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Competitive swimming turn start techniques teaching and training guidance optimization diagnosis

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ABSTRACT

Competitive swimming is a kind of sports event that lays equal important on physical ability and technique, reasonable and scientific technical features are powerful guarantee to promote competitive swimming results. Competitive swimming is a sports event that is well received by masses; the event is composed of starting, turning, on passage swimming, reach to the ball and sprinting as well as others five parts, because athletes have many individual differences in adopting same technical movement, the paper states and analyzes competitive swimming technical diagnosis optimization process, makes corresponding theoretical basis for improving athletes technical rationality and scientificity. In the paper, by analyzing and researching on lots of competition data, it carries on systematically researches on turning and starting techniques that trouble Chinese swimming athletes for a long time, in the hope of generating reasonable and scientific suggestions for Chinese competitive swimming event training.

KEYWORDS

Competitive swimming; Technique diagnosis optimization; Starting technique; Turning technique.

INTRODUCTION

Swimming event has a profound history, starting from international swimming federation was founded in 1908 till now, through above one hundred years development, such event has become a sports event of greater impacts in Olympic Games, and is also one of important events that every country snatches gold in Olympic Games. Modern swimming event competition becomes increasingly fierce, winning or losing in competition only has 0.01 second difference, as long as any one technical motion has unscientific factors in whole competitive swimming, it can generate huge impacts on competition performance ranking. Swimming event result is mainly up to physical ability and technique two aspects, physical ability is basis, but technique is guarantee. Nowadays, swimming event rapidly develops, short distance swimming event world record almost gets closer to human body extreme ability, each technique perfection will play key roles in excavating bigger potential[1]. Domestic and foreign countries have carried on widely and deepen analysis and research on competitive swimming technical features. The paper carries on theoretical and data analysis of competitive swimming technique diagnosis optimization and turn start techniques, in the hope of providing certain theoretical basis for Chinese swimming training.

For competitive swimming technique diagnosis optimization and turn start technical features analysis and researches, lots of people have made contributions, just these people contributions let competitive swimming to make considerable development, some scholars have put forward their opinions, from which Yang Hong-Chun etc. (2012) by analyzing and comparing championships event start reaction time, starting 15m time data, research thought that grab technique would become history, all athletes should master new pattern starting block track start technique with booster[2]; Lin Hong etc.(2006) applied biomechanics, fluid mechanics, program designing and other research methods, provided a multiple diagnosis method for swimming technical research, put forward swimming technical training and technical research operable sequencing model, which ensured key athletes technical training and technical research[3].

On the basis of formers research theories, the paper studies on competitive swimming technique diagnosis optimization and turn start technique, in the hope of making contributions to Chinese competitive swimming operation event undertakings.

COMPETITIVE SWIMMING MOVEMENT TECHNICAL ANALYSIS

Movement technique is a process; it has features of quantity and quality. Quantity feature includes kinematics and dynamics features, it can make quantitative testing, analysis and evaluation by corresponding instrument equipment and methods ways; quality feature includes rhythm, accuracy and range as well as other features, which can use coaches and athletes to make qualitative analysis and evaluation on them [4]. Whether swimming technical analysis can correct, really reflect athlete technical status and level is foundation of diagnosing athletes techniques, is also important basis to propose improvement and perfection suggestions as well as countermeasures. Swimming athletes training, competition technical analysis and technique and tactics indicator analysis.

In Figure 1 No.1-31 respectively represents: competition swimming training competition technique video; starting technique; block technique; leaving block technique; flight entry technique; turning technique; technique of reaching to wall; touching technique; push-off technique; diving and kicking technique; connective on passage swimming; technique of terminal point reaching to wall; sprinting; reaching to wall and touching; on passage swimming technique; body posture; leg technique; breathe technique; arms technique; whole-stroke swimming technique; athlete competitive swimming technical analysis report; swimming competition data statistics; pedaling out of block(s); starting(s); turning(s); on passage swimming(s); distance per stroke(m/time); stroke frequency(time/min); sprint(s); swimming speed(m/s); And competition technical and tactical indicators analysis report.

