Coaching Applications

Is it Time to Consider a Different Way of Swimming Backstroke?

Ernest W. Maglischo
1970 Lazy Meadow Lane
Prescott, AZ 86303 USA
ewmaglischo@cox.net

Abstract. For several years many of the world’s best backstroke swimmers, both male and female, have been performing this stroke in a unique way which may be superior to the traditional way that backstroke has been taught. In this paper, I want to describe the various ways this unique style of backstroke is being swum and its possible benefits.

Introduction.

The backstroke arm stroke has traditionally been taught with two propulsive phases, a pull and a push. The graph in figure 1 demonstrates the location of those propulsive phases during the underwater arm stroke as well as the transition period albeit between them. The graph is for Kristina Egerszegi, former World Record Holder and Olympic Champion in the backstroke events. It was constructed from data collected in competition at the 1991 World Swimming Championships where she won the gold medal in both backstroke races.

Figure 1. A forward velocity graph for Kristina Egerszegi, multiple Olympic Gold Medalist and former World Record Holder in the 100 m and 200 m backstrokes. This graph was drawn from data collected at the 1991 World Championships. It shows her velocity during the left underwater arm stroke. It also identifies the location of two propulsive phases, the pull and push. Modified from: J. Cappaert and B.S. Rushall. (1994). Biomechanical Analyses of Champion Swimmers. San Diego: Sports Science Associates. P. 2.3
The forward velocity of her center of mass was calculated and plotted for her left arm stroke. The first propulsive phase, the pull, occurs as she flexes her arm and brings it up toward her body, during the middle of her underwater arm stroke, and the second, the push, takes place as she extends her arm back and in toward her thigh. Let me describe the velocity pattern produced by her arm stroke in greater detail.

The graph begins when her left arm enters the water. At that time, she has just completed the underwater arm stroke with her right arm. Consequently, the velocity peak you see at the time her left arm enters the water is the result of propulsion from her right arm stroke. Her forward velocity decelerates after her right arm releases the water and it will continue to decelerate until she reaches the catch position with her left arm. That occurs at about 0.2 secs. on the graph and is the point where she begins to accelerate her body forward with her left arm stroke.

The catch is the beginning of the two propulsive sweeps that take place during her underwater arm stroke. In the first of these, she sweeps her arm up and back. This phase of the arm stroke is referred to by some as the “pull”, although I prefer to call it the “”.

After a slight period of deceleration between 0.5 and 0.6 secs. on the graph, she executes the second propulsive sweep by extending her arm back and down. Most refer to this stroke phase as the “push” while I call it a “downsweep”. Photos of her pull or upsweep and push or downsweep are shown in figure 2.

![Figure 2](image-url). Kristina Egerszegi’s left arm stroke. The photo on the left shows her left arm when it is midway through the pull or upsweep, and the photo on the right shows her left arm starting the push or downsweep.

In the next section, I will describe how many modern-day elite backstrokers are using three propulsive sweeps, rather than two, during their underwater arm strokes. The third propulsive sweep actually occurs after the downsweep, during a stroke phase that has generally been considered the beginning of a backstroker’s arm recovery.
The Three-Peak Backstroke

A center of mass velocity graph for a three-peak backstroke is shown in figure 3. The swimmer is Martin Zubero, former World Record Holder and 1992 Olympic Gold Medalist in the 200 m backstroke. The graph begins when his right arm enters the water. His velocity at that point comes from the final propulsive phase of his left arm stroke. When his left arm releases the water, his velocity drops to approximately 1 m/sec during the following 0.17 secs. as he positions his right arm for its catch at point #1. Point #2 indicates his peak forward velocity during the first propulsive sweep of his right hand, the pull or upsweep. From there he transitions into the next propulsive sweep, a downsweep, at point #3. His peak velocity during the downsweep, occurs at point #4, when he extends his arm down and back. The downsweep is followed by another transition at point #5, which is, in turn, followed by a third, and final, propulsive sweep , at point #6, I have termed this final propulsive phase of the backstroke arm stroke a “final upsweep” The graphs ends when his right hand leaves the water. His forward velocity decelerates at this time because he is recovering his arm.

