Splish Splash: Pediatric Motor Learning in the Aquatic Environment  
*Carrrie A. Ciaverelli, PT, MPT, CYT*

Carrie A. Ciaverelli PT, MPT, CYT is a senior physical therapist with Lakeway Aquatic Therapy and Wellness Center in Austin, TX. She focuses her practice on pediatric aquatic therapy and manual therapy across the age spectrum. She is also a certified yoga teacher. Carrie graduated from the University of Louisville with her Masters in Physical Therapy in 2002. She has been a presenter in the area of aquatic pediatric physical therapy research both locally and nationally at the APTA Combined Sections Meeting in 2010 and the 2010 World Aquatic Conference. Carrie serves on the Aquatic PT Section’s board as a Nominating Committee officer. Carrie and her husband, Michael, have two children, Sophie (7) and Harrison (2).

**Abstract**

This course will provide health care and aquatic health professionals a foundation of material for treating and working with the pediatric population in the aquatic setting. Emphasis will be placed upon translating functional motor development and skills training into the aquatic setting during treatment. Population-specific case studies will be incorporated into the presentation as means of demonstration for certain techniques. Current research will be included as to specific treatment techniques and populations.
Splish Splash!
Pediatric Motor Learning in the Aquatic Environment
Carrie A. Claverelli PT, MPT, CYT

How can you help but smile when you’re having SO MUCH FUN?

Introduction to Speaker:
• Senior Physical Therapist, Lakeway Aquatic Therapy and Wellness Center, Austin, TX 2007 to Present
• APTA Aquatic Section Presenter: Aquatic Physical Therapy’s Effect Upon Functional Head Control: A Retrospective Case Study Presented at: APTA CSM 2010 in San Diego, CA; Aquatic Summit 2010 in Colorado Springs, CO
Relevance... The nuts and bolts

Aquatic Physical Therapy interventions are designed to improve or maintain:

- Function
- Aerobic capacity/endurance conditioning
- Balance, coordination, and agility
- Body mechanics and postural stabilization
- Flexibility
- Gait and locomotion
- Relaxation
- Muscle strength, power, and endurance

More specifically for our pediatric patients...

- The aquatic setting provides a non-invasive, supportive, warm, and positive environment to address the fundamental foundational pieces of gross motor function and mobility including:
  - Head control
  - Trunk and postural recruitment
  - Tonal and reflexive movement management
  - Sensory stimulation/inhibition/modulation
  - Social, emotional and psychological influences

- Pediatric PTs have known for decades thanks to the studies of Bobath, etc. that in order to have carry-over, treatments must be functionally relevant and carried out in real-life settings.

Overview of functional motor development

"The traditional models of neural maturation and hierarchic control of the central nervous system are no longer adequate. The concepts of a dynamic systems approach to motor control need to be integrated into our understanding of motor development"

**Dynamic Systems Model**

- **Motivation**
- **Arousal**
- **Motor Plan**
- **Comparison Sensory Information with Sensory Model**
- **Dynamic Model/Neuroend**
- **Motor Coordination**
- **Sensory/Postural Synergies**
- **Motor Plan**
- **Musculoskeletal Dynamics**
- **Conditions**
- **Timing**
- **External Forces**

Adapted from Frank and Earl 1990.

**Translating the Model to Movement**

- Motor plans are translated from central pattern generators into movement by using body dynamics.
- Focal movements, postural synergies, and timing all contribute to the model.
- Sensory information is used to analyze the movement, i.e., the quality and result of the movement.
- The "evolution" of the system makes it dynamic, as well as the ability of the system to alter and choose the appropriate conditions:
  - Position in space
  - Base of support
  - Load
  - End goal

*An important piece of motor development is integration of the different sets of conditions to shape movement into something both skilled and functional.*

**Motor Learning: Birth to Age 3**

- In the Newborn, physiological flexion provides the basis for posture and random movements.
- In the older infant, primitive reflexes such as the Moro, startle, and Palmar Grasp are now used for shaping the posture prior to a desired movement.
- As dissociation develops, specifically in the arm, the infant moves more easily and sequencing of motor patterns becomes more prevalent—this provides the foundation for gait, reaching, and exploration.
Aquatic Interventions: Birth to Age 3

Pre-swimming skills
- Improves head control and UE/Trunk dissociation
- Inhibits tonal activation
- Increases midline awareness for weight shifting through extremities
- Breath control and respiratory support increased
- Repetition provides rhythm and sequencing for sensory processing/motor planning

Balance and Pre-Gait Exercise
- Allows for variances in weight-bearing and functional position depending upon surfaces
- Environmental compression provides additional sensory/tonal inhibition allowing for greater recruitment of postural control and trunk strengthening/midline awareness

Ah Ha! So that's where Midline is!

