BUTTERFLY TECHNIQUE

In his sixth technical article, Nick addresses body position (movement), legs, arms, breathing, timing (coordination) and stroke rate (tempo) for butterfly.

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Palms of the hands drive out the water with a quick return of the face to the water by the time the hands travel past the ears following an explosive breath.

THE 'BODY POSITION' (MOVEMENT)

Butterfly is the second fastest stroke with only freestyle being quicker. However, it could be argued that it is the third most efficient, sitting behind freestyle and backstroke. Confusing perhaps but the principles of physics are always with us irrespective of the stroke. This article looks to address the stroke mechanics of butterfly, the most modern of all the four competitive strokes, deriving from breaststroke in the 1930s.

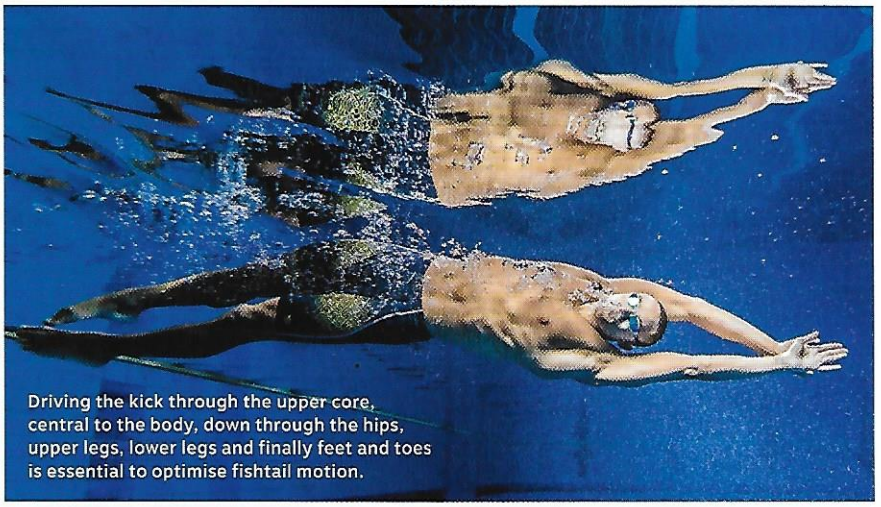
When swimming butterfly, the body position can be seen as angled head to feet from the water surface yet moving in an undulating pattern through the short axis of the hips. The body flows smoothly like a long wave across the surface. The head leads the stroke with a quick intake of breath in order to return the face to the water surface as soon as possible with a straight neckline and direct downward vision to support optimal movement. The body moves continuously, rather like a long fishtail movement with strong inertia through the stroke.

Inertia is the resistance of any physical object to any change in its speed (velocity); this includes changes to the object's (swimmer's) speed or direction of motion. The objective here is for the swimmer's body to keep moving in a straight line at a constant speed and this aspect in particular is fundamentally referred to as inertia. Fatigue and fluctuation in stroke rate (tempo), stroke count and stroke length will affect speed, either positively or negatively.

Newton in his first law of motion states an object not subject to any external force moves at a constant velocity. On Earth, inertia is 'masked' by the effects of friction and air resistance and with water being 816 times thicker than air, we find a real battle with nature. Focus on a strong flinging arm recovery to help drive the flow of the stroke. Avoid pushing the backs of hands out the water prior to recovery of the arms as this will kill momentum.