The photos in figure 4 demonstrate how Zubero performs the final upsweep with his right arm. The yellow arrows extend to the point on his forward velocity graph represented by each photograph.

He has completed the downsweep in the photo on the left and is about to begin the final upsweep. Notice, in the middle photo, that he changed the direction his palm
was facing from down to back so he could immediately begin pushing up and back against the resistance of water with his extended arm and hand as he is shown doing in the middle photo. The final upswing ends as his hand approaches his thigh, at which time, he releases pressure on the water, turns his palm in toward his thigh and recovers his hand and arm out of the water (see photo on extreme right of figure 4).

Figure 4. Martin Zubero’s final upswing with his right arm.

You can see from the velocity graph in figure 4, the final upswing can be very propulsive. This is probably because swimmers are able to make a large paddle for pushing back against the water, by using both the underside of their forearm and the palm of their hand. It may also be that they are able to move their hand at a higher velocity, and produce more power when their arm is extended instead of flexed. This would be because the hand is further from the shoulder, which is the center of rotation for the arm.

Let me describe some other aspects of the three-peak backstroke that differ from the traditional two-peak stroke. This will be done using side and front views of Martin Zubero’s stroke pattern, which are illustrated in figure 5.

The first item I want to discuss is the “catch”.Traditionally the ideal backstroke catch has been thought to take place deep or moderately deep in the water. In addition, it has traditionally been preceded by a long sweep down with an extended arm after the swimmer’s arm enters the water. Swimmers were generally taught to turn their palms down toward the bottom of the pool during this motion (see photo on the left in figure 6). This type of catch was in vogue when we thought sculling
was propulsive. The belief was, (1) that a deep catch would allow for a longer and more propulsive upsweep and, (2) that it encouraged backstrokers to roll from side to side and thus, travel through the water with less drag.

![Figure 5.](image)

**Figure 5.** *Front and side view backstroke stroke patterns for Martin Zubero’s right arm stroke. These stroke patterns were modified from data collected at the Olympic Games. From: J. Cappaert and B.S. Rushall. (1994). *Biomechanical Analyses of Champion Swimmers*. San Diego: Sports Science Associates p. 2.8*

Most modern-day backstrokers, and in particular three-peak backstroke swimmers are now making their catch much nearer the surface of the water, and they are rolling from side to side much less, only 20 to 30 degrees to each side (Mark, 2013). As a consequence, they are “catching” earlier and can start pushing back against the resistance of the water very quickly after their hand enters the water (see points #1 and #2 on the side and front view stroke patterns in figure 5).

The photographs in figure 6 show the difference between the “deep” catch and the modern-day “shallow” catch. The first two photos illustrate the difference in depth between the deep and shallow catches. The swimmer in the photo on the left is using a deep catch and the swimmer in the middle photo is catching much earlier with his hand and arm closer to the surface, and out to the side more. The final photograph on the right shows an excellent top view of Missy Franklin, 2012 World Record Holder and Olympic Champion in both the 100 m and 200 m backstrokes, just after making her catch. Notice that her arm has moved out to the side considerably after entry and that it is flexed and close to the surface of the water.

Most elite backstroke swimmers no longer sweep their extended arm down deep into the water to make the catch as the swimmer in the left hand photo of figure 6 is doing. Instead, they make the catch very quickly after their hand enters the water by flexing their hand at the wrist and their arm at the elbow. At the catch, their hand should be facing back, with fingertips pointing to the side like the swimmers in the middle and right hand photos in figure 6, and, their arm should be flexed at the elbow. Additionally, the swimmer should not roll to the side any more than is necessary to facilitate this shallow catch.
Figure 6. The photo on the left shows a swimmer who is using a deep catch. The middle photo shows Martin Zubero making a catch with his left arm. The photo on the right is an excellent overhead view of Missy Franklin just after making the catch with her right arm.

