Moving to the Next Level: Swimming Instruction for Persons with Disabilities

Gail M. Dummer, Department of Kinesiology, Michigan State University, dummer@msu.edu
Donald H. Watkinds, Peninsula Aquatics San Diego, watkinds@aol.com

Paper presented at the *37th National Adapted Physical Education Conference, Promoting Physical Activity for All*, California Association for Health, Physical Education, Recreation and Dance. San Diego, CA.

Introduction

Much of the available literature on adapted aquatics focuses on water orientation and elementary skills for beginning swimmers with disabilities. Our intention is to focus on instruction and coaching for more advanced swimmers with disabilities. Topics include adapting stroke techniques to address disability-related characteristics, teaching water entry/diving skills, using training equipment, and ensuring swimmer safety. The content of this presentation is based upon our experience and observations across several years of coaching swimmers with disabilities of all ages, from beginners to Paralympic world record holders.

Adapting Stroke Techniques for Swimmers with Disabilities

There are a number of excellent texts that describe effective techniques for performing each of the swimming strokes (e.g., Colwin, 2002; Counsilman & Counsilman, 1994; Hannula, 1995; Maglischo, 2003; Sweetenham & Atkinson, 2003). However many swimmers with disabilities experience limitations in neuro-musculo-skeletal function that require modifications to the "ideal" stroke techniques described by these experts (Dummer & Bare, 2001; Sherrill & Dummer, 2003; Prins & Murata, 2008). Our hints for coaching swimmers with various disabilities are described in Tables 1 through 7. However, we wish to begin this section with a caveat – teachers and coaches should not assume that all stroke technique problems are disability-related. Instead, many of the stroke technique problems observed amongst swimmers with disabilities are caused by lack of instruction and practice.

Table 1. *Swimmers with Hearing Loss*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Usually no physical reason for stroke technique problems.	Stroke technique problems may be associated with swimmer's inability to hear/understand coach instructions.	Use written instructions, gestures, demonstrations, and sign language in addition to verbal directions.

Table 2. *Swimmers with Vision Loss*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Inability to use vision to determine proper head position.	Poor horizontal alignment (head too high or low). Poor lateral alignment (head not returned to neutral position after breathing).	Use orientation and mobility techniques. Move swimmer's head through desired movements.
Inability to see demonstrations.	Inefficient stroke techniques.	Use rich verbal descriptions. Move swimmer's body through desired actions.
Reluctance to move hands and arms away from torso.	Inefficient stroke techniques, especially length of pull and distance of hand from torso during underwater pull.	Use resistance and assistive training such as hand paddles, stretch cords, and fins to help swimmer experiment with propulsion movements. Teach arm movements on swim bench.
Inability to see end of pool and related fear of collision.	Stroke technique deteriorates and speed decreases as swimmer approaches end of pool.	Use tappers, sprinklers hanging from backstroke flags, or other methods to notify swimmer about end of pool. Teach swimmer to use stroke counts to estimate length of pool. Use padding in swim cap.

Table 3. *Swimmers with Cognitive Disabilities*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Usually no physical reason for stroke technique problems.	Stroke technique problems may be related to poor understanding or memory of coach instructions.	Use simple 1-part and 2-part directions, gradual introduction of new skills, and frequent review of instructions.

Table 4. *Swimmers with Dwarfism*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Short stature, arms, and legs.	Greater form drag (increased ratio of cross-sectional area to height). Limited ability to achieve streamlined position, especially with arms.	Although it is not possible to modify height or limb length, usually improvements in streamline are possible.
Short arms and legs.	Limited ability to develop propulsive pull or kick, thus poor distance per stroke.	Increase stroke rate. Maximize distance per stroke using sculling movements during pull.
Short arms.	Poor body roll associated with an arm stroke that usually has a short catch, wide pulling pattern, short finish, wide straight arm recovery, and poor lateral alignment.	Increase core strength, especially muscles that contribute to body roll. Maximize distance per stroke using sculling.
Possible hip contractures (usually not permanent).	Limited range of motion when kicking. Increased leg drag.	Increase core strength, especially hip extensors.
Spinal stenosis and possible lordosis	Legs "go numb", especially when swimming butterfly.	Increase core strength, especially abdominals and hip extensors.