LEGS

A constant fluid kicking action is essentially fishtail motion with feet and knees close together kicking as one unit. The kick action should start from the upper core central to the body and drive down through the hips, upper legs, lower legs and finally feet and toes. The thinking for the application of the kick is to drive the feet up and down in a vertical motion. However, as there is constant forward shifting, there should be a sensation across the lower legs, from the knees to the feet, of forcefully pushing the water back to the wall from which you have departed. Relaxed feet with toes pointed is highly important, indeed, the force of the water can create bowing of the feet and in-toeing where the drive is maximised due to optimal mobility of the joint, tendons and muscles. Always drive the kick from the upper core, not the hips or the knees. FINA rulings, although somewhat confusing, in relation to the butterfly turn and underwater positioning and kicking, states that the swimmer must drive from the wall and rotate onto the breast prior to any kick action as written here in SW 8.1 "From the beginning of the first arm stroke after the start and each turn, the body shall be kept on the breast. Underwater kicking on the side is allowed. It is not permitted to roll onto the back at any time, except at the turn after the touch of the wall where it is permissible to turn in any manner as long as the body is on the breast when leaving the wall".



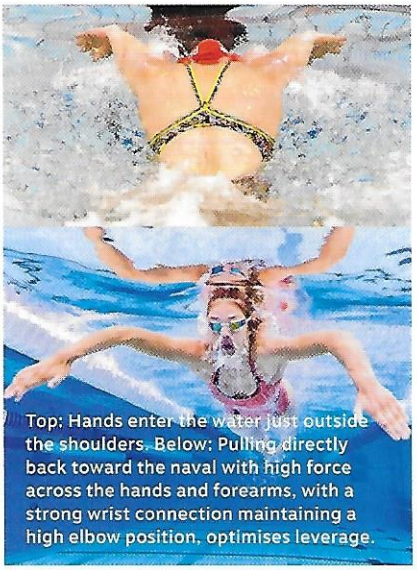
Driving the kick through the upper core, central to the body, down through the hips, upper legs, lower legs and finally feet and toes is essential to optimise fishtail motion.

ARMS

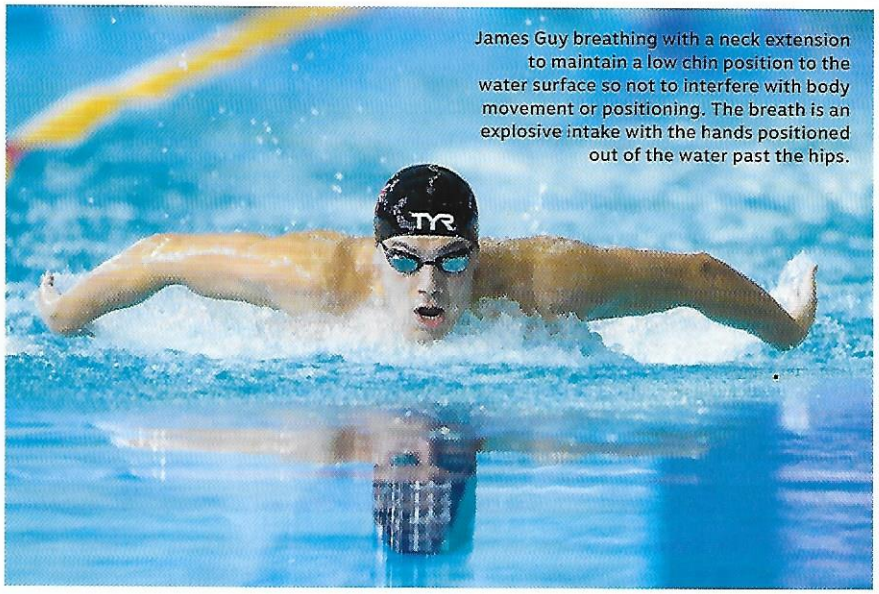
Focus on allowing the palms of the hands to drive out the water past the hips; this should happen during the downbeat of the kick action to ensure a flinging arm recovery. It is essential to demonstrate fast hand speed during the recovery phase of the pull with strong use of the deltoid muscles of the upper arms. During this recovery phase, through strong use of the deltoid muscles of the upper arms, the backs of the hands drive forward with the thumb relatively close to the water surface. Often we see a very slight bend of the elbow to allow the hands to stay closer to the water surface and reduce some unnecessary shoulder tension.