While many backstroke swimmers try to apply propulsive force immediately after their hand enters the water, it is more efficient to wait until their arm is in a backward-facing position before doing so (see middle and right hand photos in figure 6).

The velocity graph in figure 4 demonstrated that Martin Zubero’s body did not begin to accelerate forward until after his arm was flexed. This suggests that backstroke swimmers do not apply propulsive force immediately as their arm enters the water but, instead, take the time to flex their arm and position it so they can push back against the resistance of the water with the palm of their hand, and the undersides of their forearm and upper arm when they make the catch and execute the final upsweep that follows.

This method of making the catch is demonstrated in the photos and accompanying forward velocity graph of Martin Zubero in figure 7. The two photos show him at the time his left arm enters the water, the photo on the left, and at the point where he makes his catch, (see right hand photo). You can see on the velocity graph that his forward velocity decelerates during the period of time between when his arm entered the water and it reached the catch position. It usually takes 0.1 to 0.2 seconds after entry, for swimmer’s to position their arms for the catch, or, to put it another way, about 1/4 of the way through their underwater arm stroke. A shallow catch, as shown in the right hand photo in figure 7, should be employed, by backstrokers whether they are swimming with a two-peak or three-peak propulsive stroke because it reduces the time they will decelerate between the end of the propulsive phase with one arm and the point where they initiate propulsion with the other, the catch.
Figure 7. The backstroke catch for Martin Zubero’s left arm stroke.

The Upsweep. The pull or upsweep begins at the catch. It is the first propulsive sweep of the arm. At one time it was taught as a long upward and inward motion of the hand and arm, which started with the swimmer’s arm fully extended and ended as his/her hand approached the surface of the water near the ribs.

Many of today’s world-class backstrokers are using a much shorter upsweep with an emphasis on moving water back instead of sweeping up with their hand instead of sculling it up. Following the shallow catch, they direct their hand back against the water (see point #2 in the side view stroke pattern in figure 6). They also do not flex their elbow to any greater extent during this motion. Instead, they flex their arm at the elbow while making the catch (see right hand photo of Zubero in figure 7) and it does not flex very much more during the upsweep.

The upsweep in backstroke is an example of the same shoulder adducting movement I described in an earlier paper for the breaststroke, butterfly and front crawl arm strokes. Backstroke swimmers direct their arm almost horizontally back against the water with the hand traveling up only a small amount due to rotation of the arm at the shoulder joint. Consequently, they push their arm almost directly back against the water and not up, as traditionally taught. This is probably because stroking back more and up less enables backstroke swimmers to exert propulsive force against the water with both their upper and lower arms, as well as the palm of their hand during the upsweep. The photos in figure 8 show the upsweep of Martin Zubero’s left arm.

There is one important difference between the shoulder-adducting upsweep in backstroke and the corresponding sweeps in the other three competitive strokes. Most modern-day backstrokers have eliminated the inward portion of the shoulder
adducting movement and, because of this, do not bring their arm in close to their side before they transition to the next sweep. Although the upsweep will be shorter when done in this way, there should not be any significant loss of propulsion because swimmers have retained the most propulsive part of the movement.

The right hand photo in figure 8 shows Zubero near the point in his upsweep where he begins to transition to the next propulsive phase, the push or downsweep.

![Figure 8. The upsweep for Martin Zubero’s left arm stroke.](image)

**The Downsweep.** Photos of Martin Zubero’s push or downsweep with his left arm are shown in figure 9, together with a velocity graph that demonstrates its effect on his forward propulsion. As he completes the upsweep, he turns his palm so it faces back and pushes against the water by extending his arm in a backward and downward direction. The front view stroke patterns in figure 5 shows that he sweeps his hand almost directly back for most of the distance, and not back and in, as is traditionally taught.