Though competitive swimming techniques mainly include starting, turning, on passage swimming, reaching to wall and sprint as well as others five techniques, athletes have many differences

in the same technical movements, it has certain individual specialty. Just in view of technical perspective, partial technique and technique details tend to decide competitive swimming level high-low. By making technical analysis of every athlete, targeted at athlete each technical link, movement structure, stroking instant features, make quantitative analysis and unscrambling from dynamics and kinematics orientations, and further correct judge key technical problem that constraints high level athlete to further improve competitive levels. In the following, we study from competitive swimming technical diagnosis optimization and starting turning technique two aspects.

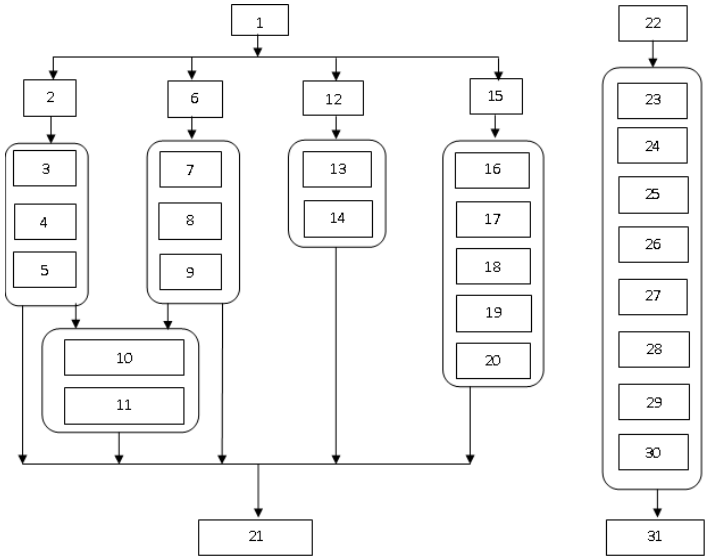

Figure 1 : Swimming athletes' technical analysis schematic diagram

COMPETITIVE SWIMMING TECHNICAL DIAGNOSES

Swimming athletes' technical diagnosis is key factor to optimize athlete technical movement and improve athlete training efficiency. In technical problem diagnosis, we should clearly distinguish and grasp that athlete technical level further improvement restriction is physical ability factor or technical problem, only get objective correct conclusion and carry on targeted effective training then can really give competitive swimming athletes maximum potential into really play. To arrive at technical diagnosis reliability and accuracy target, it should combine with athlete technical analysis report multi-media technical analysis information, by deepen exchanging between coaches and athletes,it further improves recognition on competitive swimming techniques, and carries on research analysis from world top swimming athletes technical features world top swimming athletes technical database(including competition video, multi-perspective technical simulation animation) and world swimming event development trend the three main aspects to define national excellent swimming athletes technical optimization scheme, and establish a set of complete strong targeted and high efficiency training method.

Competitive swimming technical diagnosis analysis

Evidence for making qualitative evaluation and analysis of athletes' movement technical process is coach, athlete and relative scientific research staff recognition level on competitive swimming techniques, and meanwhile also play decisive roles in diagnosing swimming techniques. Recognition on a sports event features is a process from the shallower to the deeper, is up to two aspects, on one hand is coach self recognition ability, more important aspect is science and technology as well as research method progress and development. Emergence of new theory can open up new perspective for project features recognition, appearance of new technique and new methods can promote recognition degree deepening. With times development, competitive swimming is constantly promoting, it surely will appear more scientific competitive swimming technical theory and technical training method. We can

make research analysis of new technical theories and training methods to deepen exchange with athletes and coaches, and then promote their recognition on competitive swimming technique, resonate and make popularization and application in daily technical training and practice.

