

The Effectiveness of Aquatic Therapy for Children with Spinal Muscular Atrophy

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Introduction

In today's society, there exist many diseases that prevent children from reaching their full potential in terms of motor development. Not only do these diseases prevent full maturation as an individual, but also negatively impact a child's self-efficacy as they move through life. This is where intervention by physical therapists is extremely important. Intervention and therapy at a young age is necessary to improve a child's motor learning, motor control, and ultimately, their livelihood and outlook on life. In this paper, one of these diseases (Spinal Muscular Atrophy) will be examined and therapeutic suggestions will be made to help improve an affected child's quality of life.

What is Spinal Muscular Atrophy

Spinal Muscular Atrophy (SMA) is a neuromuscular disease that is characterized by the deterioration of alpha motor neurons. This disease causes general muscle weakness throughout the body that is a result of the denervation or loss of signal transmitted from the spinal cord to the muscles (Figure 1).

Normally, in an individual unaffected by SMA, the motor signal is transmitted from motor neurons in the spinal cord to muscle cells via the motor neuron's axon (Magill, 2011). However, in all forms of SMA, either the motor neuron with its axon or the axon itself is lost. Like many pediatric



Figure 1 – Spinal Muscle Atrophy is a debilitating process that results in an extensive loss of muscle mass and function (A.D.A.M. Medical Images, 2011)

diseases, SMA is inherited as a recessive disorder. In particular, SMA is caused by the deletion or mutation of the Survival Motor Neuron (SMN-1) gene (Salem & Gropack,

2010). Although its severity ranges from total muscular paralysis to mild muscle weakness, SMA is still extremely dangerous. According to Whiteshead et al., “SMA is one of the leading hereditary causes of infant mortality” (Whiteshead et al., 2002). There are three different types of Spinal Muscular Atrophy. Type I SMA is the most severe with a child never developing independent sitting; with this type, death usually occurs during the first two to three years of life. Children with Type II SMA are typically able to sit and stand, but unable to independently walk. Type III SMA is the least severe with general muscle weakness that oftentimes does not restrict walking at all (Salem & Gropack, 2010). Regardless of the type, one thing is clearly evident: management and intervention during a child’s early years are necessary in slowing the progression of the disease and preventing further complications.

Aquatic Therapy

Although there are many therapeutic strategies that could help slow the progression of SMA, aquatic therapy has been proven as the most effective mean to intervene physically and psychologically (Figure 2).

Increasing functional mobility, maintaining muscle strength, and preventing contractures and deformities are the focal points regarding physical therapy for children with SMA. There are a number of factors that contribute to the effectiveness of working in an aquatic environment. Aquatic therapy helps improve the

functional mobility of a child with SMA by assisting with flexibility and range of motion.

As a child is learning motor skills in the water, there is a constant resistance to



Figure 2 – A physical therapist helps a boy work on motor skills in a therapeutic pool (Easter Seals Disability Services)

movement that is greater than the resistance provided by air on land. Thus, as the child's body moves through the water, there is a constant force exerted on the body. This constant force allows slow, fluid movements that reduce the risk of injury while the child is still performing at their elastic capacity in the stress/strain relationship (Figure 3). The stress/strain relationship of human tissue is useful in determining the optimal way to practice for improvement in performance without risk of injury. By looking at the elastic and plastic regions in Figure 3, it can be

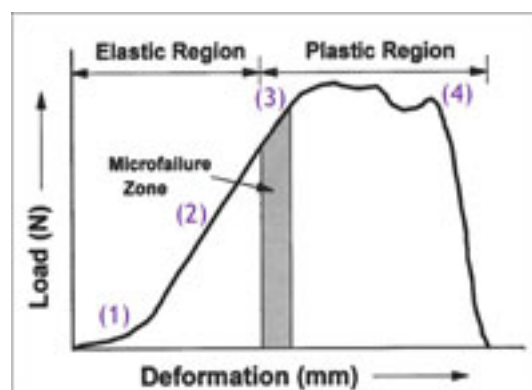


Figure 3 - Stress/Strain Relationship of Human Tissue (Norfolk Biomechanics Clinic, 2009)

concluded that motor skills should be practiced at the elastic capacity without pushing into the plastic region. Due to the high levels of load in the plastic region, human tissue is forced to strain (deform) past their normal limit. The result is broken bones and torn ligaments, something that we especially do not want when working with a child with SMA. By performing in water, a therapist can easily identify the stress/strain capacities because the movements are slow and controlled. Therefore, it is easy to work on range of motion and flexibility with a child with SMA in the water. It is now evident that outcomes for aquatic therapy are often related to the physical properties of water. As Salem & Gropack discuss in their case study of a child with SMA, the properties of water “facilitate antigravity movements allowing more freedom of movement” (Salem & Gropack, 2010). Also, water gives children an opportunity to try activities or movements that they would not be able to do on land. Other examples of physical benefits of working with a child with SMA in the water include strengthening muscles (by moving body or body parts through turbulent waters), reinforcement of already acquired movement skills

(by working on balance and coordination), and relaxation of muscles in the warmth of the water.