The downsweep ends when his arm is completely extended, below his body and away from his side (see stroke pattern in figure 6 and the right hand photo in figure 9). Extending the arm back and down should allow backstroke swimmers to use their forearm to push water back for a longer period of time during the downsweep, whereas, pushing the arm in toward the side at this time would eliminate the forearm as a propulsive surface almost immediately because the swimmer would be pushing water in toward his leg/her. Perhaps even more importantly, it enables them to finish the downsweep with their hand and arm below their body and away
from their side. This will position their arm for a longer and more propulsive third sweep, the final upsweep (see figure 9).

![Figure 9](image)

**Figure 9.** Martin Zubero’s push or downsweep during his left arm stroke.

**The Final Upsweep.**

The final upsweep is the third propulsive phase of the underwater arm stroke. Most three-peak backstroke swimmers have learned to do this sweep intuitively. In fact, they may not even be aware it is propulsive, thinking instead, that they are recovering their arm to the surface. Photos of the final upsweep of Zubero’s left arm are shown in figure 10.

![Graph](image)

Swimmers should rotate their palm to a fingers-down position as they complete the downward portion of the preceding downsweep so they can transition smoothly and quickly into the final upsweep (see the left hand photo in figure 10). From there they should sweep their extended arm up and in toward their thigh, using the palm and the underside of the forearm to push back against the resistance of the water.

You’ll notice that these photos are not in sequence with those of his left arm stroke that were displayed in figures 7, 8 and 9. This is because Zubero traveling in the opposite direction in figure 10. In figures 7,8 and 9 he is swimming the first 50 m of the 100 m backstroke. He is swimming the second 50 of that race in figure 10. The sequence in figure 10 was chosen because the propulsive motions he executes with his left hand and arm during the final upsweep can be seen more clearly. He is in the first portion of the final upsweep in the photo on the left in figure 10.
The final upsweep should end, and the arm recovery should begin, as his left hand approaches his thigh. At that time, he should turn his palm in and release backward pressure on the water. This should be done before his hand passes his thigh on its way out of the water so it (his hand) can exit the water on edge, with thumb leading. This will reduce water resistance as his hand and arm leave the water. The photo on the right in figure 10 shows Zubero releasing the water and starting the recovery of his left arm.

Backstrokers should not carry the final upsweep to the surface of the water. They should release pressure and start their recovery before their forearm and hand begin pushing up excessively against the water as Zubero has done in the right hand photo in figure 10. If they attempt to push against the water for too long a time during the final upsweep, the upward motion of their arm will push the shoulder of their stroking arm underwater. Consequently, as a teaching point, they should be cautioned to terminate this stroke phase and begin their arm recovery before that happens.

In the past, many coaches have noted that good backstrokers are often able to hyperextend their arms at the elbow. This was considered an advantage for performing the recovery correctly. It may be, however, that the ability to hyperextend the arm at the elbow joint allows for a more effective final upsweep. Three-peak backstroke swimmers who can hyperextend their arms at the elbows should be able to start the final upsweep earlier and push back against the water.
with the underside of their forearm and the palm of their hand for a longer time (see the photos of Martin Zubero right and left arm strokes in figures 4 and 10).

**Other Three-Peak Backstroke Styles.**

My observations indicate that modern-day backstrokers, (and many from the past), are swimming the three-peak stroke in several different ways. The first of these was described earlier and illustrated in figure 10 with photos and a forward velocity graph of Martin Zubero. In this method the upsweep and final upsweep are the major propulsive phases and the downsweep is abbreviated to allow more time for a substantial final upsweep.

In the second method, swimmers execute a upsweep and downsweep which are similar in length and propulsion to the traditional two-peak stroke. Then they sweep their hand up, in and back for a short distance during the final upsweep. When the final upsweep is done in this way, it is probably best communicated to swimmers as an “inward scull” because of the brevity of its inward and upward motions, even though the purpose is to push back against the water with their hand. In the few forward velocity graphs available, this method of executing the final upsweep/inward scull delivers a short but very powerful acceleration of forward velocity.