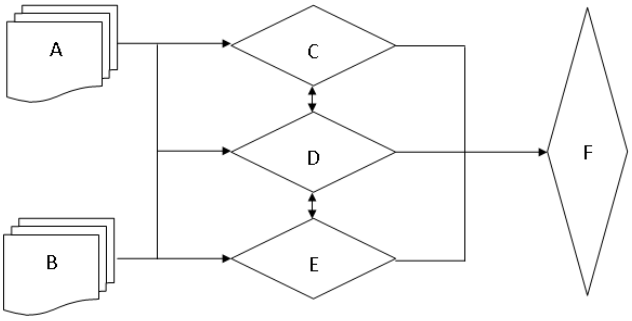

Figure 2 : Competitive swimming athletes' technical diagnosis system schematic diagram

In Figure 2, A: athlete competitive swimming technical analysis report; B: competition technical and tactical indicators analysis report; C: in-depth exchange with coaches, athletes and enhance competitive swimming technical recognition; D: swimming event development trend and world top swimming athlete technical features; E: world top swimming athlete techniques database; F: Define national excellent swimming athlete technical optimization plan

Competitive swimming technical optimization control analysis

Competitive swimming new theory methods study, world competitive swimming technique new development trend recognition extent, swimming technical motion analysis new software, multi-media and others advanced scientific tools mature application and scientific researches as well as in-depth exchange and communicate with coaches, athletes to define national excellent swimming athlete technical optimization target control plan and else four aspects are the basis and foundation of athletes technique optimization control.

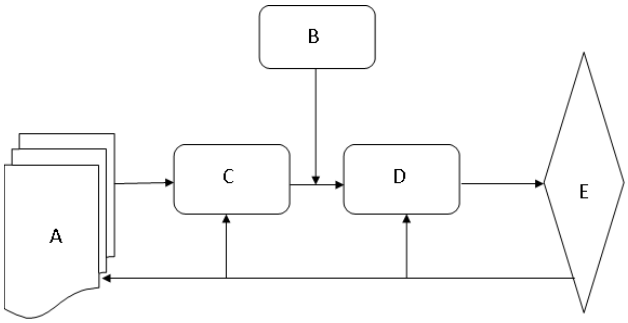

Figure 3 : Swimming athlete technique optimization control schematic diagram

In Figure 3, A:Define national excellent swimming athlete technique optimization target control plan; B:Scientific researchers assist and participate in coaches teaching and training guidance to athletes, perfection and improvement techniques; C:Timely find out problems in training, make explanation and analysis on spot, let athlete to notice the problems; D:carry on competitive level tracking research on national excellent athletes competitions participation; E: Test preparations' swimming technical training effects and competitive level performance status by competition

Coach technical teaching and training guidance promotion technique optimization

Technical training method applied correct procedures decide athlete training effects to a certain extent, when improve techniques, it should follow order from shallow to deep, and from part to entity to develop. Targeted at Zhang Lin technical movements in 2006 world swimming short-course meet, it

makes analysis, finds out he exists loosely tucked, stretched and lifted hips, pushoff pool wall directions deflect from swimming direction and other technical drawbacks when turning, which also becomes important barriers to promote self technical level performing. By researching and discussing his turning techniques, it defines Zhang Lin relative turning techniques optimization target control method and scientific training methods. After techniques improving, Zhang Lin has improved from the tenth national games 400m free stroke turning 15m section average consumed time as 8.11s to 7.55s in 29th Olympic Games, overall improves 0.56s.

TABLE 1 : Zhang Lin technique and tactics data table

No.	A	B	C	D	E
1	3:51.32	3:42.44	8.88		100
2	6.30	6.42	-0.12	3.75	-1.35
3	56.80	52.85	3.95	26.25	44.48
4	165.52	163.17*	5.05*	70.00	56.87*
5	2.7				

Note:* Include sprint 5m time,in TABLE 1 A:Year 2005 the tenth national games; B: the 29th Olympic Games; C: Olympic Games improvement;D: percentage of whole journey;E: percentage of improvement;1: competition result(min:s); 2:starting 15m(s); 3:turning 15m×7(s);4: on passage swimming 275m(s):5: sprint 5m(s)

By comparing Olympic Games each item data as TABLE 1 shows,400m free stroke competition turning section only occupies 26.55% of whole journey distance,and turning section occupies 44.48% of total improved performance,which is far larger than other technical movement contribution value to competition performance.