Table 5. *Swimmers with Amputations and Limb Deficiencies*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Parts or all of arms and legs are missing.	Asymmetrical, unbalanced stroke technique. Compromised body roll in long axis strokes.	Increase core strength, especially muscles that contribute to body roll. Swim against stretch cords to identify asymmetries and gaps in propulsion.
Single-leg amputation	Asymmetrical kick. Possible difficulty attaining good streamline.	Center kick behind body rather than same-side hip. Experiment with different kicking patterns (e.g., 4-beat with 2-right then 2-left) or use dolphin kick.
Double-leg amputation	Limited propulsion from kick. Excessive drag caused by low hips and legs.	Experiment to find best way to kick with stumps. Experiment with effect of different head positions on body position.
Double-arm amputations	Limited or no ability to scull.	Use "paddle-wheel" motions, stressing arm pressure against the water and a faster stroke rate.

Table 6. *Swimmers with Spinal Cord Injury, Spina Bifida, and Other Lower Limb Impairments*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Limited hand function, especially in quadriplegia.	Difficultly maintaining optimal hand shape and hand pitch.	If possible strengthen affected muscles. Emphasize high-elbow pull that allow forearm to act as extension of hand.
Limited arm and trunk strength and mobility, especially in quadriplegia.	Poor body roll associated with a arm stroke that usually has a short catch, wide pulling pattern, short finish, wide straight arm recovery, and early breathing.	If possible strengthen core muscles that contribute to body roll. Emphasize sculling actions across the longest possible distance with hands moving under center of gravity. Encourage swimmer to breathe at end of same side pull.
Limited leg function and mobility. Hip, knee, and ankle contractures as a result of long-term wheelchair use.	Little or no propulsion from kick. Excessive drag caused by low hips and legs.	If possible strengthen core muscles that help to hold hips and legs near water surface. Encourage kicking if possible. Experiment with effect of different head positions on body position. Use a pull buoy, leg floats, or stretch cords (not allowed in competition). Note that hip contractures help to hold the hips and legs near the surface when swimming on the back.
Contractures and range of motion limitations.	Poor ability to streamline. Increased drag.	Use range of motion exercises, relaxation exercises, and physical therapy interventions to minimize contractures.

Table 7. *Swimmers with Cerebral Palsy, Stroke, and Head Injury*

Disability Characteristic	Effect on Stroke Technique	Coaching Hints
Unwanted movements because of persistent postural reflexes, spasticity, or athetosis.	Poor body roll. Asymmetries in pulling and kicking movements. Truncated arm pull with short entry and short finish. Difficulty breathing in front crawl stroke.	Use resistance training (e.g., hand paddles, stretch cords, fins) both in and out of water to help develop better feel for desired movements. Extensive repetition of drills and desired movements.
Limited hand function, especially with more severe disability.	Difficultly maintaining optimal hand shape and hand pitch.	Use relaxation and imagery to minimize unwanted flexor muscle tone. Emphasize high-elbow pull that allow forearm to act as extension of hand.
Contractures and range of motion limitations.	Poor ability to streamline. Increased drag.	Use range of motion exercises, relaxation exercises, and physical therapy interventions to minimize contractures.
Hemiplegia (limited use of one side of the body).	Asymmetries in stroke technique. Problems with horizontal and lateral alignment.	If action causes more drag than propulsion, consider using one arm or one leg. Maintain unused limb in streamlined position.
Diplegia (affects legs more than arms or trunk). Limited use of legs.	Little or no propulsion from kick. Excessive drag caused by low hips and legs.	If possible strengthen core muscles that hold hips and legs near water surface. Encourage kicking if possible. Experiment with effect of different head positions on body position. Use a pull buoy, leg floats, or stretch cords (not allowed in competition). When leg function is severely compromised, consider not kicking.