Former U.S. Olympic backstroke swimmer, Lea Loveless Maurer, is shown completing the downsweep and positioning her right arm for a short final upsweep/inward scull in figure 11. Notice that her right arm is extended and away from her body, rather than in close to her thigh. From there, she will execute the final upsweep/inward scull by directing her extended arm in, up, and back while pushing back against the resistance of the water with the palm of her hand, and for a very short time, the under side of her forearm.
Figure 11. Lea Loveless Maurer finishing the push or downsweep in backstroke with her left hand and transitioning to the final upsweep/inward scull with it. Lea was a member of the 1992 U.S. Olympic swim team, winning a good medal in the 4 x 100 medley relay and a bronze medal in the 100 m backstroke.

The photo in figure 12 shows 2012 Olympic Champion, Missy Franklin, completing her right underwater arm stroke with what also appears to be a final upsweep/inward scull. Although it is difficult to be certain from this angle, the backward-facing position of her palm suggests she is probably applying propulsive force to the water with it. A swimmer with her skill would be expected to have her palm facing inward toward her thigh to reduce water resistance if she was merely recovering her arm at this time.

Figure 12. A photo of Missy Franklin performing what appears to be a final upsweep/inward scull near the end of her right arm stroke. Photo courtesy of Christopher Sullivan.

Hours of observing video of elite backstroke swimmers in competition suggests to me that the majority of swimmers who use a three-peak backstroke, appear to be performing the final upsweep or inward scull in the manner just described and not in the way it was performed by Martin Zubero, (see figures 4 and 10). That is understandable considering, as mentioned earlier, they have probably added the final upsweep/inward scull intuitively and unknowingly after they were taught to swim backstroke with a traditional two-peak stroke.

The third method by which some backstrokers appear to propel themselves through the water with a three-peak stroke, is by eliminating or abbreviating the upsweep and executing a long downsweep and a long final upsweep.

As mentioned, the upsweep may be missing or greatly abbreviated so that the first major propulsive peak would be a long downsweep that starts at the catch and ends when the swimmer’s arm is extended below and wide of his/her hip. Of course, when they eliminate the upsweep they are actually performing a two-peak arm stroke, albeit, one that is different from the traditional two-peak style that was described earlier in this paper (see figure 1).

A swimmer who abbreviates the upsweep but does not eliminate it completely, before starting the downsweep, will exhibit a three-peak stroke. That swimmer
would rotate his/her palm up for a very short time following the catch, before turning it down again, during the downsweep. As mentioned, this stroke will have three-peaks with the upsweep as the least propulsive of these.

It would be nice to know which of these methods will generate the greatest forward velocity. However, there is not enough quantitative data available to make that determination at the present time. Until such time, as more stroke patterns and forward velocity graphs are available for swimmers who use these various non-traditional styles, of swimming a three-peak backstroke, the exact methods, they employ to apply propulsive force and the relative effectiveness of those methods will remain unresolved.

Some thoughts on the three-peak backstroke.

I think a backstroke that is swum with three-peaks could be superior to a two-peak style for several reasons. These involve the propulsive force that can be generated during the final upsweep as well as the way it encourages a different and better timing for the arm stroke. Let me describe the potential advantages of the three-peak backstroke in greater detail.

The average velocity per stroke cycle is the measure that determines how fast an athlete can swim. The average velocity per arm stroke and the distance traveled are the key components of fast swimming. Any method, whether it be the addition of a third propulsive peak, an increase in the velocity of one or both of the two traditional propulsive peaks, or an increase in the length of one or both of those propulsive peaks should improve a swimmer’s performance markedly. That said, it seems probable that greater stroke length and average velocity per stroke are more likely to occur through the addition of a third propulsive peak, especially one that has the potential to increase forward velocity to a greater extent than the traditional upsweep and downsweep.

The unique style of the final upsweep may increase velocity more than the traditional upsweep and downsweep. All of the forward velocity graphs that are available for three-peak world-class backstrokers during competition demonstrate that they achieve a greater forward velocity during the final upsweep than they do during the preceding upsweep or downsweep (Cappaert & Rushall, 1994). For example, Jeff Rouse achieved a forward velocity in excess of 2 m/sec during the final upsweep of his right arm stroke but never reached a velocity greater than 1.9 m/sec during any other propulsive phase of either arm stroke. Martin Zubero’s peak velocity was approximately 2.4 m/sec during the final upsweep but did not exceed 1.8 m/sec at any other time ().