Swimming technical diagnosis optimization application

If make research analysis from competition performance influence or technique and tactics data, factors that decide athletes fulfill competition are fixed, due to every athlete technical movement is different, and has significant individual features. Start from key factors that constraint national excellent athletes potentials performing, firstly work on primary contradiction, and then solve secondary contradiction, and further arrive at movement technical optimization target. Firstly take Liu Zi-Ge as an example to illustrate.

Liu Zi-Ge has formally become one member in national team in January, 2008, his 200m butterfly best performance is 2min10s15,by verifying world top swimming athletes technical information, and going deeper analysis and research on Liu Zi-Ge techniques, his arms recovering technique and stroking technique coherence is world butterfly technique development trend, physical quality and physique are qualified to become world champion, but at the same time he should make further improvements in stroke timeliness, starting turning technique, diving and kicking and other technical details, and carry on targeted training and explaining on him. For starting turning and underwater diving kicking details that are maximum barriers of his potentials performing, so firstly implement scientific training on turning, diving and kicking techniques.

TABLE 2 : Table of Liu Zi-Ge each data in 2007and 2008

No.	A	B	C	D
1	2:10.15	2:07.76	2.39	
2	0.82	0.83	-0.01	-0.42
3	7.12	6.84	0.28	11.72
4	29.48	27.86	1.62	67.78
5	90.46	89.86	0.60	25.10
6	3.09	3.2	-0.11	-4.60

In TABLE 2, A: Year 2007championship meet; B:Year 2008 championship meet; C:Improve(s); D: Percentage of improvement; 1: Competition performance(min:s); 2:Leaving block(s); 3:Starting 15m(s);4:Turning 15m×3(s); 5: On passage swimming135m(s);6:Sprint 5m(s)

In short three weeks, as Table 2 shows,Liu Zi-Ge qualification trials performance is 2min07s76,which improves 2.39s to previous best performance,from which 3 times turning 15m section has improved 1.62s that occupies 67.78% of total improved performance, it implements priority solving primary contradiction to improve self competitive level target.

COMPETITIVE SWIMMING TURNING STARTING TECHNIQUES

In Figure 4, we can see that swimming techniques mainly contain starting, turning, on passage swimming, reaching to wall and touching and sprinting so on. Among them, staring and turning techniques occupy crucial position in the whole swimming process. Swimming starting and turning rely on legs pedaling and stretching to let human body to get forward initial speed, and improve preliminary speed for athletes underwater sliding. And athlete underwater sliding average speed is up to preliminary speed size to a great extent, which will further affect swimming athlete whole sports performance. To provide reliable theory and technical support for coaches and swimming athletes, it should make research and analysis of excellent swimming athlete starting and turning technical features.

Swimming starting technical analysis

Swimming starting technique refers to the generic terms of methods that swimming athletes use to arrive at fastest speed in shortest time to get rid of static state. It is composed of ready position, takeoff movement, flight phase, entry and sliding and overhand so on six technical links. In current stage researches, in order to avoid troubles, it habitually calls swimming starting ready position to starting front 15 m such phase as a joint name of swimming starting technique.

Swimming starting postures are ready position before athlete starting, it can ensure athlete to be in the most beneficial starting state, and then get maximum leaving block preliminary speed. With the development of times, swimming competition intense extent increases accordingly, swimming starting postures also has gone through several different development phases. Before the sixties of 20th century, swimming athletes mostly adopted swinging arm style starting postures, since entering into the sixties, grab starting technique dominants, while to nineties of 20thcentury, it appears track starting technique, by far, grab style, forward lean track and back-swing style these three types have become starting postures that world excellent swimming athletes adopt. Now take grab starting posture as an example, analyze it technical movement.