As the hands travel past the ears, the wrists rotate moving the back of the hands to fingertip entry into the water. Variables are noted of course where swimmers demonstrate a thumb entry. However, if this technique is used then swimmers must immediately rotate the wrists when the hands are in the water to optimise and demonstrate an efficient catch, or anchor set position as it can be called. Swimmers then drive a high elbow leverage pull with the palms of the hands pushing back and towards the naval rather like the letter V and often referred to as the V pull as we now move away from the traditional keyhole pull. If this is not achieved, then the pull sweeps too wide losing time, strength and speed.

Hands enter the water just outside the shoulders. However, once again we see variables. In the majority, a position of 11 o'clock and one o'clock is considered a blueprint for best practice. Pulling directly back toward the naval with high force across the hands and forearms with a strong wrist connection maintaining a high elbow position optimises leverage. Whilst hand entry is just one element of the butterfly pull, an incorrect hand entry can lead to a poor catch, resulting in many common faults thereafter. Finding your hold on the water is simply called the 'catch' phase. Find this as quickly as possible once the hand is in the water to create a powerful pull.



Top: Hands enter the water just outside the shoulders. Below: Pulling directly back toward the naval with high force across the hands and forearms, with a strong wrist connection maintaining a high elbow position, optimises leverage.


James Guy breathing with a neck extension to maintain a low chin position to the water surface so not to interfere with body movement or positioning. The breath is an explosive intake with the hands positioned out of the water past the hips.

BREATHING

A regular breathing pattern is required for butterfly and may vary across the differing individual race events of 50m, 100m and 200m. At the highest level, elite athletes can now keep a fixed head position with no breath for the 50m race event to reduce resistance and optimise efficiency.

The taller the athlete, the bigger the lung capacity. However, swimmers must have strong breathing muscles to utilise the volume. Breathe with a neck extension to maintain a low chin position to the water surface so not to interfere with body movement or positioning. The breath is an explosive intake with the hands positioned out of the water surface past the hips. Breathing out through the mouth, when the face is back in the water, rather than through the nose allows for quicker exhalation and can therefore be more easily coordinated if a more immediate intake is required.

Breathe out when the head and face return to the water with a straight neckline aligned with the spine. Focus on engaging the breathing muscles and develop deeper diaphragmatic breathing, simply referred to as tummy breathing. It has taken until the first decade of the 21st century for breathing muscles to be considered an integral part of the conditioning process and now very much part of elite sport.

TIMING (COORDINATION)

The timing and coordination of butterfly is typically seen as two kicks to every one pull, whereby the feet kick down during hand entry and kick down again as hands drive to exit the water past the hips. At the end of the downbeat of the kick, hands will have exited the water with palms facing upward. There is no dead spot in butterfly as the stroke should be well coordinated with constant high pressure through the water during a well-timed and connected kicking and pulling action. Fast hand speed during arm recovery is very much part of the process of a well-timed and well-coordinated stroke technique, with a quick return of the face to the water with downward vision to support the flow and undulation of the stroke.


The feet kick down during hand entry.

STROKE RATE (TEMPO)

Stroke rates can be taken in real time and can be taken in strokes per minute on a stopwatch. Technology software is now very much part of the process for competitive swimmers as pictured in the data table, where two good examples of a successful male and female national standard youth swimmer are recorded with respectful times of 55.08 and 62.65 seconds for the 100m Butterfly. Within the data table, the stroke rate (SR) is excellent for male and female. Note, although there are more strokes during the second 50m, the distance travelled per stroke is quite similar due to efficiency and strength endurance. The dive start advantage and the occurring under-waters are the main factors for less strokes during the first 50m. The split

differential is 3.24 and 3.67 seconds respectively. This is world class when compared to perhaps the greatest swimming final in the history of our sport, 'Phelps v Cavic', Beijing 2008. The split differential for Cavic was 3.74 seconds and he only lost the race due to the lack of a core aquatic skill, streamlining into the finish where his head was up looking for the wall due to a long reach / drift into touch. Head up simply kills speed! Finally, maintain full stroke length when trying to increase or achieve an appropriate stroke rate for the differing race distances. Do not over reach. Chopping the stroke short to increase stroke rate will not equate to a more effective performance.

Male data table

Reaction (s)	Entry		Breakout			15m (s)
	Distance (m)	Time (s)	Distance (m)	Time (s)	Velocity (m/s)	
0.72	3.00	1.09	12.00	4.37	2.75	6.16

Length	Stroke			Velocity (m/s)	Turn Time	Breakout		Distance	Time
	Count	Avg Dist	Rate			Time	Dist		
1	22.0	1.73	61.25	1.93		4.37	12.00	50m	25.92
2	25.0	1.68	60.27	1.71	8.15	4.27	8.00	100m	29.16

Length	25m		50m		100m		Cumulative Time
	Time	Diff	Time	Diff	Time	Diff	
1	11.51		25.92				11.51
	14.41	2.90					25.92
2	14.22	-0.19	29.16	3.24	55.08		40.14
	14.94	0.72					55.08

Female data table

Reaction (s)	Entry		Breakout			15m (s)
	Distance (m)	Time (s)	Distance (m)	Time (s)	Velocity (m/s)	
0.81	2.50	1.17	12.50	6.42	1.95	7.59

Length	Stroke			Velocity (m/s)	Turn Time	Breakout		Distance	Time
	Count	Avg Dist	Rate			Time	Dist		
1	22.0	1.70	57.22	1.70		6.42	12.50	50m	29.49
2	27.0	1.54	58.82	1.51	12.89	5.62	8.50	100m	33.16

Length	25m		50m		100m		Cumulative Time
	Time	Diff	Time	Diff	Time	Diff	
1	13.69		29.49				13.69
	15.80	2.11					29.49
2	16.30	0.50	33.16	3.67	62.65		45.79
	16.86	0.56					62.65

Complexities

The medium of the water and its density is the biggest hurdle and battle to overcome. Always revert to the core aquatic skill streamlining. Lack of mobility in joints and muscles result in complexities as this restricts optimal movement. Check out the head position first, throughout all aspects of the stroke technique. Use the methodology BLABT (body position, legs, arms, breathing, timing) to ascertain if the head is actually causing issue across any of these sub areas. Technique changes require a swimmer to process a great deal of information derived from the principles of physics, specifically biomechanics and hydrodynamics, and it will require tens of thousands of repetitions of each skill to develop autonomy.

Common faults

A slow intake of breath sees the body angled head to feet for too long, causing increased frontal resistance. Breathing too early also sees the body angled too steep and increases resistance. Pressing down with the hands and arms to gain lift to breathe early is a common fault and results in swimming up a mountain! Sweeping too wide with the pull as the subject moves forward increases resistance. A weak downbeat of kick action as the hands exit the water has a negative result on the flinging arm hand speed recovery. Swimmers must constantly talk to themselves using cues to allow an action to be more deliberate.

Good practice summary

Swim with the whole of the body not just the arms and the legs through engagement of the core. Swimmers need to feel there is a long wave action, a fluid constant flow with the head leading the stroke after a powerful intake of breath. Return the face to the water surface as soon as possible with a straight neckline and direct downward vision to support optimal movement. The kick action should start from the upper core central to the body and driven down through the hips, upper legs, lower legs and, finally, feet and toes. Focus on allowing the palms of the hands to drive out the water past the hips – this should happen during the downbeat of the kick action to ensure a flinging arm recovery. Breathe with a neck extension to maintain a low chin position to the water surface so not to interfere with body movement or positioning. Breathe out when the head and face return to the water with a neutral head position and a straight neckline aligned with the spine. At the end of the downbeat of the kick, hands will have exited the water with palms facing upward. ST