Although data from only two subjects is far from compelling, they suggest the possibility that pushing against the water with an extended arm during the final upsweep (see figure 10) may be more effective for increasing forward velocity than the upsweep or downsweep of the traditional two-peak backstroke. This may be, as
mentioned earlier, because the swimmer can apply more force with his entire arm when it is extended and/or because his hand can achieve a higher velocity at the end of his extended arm.

**Because of what was just said, a three-peak backstroke with a long final upsweep may be preferable to a shorter, inward scull, type of sweep.** As mentioned earlier, there are a greater number of world class backstroke swimmers who use a short final upsweep in the manner of an inward scull than those using a longer more substantial final upsweep similar to the one depicted for Martin Zubero in figures 4, 7 and 9. Regardless, this observation should not be considered evidence that a short final upsweep/inward scull is the most effective way to swim a three-peak backstroke.

In my opinion, the fact that a smaller number of swimmers are using a long final upsweep, like the one Martin Zubero uses does not disqualify his style as potentially the most effective way to swim a three-peak backstroke. It is very likely that the traditional two-peak style that most backstrokers are taught at a young age has discouraged many from developing a longer final upsweep and, consequently, a higher average velocity per stroke cycle. Nevertheless, what was just said is entirely speculation on my part and not proof that a long final upsweep should be adopted without a period of trial and error.

**The use of a final upsweep or inward scull may allow swimmers to use a higher stroke rate in races.** The final upsweep is executed with a straight arm, therefore, as indicated earlier, greater hand velocity can be attained during that portion of the arm stroke. This should, in turn, result in a faster stroke rate and, greater forward velocity. There is some anecdotal evidence to support this observation.

The stroke rates used by modern-day backstrokers have increased more than those of any other competitive stroke in recent years. Could that be because more backstroke swimmers are now using three-peak strokes?

Craig and Pendergast (1979) were among the first persons to measure stroke rates. They did so for swimmers at the 1976 U.S. Olympic Trails. Stroke rates for female backstroke participants averaged 46 stroke cycles/minute (range = 46 to 47) in the 100 m event and 42 stroke cycles/minute for the 200 distance while the stroke rates for males averaged 46 stroke cycles/minute. (Range = 45-47) and 39 stroke cycles/minute (range = 39-40) respectively in the shorter and longer backstroke events. Craig and others (1985) then repeated this study for male and female backstroke swimmers at the 1984 U.S. Olympic trials. Their data showed that the average stroke rates for U.S. backstrokers were similar to those they calculated in 1976. Stroke rates were usually within one to two stroke cycles of the 1976 averages for both events and for both sexes. Apparently, not much had changed about the backstroke in the intervening decade. Something did change in the next decade, however.
An analysis, by the author, of swimmer’s stroke rates and stroke lengths at the 1996 Olympic Games and the 1998 World Swimming Championships showed, that the range of stroke rates for female backstrokers had increased to between 48 and 56 stroke cycles/minute in the 100 m event. The stroke rates for female 200 m backstrokers did not demonstrate the same upward trend, however. That range was 42 to 44 stroke cycles/minute. The stroke rates for male backstroke competitors demonstrated a similar pattern. They increased to between 48 and 53 stroke cycles/minute in the 100 m event but remained at 42 to 44 stroke cycles/minute in the 200 m event during the period between 1985 and 1998 (Maglischo, 2003).