Motor Learning: The Young Child
- Increasing functional demands require greater emphasis upon integration of postural stability and postural control
- Maintenance of postural stability becomes less reliant upon visual cues and shifts to integration of vestibular and somatosensory inputs for environmental adaptation
- Ability to recruit, organize and adapt sensory information becomes paramount for completing functional tasks

Movement affects senses - senses affect movement
Adaptation depends upon experience and learning
Aquatic Interventions: Age 4 and Up

- Movement and Mobility
  - Functional transition training
  - Varying water depth offers endless options
  - Static vs. dynamic foundations
  - Postural and Core Muscular Facilitation
  - Kayaking and Stroke work
  - Top-down vs. bottom-up approach
  - Gait training
  - Aquatic rehab for the athlete

- Sensory Integration and Modulation
  - Desensitization via Compression
  - Rhythm and Sequencing
  - The visceral/GI piece of the puzzle

Case Study: Cerebral Palsy

"Brookie"

Age: 36 months
Diagnosis: Periventricular Leukomalacia “Cerebral Palsy”

Clinical Presentation:
Spastic quadriplegia, non-verbal child with little to no active cervical extension. Max-assist in all transfers and functional transitions. Hypoactive Moro and ATNR reflex not integrated. G-tube, possible left knee contracture.

PT Goals:
1. Increase functional independence in all transfers and transitions.
2. Increase head control in all functional positions.
3. Increase child’s ability to modulate sensory deficits to increase communication ability

Aquatic PT Intervention:
Once-weekly 60-minute aquatic PT sessions applied over a 9-month period. Utilized pre-swimming exercise, reflex integration and postural training using noodle and inflatable boat, gait and functional training while inclined, PROM and craniofascial techniques for soft tissue restrictions.

Functional Gains measured at PT Re-evaluation (after 9 months of PT):
1. CGA to min assist in rolling supine<>prone, CGA to min assist supine<>sit.
2. Time that child could maintain neutral head control in all functional positions doubled, tripled in standing.
3. Observed use of one and two word utterances more than doubled.
4. L knee AROM normal.

Comparative Video Clips: “Brookie”
Case Study: Torticollis

Baby H

Age: 6 months
Diagnosis: Torticollis with Plagiocephaly

Clinical Presentation:
Moderate to severe soft tissue contracture of R Sternocleidomastoid muscle with associated lateral mandibular translation, posterior L ear migration, scapular winging and poor postural cervical lordosis, L ear lateral. Global gross motor delay ~ 2-3 months at initial PT evaluation. Moderate plagiocephaly.

PT Goals:
1. Decrease R lateral muscle guarding/tension in cervical musculature.
2. Improve cranio-caudal postural symmetry for carry-over into functional transfers.
3. Patient to demonstrate age-appropriate gross motor skills.

Aquatic PT Interventions:
Two 60-minute PT sessions weekly incorporating pre-swimming and prone cervical activation exercises, reflex and protective reflex integration, neck strengthening exercises, functional transition training, cervical and paraspinal muscle stretches, cervical PROM/AAROM/AROM.

Functional gains as measured at PT Re-evaluation (3-4 months of PT):
1. Little to no lateral head tilt at rest.
2. Equal use of UEs/LEs during all functional transfers.
3. Crawling and creeping symmetrically observed by PT.
4. No gross motor delay per PDS.

*Patient fitted with cranial orthosis to correct plagiocephaly.

Case Study: Juvenile Rheumatoid Arthritis

Sarah

Age: 8 years-old
Diagnosis: Polyarticular Juvenile Rheumatoid Arthritis

Clinical Presentation:
Very active and athletic 8 year-old female with history of multiple Strep A primary infections within last 6 months, presents to PT with apparent rheumatic exacerbation in L hip, L knee, R ankle and R 5th finger MCP joints. Symptoms include increased pain, effusion, loss of joint mobility PROM/AROM, functional ADL and recreational ADL losses. Patient also has chronic constipation, appetite loss and history ADHD/sensory processing deficits. No history of previous injury to joints. Elevated SED rate and ARA – factor +. Patient has started on Rx NSAIDs x 3 weeks.

PT Goals:
1. Decrease pain and improve joint ROM.
2. Improve functional participation in sports/ADLs.

Aquatic PT Interventions:
Twice weekly 60-minute PT sessions incorporating compression and diving exercises, diving retrieval in 7-ft. depth using weighted letters, stroke and lap swimming, proprioceptive and balance uptraining, cardio and aerobic conditioning exercises, UE/LE stretches, craniofascial soft tissue mobilization.

Patient also counseled on dietary habits – began incorporating additional fruits and "Superfood" daily into her diet.

Functional gains as measured at PT Re-evaluation (3-4 months into PT treatment):
1. Normal joint mobility (A/PROM) with little to no pain during ADLs.
2. Improved sensory modulation and reported increased attention during school-related ADLs.
3. Patient returned to participation in soccer and martial arts as prior to exacerbation.
4. Resolution of constipation and return of full appetite.
In Conclusion...

• Physical therapy treatment in the aquatic setting provides a dynamic, challenging, safe and motivating environment to treat our pediatric patients
• Physical therapy treatment in the aquatic setting allows for faster and oftentimes more effective management of challenging sensory and perceptual deficits
• Treatment in the aquatic setting provides real-life carry-over of both land and aquatic-based locomotion skills
• Motor movement and acquisition of those skills necessary for mobility are acquired easily with less physical strain on the treating therapist/therapist assistant
• Functional returns following injury are achieved with less pain and difficulty
• Much fewer, if any emotional meltdowns occur during or prior to treatment
• EVERYBODY HAS FUN!

Pediatric Aquatic PT Research

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