By now it should be obvious that the teacher, in collaboration with the swimmer, must be willing to experiment with stroke technique to identify the best possible solutions to disability-related limitations in stroke technique. Three principles are especially helpful in this regard:

1. **Minimize drag**. Drag (resistance) refers to water forces that cause the swimmer to slow down. In this formula, D refers to drag, Cd to coefficient of drag (a number that expresses the relationship between the swimmer's body shape and the flow/viscosity of the water), d to water density, A to cross-sectional area, and V to velocity.

$$D = \frac{(Cd)(d)(A)(V^2)}{2}$$

The swimmer has the most control over A, the cross-sectional area comprised of any body surface that is facing forward when swimming. To reduce cross-sectional area swimmers can: (a) *streamline* to make the body shape as long as possible from fingertips to toes and as tapered as possible with hands and feet together; (b) achieve good *horizontal alignment* with head, shoulders, hips, knees, and feet all parallel to the water surface regardless of depth under the water; (c) achieve good *lateral alignment* with little or no sideways movement of

the body; and (d) use *shoulder/body roll* when swimming freestyle or backstroke to reduce cross-sectional area, center propulsive forces under the center of mass, center arm recovery over the center of mass, and use the large muscles to develop propulsive forces.

2. **Increase propulsion**. The most important propulsion skill is *sculling* (Colwin, 2002; Counsilman & Counsilman, 1994; Hannula, 1995; Maglischo, 2003; Rutemiller, 1991). The fastest, most efficient scullers use a *hand pitch* or *angle of attack* of about 40° to the direction of movement. Although they may not be conscious of their efforts, efficient swimmers change hand position several times during an arm pull. At different times during a single arm pull, the hand may be pressing downward, upward, outward, or inward. Efficient scullers have a good "*feel for the water*".
3. **Improve physical fitness**. Swimmers benefit from increased core strength by improved body roll, ability to transfer forces from one side of the body to the other, and ability to maintain good horizontal and lateral alignment. Adequate joint range of motion helps the swimmer to execute different stroke techniques, and adequate muscular strength and endurance facilitate effective propulsion.

Teaching Water Entry/Diving Skills

Most swimmers with disabilities are capable of learning to dive, even if they have limited or no leg strength and mobility. The sitting dive is usually the first step in the progression for teaching diving (Figure 1) because it starts with the swimmer's hands, head, and body close to the water, and because there is little chance of injury from "belly-flopping". The next steps are a kneeling dive, tip-in dive, and standing dive. Regardless of step, the diver should be encouraged to look at the point of entry, have the arms streamlined overhead with hands together, and enter the water in a hands-to-toes sequence (hands, then head, then shoulders, then hips, then legs). Swimmers can use a similar progression when learning to dive from starting blocks in competitive swimming settings, but they may need assistance from the coach to step onto the starting block and to assume a balanced starting position.

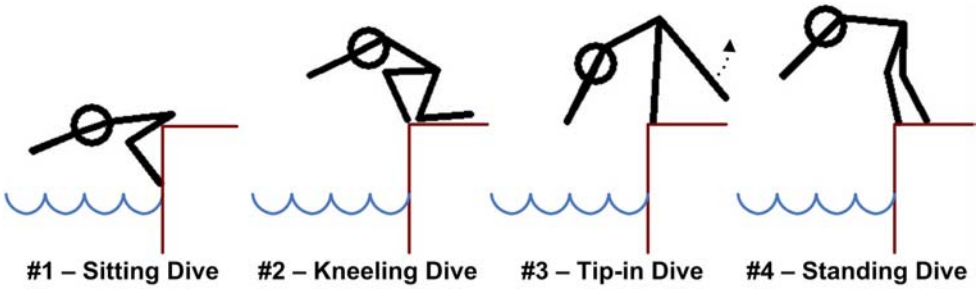

Figure 1. Progression for Teaching Diving

Some swimmers with vision loss and some swimmers with physical disabilities may need disability accommodations when entering the water. Swimmers who are deaf typically can dive with no problem, but may require hand movements or a light flash as a starting signal in competitive arenas.

- **Swimmers with vision loss**. Swimmers with vision loss often are fearful of diving into the water, especially in the beginning stages of learning. To experience diving from the perspective of a blind person, the teacher can cover her/his goggles with tape or line the goggles with waxed paper. Anyone who tries this exercise will quickly learn that the blind swimmer must be able to trust the teacher about water depth, absence of hazards, etc. Teachers can also use a tapping device to splash the water where the swimmer is expected to dive or jump so that the swimmer can orient to the noise.

- **Swimmers with physical disabilities**. Swimmers with physical disabilities may choose to start from a standing, kneeling, or sitting position on the starting blocks or on the pool deck. Some of these swimmers will need assistance from another person to attain the starting position, but always the swimmer should be responsible for initiating and performing the actual dive. Some swimmers with physical disabilities choose to start in-the-water. If needed, another person can assist by holding the swimmer's wrist (front start) or feet (backstroke start) until the starting signal is given. Of course the helper must simply let go of the swimmer at the start, without providing any propulsion.

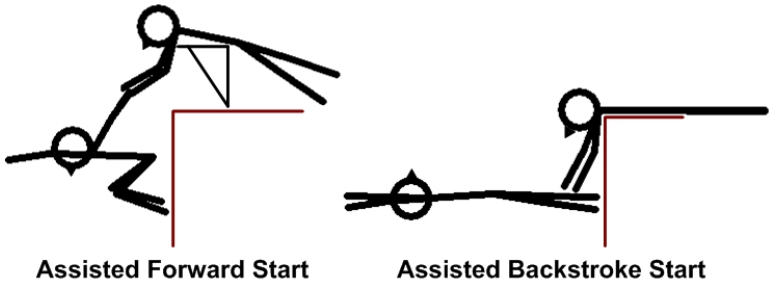

Figure 2. Assisted Starts

Using Training Equipment as Teaching Aids

- **Flotation devices**. Flotation devices such as life jackets, kick boards, swim noodles, inflatable arm cuffs, leg floats, jog belts, pull buoys, and head/neck floats can be very helpful in attaining a horizontal body position and supporting the body while learning stroke techniques. Some hints: (a) choose flotation that fits the swimmer's body, allows freedom of arm and leg movements, and provides an optimal amount of flotation; (b) gradually wean the swimmer off the flotation toward independent swimming; and (c) do not treat flotation gear as safety equipment.
- **Kickboards and fins**. Kickboards help the swimmer to isolate the legs when learning strokes or when working on leg strength and endurance. Kickboards have the advantage of providing flotation and permitting comfortable breathing. The swimmer should place hands along the sides of the kickboard. A face-in-the-water position promotes good body position and breathing practice. Fins are used to help develop feel for the water, to develop muscular strength and endurance, to give the swimmer some forward momentum while working on arm propulsion, and as speed-assisted training.
- **Pull-buoys and hand paddles**. Pull-buoys (also called leg floats) help the swimmer to achieve a good body position and to isolate the arms when learning strokes or when working on upper body strength and endurance. Hand paddles help to achieve a feel for

the water and develop upper body strength (swimmers with hand amputations can use breaststroke fins as paddles). Swimmers should avoid overtraining with hand paddles because of the potential for injury. Using hand paddles that are about the size of the swimmer's hands is another way to help avoid injury.

- **Stretch cords**. Stretch cords can be used as a form of resistance training when swimmers are asked to swim against the cord. Such resistance training is especially effective for swimmers with cognitive disabilities who may not understand the concept of "pull as hard as you can". Use of stretch cords can also help the swimmer or coach to diagnose "dead spots" in the stroke where there is a lapse of propulsion. Stretch cords can also be used for speed assisted training. Regardless of purpose, stretch cords should never be used if frayed or damaged. Consider using safety cords that have a safety cord inside the rubber tubing.
- **Backstroke flags and lane lines**. The purpose of lane lines is obvious, namely giving the swimmer a clear path in which to swim. Swimmers are taught to use a circle pattern within the lane (stay to the right of the black line) to help avoid collisions. Overhead backstroke flags and a corresponding color change in the lane lines alert the swimmer that the finish is five yards/meters away. Avoid lane lines with sharp edges when coaching blind swimmers.
- **Tappers**. A tapping device is a long pole with a soft end that is used to tap a blind swimmer on the head or shoulder (swimmer's preference) as notice that s/he is approaching the end wall of the swimming pool. Many swimmers use a long white cane with a tennis ball at the end. Swimmers who want more advance notice of the end of the pool use a telescoping pole tipped with a soft object. Some coaches have experimented with an overhead sprinkler hose positioned at the backstroke flags as an alternate way to notify the swimmer about the finish.
- **Pace clock**. Pace clocks are used to specify send-off intervals in a swimming practice, or to help swimmers time themselves during practices. Some digital pace clocks have beepers that may be especially useful for swimmers with vision loss.

Ensuring Swimmer Safety

Teachers and coaches should help prevent drownings, injuries, and health risks by checking the pool for hazards, supervising swimmers for safety even when lifeguards are present, teaching swimmers to be safe, maintaining first aid/CPR and other safety credentials, and setting an example of safety-conscious behavior. A thorough knowledge of the *emergency action plan* at each facility is absolutely essential. Teachers and coaches should also be aware of the following disability-related concerns.

- **Seizures**. The biggest risk associated with seizures is swallowing water. This can happen in a few seconds and can lead to death, so supervise closely. If a seizure does occur, follow standard first aid procedures. If the seizure occurs in the water, implement the emergency action plan without delay.
- **Atlantoaxial instability**. AAI refers to ligamentous laxity between the 1st and 2nd vertebrae, a condition that occurs in some people with Down syndrome or dwarfism. The spinal cord may be injured if a person with AAI forcefully flexes or extends the neck. Special Olympics recommends no butterfly and no diving for persons with AAI.

- **Lack of sensation**. Persons with spinal cord injuries typically lack sensation in the lower body. Therefore they are prone to developing pressure sores from sitting in one position too long, as well as injuries to the lower limbs associated with bumps or scrapes. Persons with pressure sores should not swim until the wound is healed. To avoid injury, swimmers should wear water shoes when doing dry-land work, when transferring to the pool, and in some cases while swimming.
- **Poor balance or poor vision**. Slippery and uneven surfaces are especially problematic for swimmers who have vision loss or impaired balance, as well as those who use mobility equipment such as crutches, canes, or walkers. Keep pool decks as uncluttered and dry as possible to prevent injury.
- **Diabetes**. Require swimmers with diabetes to establish a routine of drinking water and eating snacks that promotes good performances and helps to avoid diabetic incidents.
- **Shunts**. Avoid diving, underwater swimming, and blows to the head.
- **Hypothermia**. Persons with quadriplegia are prone to hypothermia. Avoid overexposure to cold water and/or have the swimmer wear a wet suit/vest. After swimming use towels, blankets, parkas, or warm showers for warmth.
- **Sun sensitivity**. Some persons with disability (e.g., albinism) cannot tolerate sun exposure, and others have difficulty applying sunscreen because of limited mobility. These swimmers should consider using "rash shirts" and/or seeking help to apply sunscreen.

Conclusion

In this presentation we discussed many technical aspects of teaching and coaching swimmers with disabilities. However, a positive attitude is more important than technical knowledge – teachers and coaches must demonstrate a willingness to try, as well as acceptance and respect for the swimmer. Ways to show acceptance and respect include collaborating with the swimmer to determine best techniques for the individual, establishing high standards for skill performance, and using creativity and problem-solving skills. Remember to treat them as the athletes and skilled swimmers that they are.

References

Colwin, C. M. (2002). *Breakthrough swimming*. Champaign, IL: Human Kinetics.

Counsilman, J. E., & Counsilman, B. E. (1994). *The new science of swimming*. Englewood Cliffs, NJ: Prentice Hall.

Dummer, G., & Bare, J. (2001). Including swimmers with a disability: A guide for coaches. *Coaches Quarterly, 7*(2), 18-26. Also available online at www.usaswimming.org (click on swimmers, then disability, and then coach brochure).

Hannula, D. (1995). *Coaching swimming successfully*. Champaign, IL: Human Kinetics.

Maglischo, E. W. (2003). *Swimming fastest*. Champaign, IL: Human Kinetics.

Prins, J., & Murata, N. (2008). Stroke mechanics for swimmers with permanent physical disabilities. *Palaestra, 24*(1), 19-25.

Rutemiller, B. (1991). The sculling sensation. *Swimming Technique*, *28*(2), 14-23.

Sherrill, C., & Dummer, G. M. (2003). Adapted aquatics. In C. Sherrill (Ed.), *Adapted Physical Activity, Recreation and Sport* (6th ed., pp. 454-483). Champaign, IL: Human Kinetics.

Sweetenham, B., & Atkinson, J. (2003). *Championship swim training*. Champaign, IL: Human Kinetics.