Although there is a long list of physical benefits of aquatic therapy, the psychological benefits are also extremely important. As the child begins to work on fundamental movement skills in the water (such as walking), there is a decreased fear of falling, which makes children feel comfortable in their surroundings. Water also gives children a sense of freedom and independence. Children with SMA oftentimes have a hard time holding up their body on land. In water, however, the child can move around freely without constraints (such as wheelchairs, or braces) allowing for a growth of independence. This cognitive growth also relates to self-efficacy, a predominant goal in any type of therapy (outlined in Figure 4). As the child learns to become comfortable in the

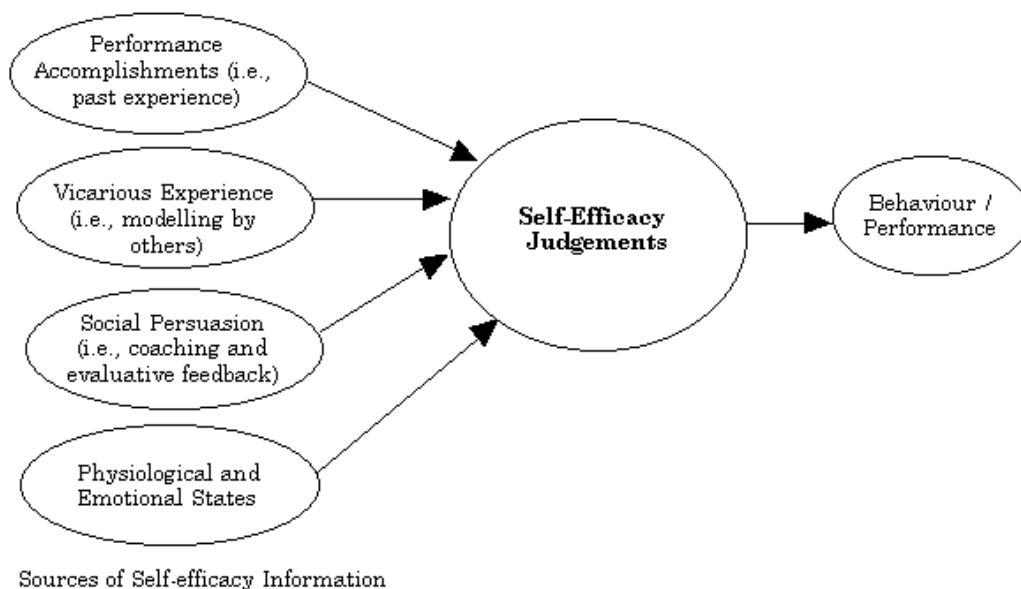


Figure 4 - Flowchart of Sources of Self-Efficacy

water, they can transfer this confidence to all facets of their life (i.e., if they feel comfortable walking in the water, then they are more likely to try to walk on land). This paradigm can be applied to a wide variety of skills as children become more confident in

themselves and more motivated to try something new. Finally, and arguably the most important psychological benefit, is the amount of fun children have in the water. If a child is having fun, they are more likely to be motivated to continuously engage in an activity. Thus, it is the responsibility of the therapist to ensure that the child is engaged in a fun environment at all times. Combining fundamental motor skills with fun and games is an important development strategy. Some examples include: blowing a Ping-Pong ball across the surface of the water to work on breathing, playing with a water noodle to increase flexibility and manual dexterity, and working on balance by sitting on a flotation device.

Conclusion

Children with Spinal Muscular Atrophy are often viewed as disadvantaged with regards to opportunities in life. However, this doesn't have to be the case. The aforementioned strategies can be applied by physical therapists in an aquatic environment to help children suffering with SMA. By implementing these strategies at a young age, children with SMA will be able to work on the motor control of their muscles as they learn and develop. It is important to note that children with SMA do have the ability to sense and to feel (as the sensory neurons are not affected). Also, their level of intellect is completely normal. This is important to keep in mind while working with children with SMA; they are regular children. They want to learn, they want to move around, and they especially want to have fun. With these considerations, a therapist can use an aquatic environment to help children with SMA reach their full potential as students, athletes, and as people.

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