect of gravity are the ideal sources of stimulation for a baby in utero.

Light is dim and sounds are dominated by the mothers heartbeat and borborygmus (intestinal gurgles)

Hence,

rhythmic stimulation
is deeply significant

- The first primitive reflexes to emerge in-utero are withdrawal reflexes
- The first tactile reflexes are the hand and mouth
- If these withdrawal reflexes persist then the baby may have trouble nursing or crawling

- Excessive stimulation of a developmentally non-dominant sensory modality can permanently alter the developing course of competing sensory modalities by strong inhibition during development and synaptic stabilization.

O.M.G...

- (Philbin, Ballweg & Grey, 1994, Spinelli, Jensen & DePrisco, 1980)
- (Buehler, Als, Duffy et al, 1995)
- (Korner 1990)

Inappropriate timing and sequencing of the appearance and disappearance of primitive reflexes ALWAYS effects processing speeds!

Professional Opinion

Re-emergence of Primitive Reflexes

- It is well accepted that trauma and degeneration to the CNS are often marked by re-emergence of primitive reflexes. In fact, this is often noted as a frank presentation in severe mental illness.

WHY?

- Recall that the primitive reflexes fire rostrally to drive the development of the cortex.
As the cortex matures sufficiently, it fires back down to inhibit the primitive reflex that undergirded it's development,
allowing more complex environmental and cortical-cortical influences to have a shot at shaping neuroplasticity.

- As the cortex fails, it allows the primitive reflex to "escape".

These events are, in fact, commonly referred to as "release signs"

We will review the primitive reflexes in detail shortly, but here are some fairly common examples you have probably seen yet didn't recognize.

Frontal release signs are commonly “orofacial”, such as the re-emergence of the sucking reflex indicated by tic like pursing of lips and rooting reflex by twitching of the side of the mouth.

- These signs can be much more subtle in people who seem to be functioning fine.

The Spinal Gallant and Perez are often seen by touching someone’s back and observing them twitch with a slight arched back toward the side touched or jerk away.

Just ticklish eh?

- The Moro can often be seen in people with incessant eye blinking when they are nervous.

Also, in people with an exaggerated startle response, especially if they move their arms, even slightly, out to their side when they react.

- The Babinski reflex is commonly seen with a Upper Motor Neuron Lesion (Spinal cord or above) and is observed when the doctor scrapes the bottom of a patients foot along the lateral margin and observes the big toe extend.

This can be seen in a cervical spine herniation, stroke, Arnold Chiari Malformation...etc.

- The last peripheral tract to myelinate is the corticospinal and the longest nerves reach the bottom of the feet.

This process should be complete by age 1.

Significance...We walk by age 1

Otherwise, someone would raise their toes when they step on their foot and create an instability which could be disastrous...

yet many fail to inhibit this reflex and show mild + Babinski

Principle: retained primitive reflexes impair associated voluntary actions

I commonly see mild + Babinski in children with Autism, Asperger's, AD/HD, Dyslexia...

sometimes unilateral
sometimes bilateral

Certainly in TBI/ABI

the Beast – Revisited

- Just like implicit learning operates below cognitive manipulation yet can be selectively inhibited, emotional issues before declarative memory formation can hijack cognitive processes... (attachment theory, etc...)

persistent primitive reflexes can hijack motor influenced cognitive processes...

There is a potential to influence all decisions and behavior associated with approach / withdrawal strategies.

PRIMITIVE REFLEXES AND ATTENTION DEFICIT/HYPERACTIVITY DISORDER: DEVELOPMENTAL ORIGINS OF CLASSROOM DYSFUNCTION
Myra Taylor, Stephen Houghton and Elaine Chapman International Journal of Special Education, 2004, Vol 19, No.7

- **The present research studied the symptomatologic overlap of AD/HD behaviors and retention of four primitive reflexes (Moro, Tonic Labyrinthine Reflex [TLR], Asymmetrical Tonic Neck Reflex [ATNR], Symmetrical Tonic Neck Reflex [STNR])**

in 109 boys aged 7-10 years. Of these, 54 were diagnosed with AD/HD, 34 manifested sub-syndromal coordination, learning, emotional and/or behavioral symptoms of AD/HD, and 21 had no (or near to no) symptoms of AD/HD. Measures of AD/HD symptomatology and of the boys' academic performance were also obtained using the Conners' rating scale and the WRAT-3, respectively.