So, between 1976 to 1998, stroke rates increased noticeably in the 100 m backstroke event while in the 200 m backstroke they tended to stay the same or even decrease slightly. It is also of interest to note that female backstrokers were able to increase their stroke rates with no noticeable decrease in stroke length in the 100 m backstroke event while the stroke length for male backstroke swimmers tended to decrease in the 100 m event. Average stroke lengths for women were 1.94 m/stroke cycle (range = 1.91 to 1.97) in the 100 m event in 1976 while the range of stroke lengths for females in the 1996 Olympic Games and the 1998 World Championships was 1.75 to 2.03 m/stroke cycle in the 100 m event. For men, competing at the 1976 U.S. Olympic Swim Trials, the average stroke length in the 100 m backstroke was 2.24 m/stroke cycles (range = 2.21 to 2.27). The range of stroke lengths for male backstrokers competing at the 1996 Olympic Games and the 1998 World Championships was 2.05 to 2.20 m/stroke cycle in the 100 m event.

Of course, it could be argued that today’s world-class 100 m backstroke swimmers are stroking faster because they catch earlier and do not sweep their hand up very much during the upsweep, and or, because they spend more time kicking underwater and less time swimming on the surface. These changes probably do account for the fact that backstrokers have been able to increase their stroke rates with no significant loss of stroke length. Nevertheless, the higher stroke rates of modern-day swimmers could also be a result, at least in part, of greater hand velocities because they have incorporated a propulsive final upsweep with a straight arm. What cannot be explained is why the same trend toward increased stroke rates was not found for 200 m backstroke swimmers.

**The three-peak backstroke may be more continuous than the two-peak style.**

Another possible advantage in favor of a three-peak backstroke may be that swimmers decelerate less between arm strokes. In the traditional two-peak backstroke, the hand of the swimmer’s recovering arm usually enters the water when the other hand is finishing its downsweep. After that it requires approximately 0.25 secs. until the swimmer makes the catch with the overhead arm and begins to accelerate his/her body forward. The other arm will be recovering up to the surface during most of this period and, with only the kick for propulsion, the swimmer’s body will decelerate rapidly during this period so that the loss of velocity
may be in excess of 0.6 to 0.8 m/sec during this period of deceleration between strokes.

Videos suggest that both the length of time spent decelerating and the loss of velocity between strokes can be shortened considerably by using a three-peak backstroke. Swimmers who utilize a third propulsive phase in their backstrokes will be accelerating their bodies forward with a final upsweep or inward scull during a sizable portion of the time their hand is traveling up through the water in what otherwise would have been a recovery movement. Consequently, the addition of a propulsive final upsweep should shorten the time swimmers decelerate between the end of the propulsive phase of one stroke and the beginning of forward propulsion with the other arm. In the traditional two-peak backstroke a swimmer’s forward velocity would be decelerating from the time their stroking arm was fully extended at the end of the downsweep until the recovering arm reached its catch position to begin the propulsive phase of the next underwater arm stroke. Whereas, three-peak backstrokers would continue to accelerate their bodies forward during a portion of the time their stroking arm was traveling to the surface.

The, small amount of data available, only 3 subjects, indicates that the period of deceleration between the propulsive peak from the final upsweep or inward scull of the other arm and the catch of the stroking arm was in a range between 0.10 and 0.15 secs. for the three-peak backstrokers that have been analyzed (Cappaert and Rushall, 1994). On the other hand, the period of deceleration is usually greater than 0.2 secs. for traditional two-peak backstroke swimmers. Thus a competent three-peak backstroke swimmer should be able to maintain a faster stroke rate and a higher average velocity per stroke due to the combination of, (1) a higher ending forward velocity for each stroke occasioned by a third propulsive phase that takes place during the time a traditional two-peak backstroke swimmer would normally be decelerating, and (2) a shorter period of deceleration between that stroke phase and the catch of the other arm.

To finish this paper, I have included a YouTube video of Martin Zubero swimming a three-peak backstroke. This video shows him competing in the 100 m backstroke at the 1992 Olympic games. Click on the screen and you will be taken to the video so that you may observe his unique three-peak backstroke in real-time and slow motion.
Figure 13. A YouTube video of Olympic Gold Medalist, Martin Zubero swimming the 100 m backstroke at the 1992 Olympic Games.

REFERENCES:


