The Mechanics of Modern BACKSTROKE Swimming
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Backstroke rules allow any type of arm and leg movement; the only requirement being that the body must remain on the 'back'. The most efficient methods of swimming propulsion on one’s back make use of rotation about the body’s long-axis and a transfer of force from the surface of the hand/arm, through the shoulder, to a stable platform that is the trunk. A flutter kick (except following the start and turns when a dolphin kick is used) assists with trunk stability and streamlining the body position. Most ‘high performance’ coaches strongly emphasize body position and streamlining and an efficient transfer of force (generated off the pulling surface of each arm) through the kinetic chain. In addition, the 15m of underwater dolphin kicking off the start and each turn represents a significant opportunity for backstrokers to improve their performance. Therefore, the mechanics of modern backstroke involve a high level of skill, endurance, and power in developing one’s stroke, but also includes special attention to powerful and efficient underwater dolphin kicking.

Streamlining and Body Position

In theory, streamlining is similar to freestyle, the ideal body position is as close to horizontal as possible. This maintains a smooth flow of water over/around the body. Resistance is increased if the kicking action lifts the knees out of the water or if the hips are allowed to drop. Head position will also have great affect on streamlining. If the head is held too high or tilted excessively forward or back, or if lateral movement is allowed, the trunk may deviate from the horizontal. These actions result in a body position that increases frontal resistance. The head should be kept comfortably aligned with the body in the horizontal plane, independent of body roll. A smooth rolling action of the trunk, approximately 40-45 degrees to either side of horizontal, will assist in rotating the shoulders for both arm recovery and application of propulsive force. Rotation about the long-axis of the body primarily serves to position the hand/arm for propulsion, but also serves to lift the shoulder out of the water and streamline the trunk.
Because each arm recovery is made using a high, out of water motion, there are considerable downward forces acting against the horizontal positioning of the body. Therefore, a strong 6-beat kick must be used to keep the hips near the surface, as compared to freestyle swimming where a 2-beat kick is often used. The flutter kick used in backstroke swimming relies upon the upbeat as the propulsive phase. Hip extension moves the leg downward (leg recovery) from the horizontal until the foot reaches its lowest point. The knee bends to position the lower leg and foot and then a combined hip flexion and knee extension drives the foot to the surface, ending in a whip-like action. As the foot drives upward it also angles inward slightly, finishing with the toes at the surface. Ankles are extended to increase the surface area of the leg. Correct mechanics of the kick will work smoothly with the roll of the hips and trunk. Viewed from underwater, the swimmer’s body position remains streamlined throughout the successive phases of arm stroke (i.e. propulsion) and recovery.

**Armstroke – Propulsive Phase**

The pulling pattern is best described as being shaped like an "S' on its' side. Stroke-rate will be a determining factor in how ‘curved’ or how ‘narrow and straight’ the S-pattern becomes. Swimmers using a slower stroke rate tend to add more depth to their stroke pattern and swimmers using a faster stroke-rate may appear to have a very linear pulling pattern. Efficient arm technique begins with a straight and extended arm; hand entry is made in line with the shoulder.

As the hand enters the water, the shoulder will roll substantially with the entry arm. At this point the hand is turned so that the palm is facing outward, allowing the hand to enter on its little finger edge to minimise resistance and maintain the momentum developed during the arm recovery. The hand moves downward and somewhat outward until it achieves the desired depth. Pressure increases on the
hand as it begins to move into its’ pulling pattern; this is usually defined as the catch position. There is some debate amongst experts regarding where the catch actually begins. Some believe that lift forces begin to act as the hand moves downward, others argue that the catch begins when drag forces take affect. Each argument may be correct, as the depth attained, distance the hand travels away from the body, and angle of the hand all affect the magnitude and direction of the propulsive force generated.

From the catch position the hand sweeps up to its’ closest point to the surface at mid-stroke. This action may be combined with a slight insweep due to increasing elbow bend. As with freestyle, the elbow must be held in a position, relative to the hand, so that it does not slip. If the elbow leads the hand, maximum pressure will not be maintained on the hand-forearm surface. From the point where maximum elbow bend is achieved, the hand pushes toward the feet. This action is simultaneous with the rotation of the hips and trunk so the hand is pushing down as the hips (on that side of the body) roll up. Hand-speed increases throughout the second half of the pulling pattern. During the final third of the stroke pattern the wrist flexes so the hand may continue to apply pressure on the water. When the arm is fully extended the palm turns inward and the hand begins to move upward as the result of shoulder lift; the arm is now into the recovery phase. Slight right-left differences in symmetry are common and do not necessarily represent a problem. There are also differences in finishing depth; some swimmers will finish level with the hip and others significantly deeper.

Armstrokce – Recovery Phase

During the recovery the arm remains straight, yet relaxed, as it swings upward in an arc directly above the shoulder. Arm recovery is assisted by rotation of the trunk around the long-axis of the body. When the arm reaches a vertical position and begins its downward arc, the hand should rotate so that the palm is facing outward in preparation for a smooth and streamlined hand entry. The timing of each underwater stroke and recovery keeps the hands at opposite sides of the stroke cycle when the entry is made. Rolling into the catch helps to conserve momentum generated by the straight arm-swing recovery. Breaks in timing occur when the shoulders do not roll sufficiently or the head moves laterally. Any hand/arm movement across the long axis of the body will result in a lateral transfer of force through the trunk.
The Importance Underwater Dolphin Kicking

There is the potential that 30% of a backstroker’s race may be spent underwater using a dolphin kick. Coaches must plan their training appropriately to develop maximum potential in this area. This involves a skill component in executing efficient dolphin kicking that is both powerful and keeps the body streamlined. The second component is developing a high level of fitness to maintain the dolphin kick through the allowable distance. Coach Leigh Nugent makes the observation that effective underwater dolphin kicking may take one of two forms:

- A very fast kicking action that is generated in the upper leg, but demonstrates a fast ‘whip’ action through the legs and feet. The upper body remains streamlined to allow the trunk to act as a platform for the resulting summation of forces through the lower body. OR

- A strong body action that involves the abdominal and lower-back muscles and progressively sends the kicking impulse through the lower body.

Regardless of the variation of kicking technique, all top backstroke swimmers must remain streamlined and stable through their upper body. This means that any up-and-down movement of the head or arms is detrimental to the smooth flow of water over/under the body. The head must remain firmly between the arms. Swimmers often overlap the hands to tighten their streamlining. Some swimmers may find dolphin kicking in a supine position presents a problem in
keeping water out of the nose. By equalizing the pressure in nose through controlled exhalation (or using a nose clip) this discomfort can be eliminated.

Successful coaches have used a number of creative training methods to develop the required muscle strength, power, and stamina to maintain a fast dolphin kick. Fins (mono or individual) usually play a major role in developing an underwater dolphin kick. Drills that emphasize kicking at constant depth, at speed, are also introduced into a backstroker's program. Sprint sets of underwater kicking are essential because they emphasize speed per distance (kicking distance underwater at slow or moderate speed is useless).