- **Results indicated that, in general, boys diagnosed with AD/HD had significantly higher levels of reflex retention than non-diagnosed boys. Results also indicated both direct and indirect relationships between retention of the Moro, ATNR, STNR and TLR reflexes with AD/HD symptomatology and mathematics achievement.**

- **The pattern of relationships between these variables was also consistent with the notion of the Moro acting as a gateway for the inhibition of the other three reflexes.**

INFANT REFLEXES AND ADULT DEVELOPMENT Sensory Integration through Movement
By Eve Kodlak, M.M., Newsletter of the Boston Institute for the Development of Infants and Parents, Fall, 2006

Various forms of trauma can inhibit the normal integration of reflexes.

Factors that may inhibit the development of normal movement patterns include injuries at birth or after, drugs ingested in utero or through breast milk, allergies, physical and emotional overstimulation, an unsafe environment, blinking lights and media overload.

- ***A significant inhibitor of normal development is the simple lack of opportunity for movement.***
- Babies carried around constantly in plastic car seats or other forms of bodily restraint *do not gain the necessary practice time to develop normal movement patterns.*

Older children may manifest unintegrated reflexes in the use of their bodies.

For example, children who flop to one side at their desks, reading or doing their work with their heads resting on an arm, are manifesting an unintegrated *Asymmetrical Tonic Neck Reflex*.

They place themselves in this physical position in order to concentrate.

- On occasion these children may actually fall sideways out of their chairs.
- The movements are reflexive, and thus the children lack the choice of "sitting up straight."***
- As they attempt to process information sitting appropriately they must assume a compensatory mode that creates tensions and other difficulties.

- When tired or anxious adults and children may return to unconscious movement patterns.

An example of the *Asymmetrical Tonic Neck Reflex* may be seen when observing a driver turning his or her head to the left and then automatically moving the steering wheel in that direction.

Please note the immense significance of movement/motoricity in brain related sensory integration

Postural Reflex Presentation

- As the primitive reflexes become suppressed, they usher in the emergence of the postural reflexes.
- The postural reflexes should persist throughout life.

- Postural Reflexes enable us to maintain an upright posture
- Catch ourselves from leaning or falling
- Keep our heads upright and level
- Move our eyes and head to different targets and at different rates
- Track objects and glance with our eyes

- Balance in different postures, ie sitting, standing, standing on 1 leg
- Coordinate finger and arm motions such as drawing circles and sequential finger and arm motions (Diadochokinesia)

Guidelines for Therapy

Suggested

- 1) Interventions should target the current developing system so long as earlier systems are mature.
 - 2) Targeting later developing systems cannot resolve deficits based on preceding systems immature development.
- NO Skipping Steps

- Waterbeds are excellent sources of early therapy for premature infants

Ingersoll & Thoman, 1991; Thoman & Ingersoll, 1993)

• These implicit reflexes seem to leave an a priori whisp which can soothe us or ravage us.

- Why do people feel profoundly moved holding hands?
- Why do all dogs and some cats love having their belly rubbed?
- Why do we tend to panic with rapid acceleration down?

Overview of Key Primitive Reflexes

The following discussion will highlight the primitive reflexes which are traditionally found in more severe CNS problems and those I commonly find persistent or re-emergent.

After reviewing the nature and presentation of each reflex, I will present some remediation activities which can fire the reflex to restore the normal suppression and free the cortex to function, unfettered in it's volitional pursuits, by the reflex.

Palmar Grasp Reflex

- The Palmar Grasp reflex emerges 11 weeks in utero.

Pic @12 weeks

Purpose: to help baby hold on to aid clinging and prevent drops/falls



You have probably seen pictures of human babies grasping an instrument or doctors finger or umbilical cord

pic@5 mos



- To test for the appropriate presence of the grasp reflex in an infant

- Fingers till ~ 4 mos
- Feet till ~ 6-12 mos

Touch palm or sole and observe grasp of fingers or flexion of toes



- To test for persistent or re-emergent Palmar grasp reflex > 1 year
scrape / scratch with fingernail across the palm or sole and watch carefully for any subtle finger or toe flexion (not thumb or big toe)
- Remediation: Scrape the palm/sole to elicit the reflex frequently each day until the reflex can no longer be elicited.

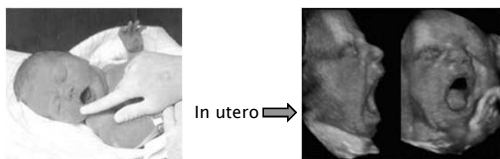
Elicit and Remediate Palmar Grasp Reflex



Persistence of a fisted hand is a sign of a UMN in an infant

Rooting Reflex

- Present in-utero diminishes ~ 4 mos and gone by 7 mos
- Rooting reflex is tested by brushing or stroking the baby's cheek.
- The Rooting reflex causes the newborn to open it's mouth and turn it's head toward anything that their cheek or mouth. They move in diminishing arcs until successful.



- Purpose: to assist successful breastfeeding.
Often co-elicits sucking reflex.

- To test >7mos and adults, scrape the cheek inward toward the edge of the mouth in 3 directions (reverse crows foot)



Sucking Reflex

- Begins in-utero should diminish as a reflex ~ 2 mos and resolve by 4 mos replaced by volitional sucking
- Tested \leq 4 mos by sticking finger in babys mouth (may require touching palate), baby sucks finger



- Test \geq 4mos by gently brushing lip and observing for slightest twitch of lips

Moro Reflex

- The Moro (Startle) Reflex should be present by 9–12 weeks in-utero and should begin to diminish around 2 months resolve within 5 months.

It occurs spontaneously with sudden movement of the baby, sudden sounds or sudden changes in temperature.

- Tested ≤ 5 mos by holding the infant on it's back and dipping an infant briskly head-ward.





- The legs and head extend while the arms jerk up and out with the palms up and thumbs flexed.

Shortly afterward the arms are brought together and the hands clench into fists, and the infant cries loudly

Bilateral absence may indicate CNS injury & Unilateral may be Erbs Palsy

- In older children and adults, the Moro can be elicited more easily by:
- Supine – extend head quickly backward and down + w/arm abduction
- Standing – Bunny Hop style, instructed to fall stiff straight back into examiners arms at the hearing of a loud clap (from behind)

Positive Moro is arms abduct/extend or waist bends with arm extension/elevation

Tonic Labyrinthine Reflex

- TLR Forward emerges in-utero @12 wks and TLR forward and backward should be gone by 3–4 months
- Tilting the head back w/pt supine causes the legs to straighten/stiffen/approximate, toes to point and arms to bend at elbows and wrists



TLR –Abnormal Extensor Tone

In the quadruped position, the head/neck is extended and the back arches somewhat and there is a tendency to retract to the haunches

When the head/neck is flexed, the tendency is to advance slightly or crumple forward.

TLR and Moro are much less severe yet interesting to compare to the decorticate posturing seen in coma patients with red nucleus lesions as they also originate in the mesencephalon.

Assymetric TLR – Fencer

- ATNR emerges @ 18 wks in-utero and should resolve within 3-4 months with resolution of the TLR
- This reflex is called the fencing reflex because as the head is turned, the arm and leg extend on the side facing and they flex on the opposite side.



This reflex can also be assessed in the quadruped position by turning the head and observing for the arm or leg to bend on the opposite side facing

The TLR and ATNR both hinder functional activities such as rolling, bringing the hands together, or even bringing the hands to the mouth.

Standing ATLR

- In children and adults, one can see persistence or re-emergence of the ATLR by examiner turning the patients head while the patient is standing with both arms outstretched straight in front of them ("Frankenstein" posture)
- The reflex is evident when the arms follow the direction of head turn

Rolling may be the first indication there is a problem.
If rolling @ 1-2 mos NOT GOOD, could be decerebrate.
Important to roll by 3-5 months. Rolling absent by 3-4 mos
✓ Spinal Gallant. Absent one side ✓ Erbs Palsy or Vestibular

- Persistent TLR and/or ATRL impair postural control during walking and running which leads to aberrant joint mechanics. Over time this leads to inflammation and joint damage, possibly impairing hip joint development.

Spinal Gallant and Perez Reflexes

- Spinal Gallant and Perez emerge @20 wks in-utero and resolve by 3-6 mos
These are called the "truncal incurvation" reflexes because stroking up the back on one side will cause a twitch like response to the same side. (Gallant)

- Gallant is best observed baby suspended or ≥ 6 mos in the quadruped position
- Perez is observed when a stroke along both sides of the spine from neck down causes a twitch with trivial to obvious extension of the back

These are among the reflexes tested in newborns to rule out brain damage!

Babinski Reflex - Up toe

- The Babinski reflex is present at birth and should recede @ 10-12 months to allow walking. Extensor toe sign.
- Stroking the side of the foot with a blunt instrument of an infant should cause the great toe to extend and others to fan out.
- ≥ 1 yr toes curl in and foot everts

- There are many more reflexes you can learn about and there are numerous models of intervention based on differing theoretical frameworks regarding how to remediate the reflexes.

- One popular opinion is that the reflexes should be present but need to be properly integrated. There are numerous protocols based on this idea.
- I do NOT share this opinion!

From a more traditional neurological framework, the reflexes must be triggered enough times to evoke efferent neuroplasticity in their respective CNS targets.

Remediation Exercises

- That said, many of the therapeutic activities from the various frameworks appear to be useful in resolving the persistent or re-emergent reflexes.

Oftentimes our observations are valid and our explanations remiss...

Plantar Palmar Exercises

- Stroke the sole of foot and/or palm



- Rub knobby rubber ball on palm/sole

Rooting Exercises

- Stroke/scrape towards the edge of the mouth to elicit the reflex. Repeat often until the reflex can no longer be elicited.



Moro Exercises

1



2



Right arm Right Leg over

3







4



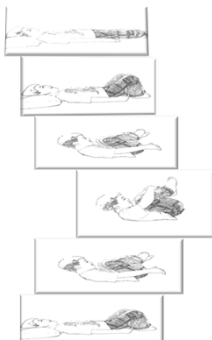
Left arm Left Leg over

Prone TLR Exercises

1. Start in prostate position head down between arms 
2. Raise head simultaneously raising off haunches slowly 
3. Continue raising up 
4. Slowly return to starting position and repeat 

Supine TLR Exercises

1. Start supine with pillow under head
2. Slowly bring knees up as a triangle
3. Slowly raise head/chin and arms so arms are straight along legs
4. Continue so as to ball-up with arms wrapped around knees -pause
5. Slowly release legs into pose #3
6. Slowly return to pose #1 - Repeat



Prone ATNR Exercises

1. Lay prone arms extended in front head up
2. Bring thumbs together by bending elbows
3. Raise chin and extend arms keeping thumbs together
4. Raise chin, chest and arms keeping thumbs together
5. Facing forward move right arm out to side and follow with eyes - not moving head
6. Bring right thumb, arms extended back to meet up with the left thumb -still up
7. Repeat with left thumb to left side n back
8. Return to pose #3 and slowly repeat



Standing ATNR Exercises

- Standing ATNR is an easier version of Prone ATNR. It is performed the same except while standing up. Remember to keep your head straight and follow your thumb with your eyes.



Gallant – Perez Exercises

1. Lay supine with arms and legs at side
2. Very slowly raise arms and legs simultaneously
3. Till arms are over-head and legs are spread apart
4. Very slowly lower arms and legs simultaneously
5. Return to pose #1



Grasp reflex in low tone neonate



Excessive Head lag



Normal Babinski



Poor Suck Reflex



Moro Reflex



Better example of Moro



Spinal Gallant Reflex