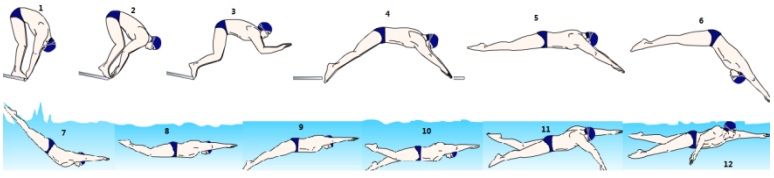

Figure 4 : Grab starting technical movement schematic diagram

In Figure 4,1 presents ready position, swimming competition starts from 2,use hand to push diving platform upward, body extends forward, it has feeling that will fall into water; 3 exert to pedal diving platform, hand extends upward from jaw; 4 when foot leaves diving platform, arms stretch downward and eyes down; 5jump is jumping in the direction of front 45 degree that forms streamline in the air; 6 when athlete mass center arrives at peak point, control waist bending;7when enter into water, it should be hand firstly entering, try to control entering in one point from hand to leg; 8 after athlete body entering into water, he should erect back, body extends forward; 9 carry on dolphin kicking in small range, and meanwhile accelerates; 10 before body going out of water, carry on two to four times kicking in shaking style, now it needs to low head to keep body streamline; 11 carry on stroking for one time in

water, and then surface, in short distance swimming event,after diving, first time stroking will not breathe;12 continue to do 11 movements.

The maximum differences between track staring postures and grab starting postures are difference of takeoff angle and ready position. Adopt track starting posture, due to arms dragging effects, it can accelerated body gravity center forward shifting, by two legs successive exerting, it will get bigger strength, when obtain faster speed, its consumed time will be shorter. And meanwhile track starting postures advantages in perching block time and leaving block instant body initial speed are relative significant.

Time from starting signal to athlete making starting movement is jointly called starting reaction time. In 1985,J.panlo Vilas-boas, M.Joo Cruz and others made researches on Portugal 11 athletes of national team and showed that adopted grab starting athletes perching block time was averagely 0.94±0.07s, track style perching block time was averagely 0.90±0.07s[5]. Researched on starting reaction time, according to research result, when track style and grab style adopted different starting postures, athletes starting reaction time had significant differences ($P<0.01$)track style starting postures were obviously shorter than grab style starting postures reaction time.

TABLE 3 : World excellent swimming athletes starting reaction time table

Type	A	B
1	0.15s	0.04
2	0.17s	0.05

Note : Extract from year 1985, J.panlo Vilas-boas, M.Joo Cruz

In TABLE 3,1 is track style starting postures; 2 is grab style starting postures; A is average value of reaction time; B is reaction time standard deviation, by TABLE 1, it is clear that track starting postures have obvious technical advantages over grab style.

Perching block time mainly is composed of starting reaction time and accelerated pedaling and extending time, is generic term that swimming athletes begin to make starting movement to legs leaving block time. Perching block time mainly is up to athlete muscle type, movement proficiency extent and athlete reaction time and else. By far, different scholars have different conclusions on track style and grab style starting postures perching block time long or short. Zhang Ming, Lin Hong etc. carried on mechanical analysis of three kinds of swimming starting postures and found that grab style perching block time was 0.71±0.01s,back swing track style perching block time is 0.80±0.03s,forward lean track style perching block time is 0.64±0.02s,and Tang Li applied kinematics analysis and research on track style and grab style starting postures, he found that track style perching block time was 0.78s, which was 0.07s more than grab style.

Flight time is directly related to leaving block instant body gravity center initial speed, it is the time from two legs leaving block instant to hand touching water surface. Flight angle being too big or small is bad for the whole swimming process, when flight angle is too big, it will lose horizontal initial speed, and flight angle being too small will shorten flight time that causes body touch water time being earlier, and so will come across underwater resistance, which will generate bad impacts on body flight speed. Research shows, swimming starting flight angle is around 15-20°, and it will more beneficial to swimming starting technique speed performing.

Swimming turning technical analysis

In competitive swimming, 100 meters distance and above 100distances swimming events should make one time or multiple times turning movements, if turning movement well fulfilled,it averagely can save above 0.02 second times, and can save strength, so turning techniques merits affect swimming performance to a certain degree, especially in long distance competitions.

In competition rules stipulation, different swimming postures have different turning technical rules, from which breast stroke and butterfly stipulate that athlete firstly use two hands to touch the pool

wall, then can turn. In current stage, butterfly and breast stroke competitions, athletes mostly apply swinging style turning, but free stroke athletes generally adopt flip turn technique. Firstly take breast stroke turning as an example to make movement analysis on it, breast stroke turning each phase technical movement are as Figure 5 shows.

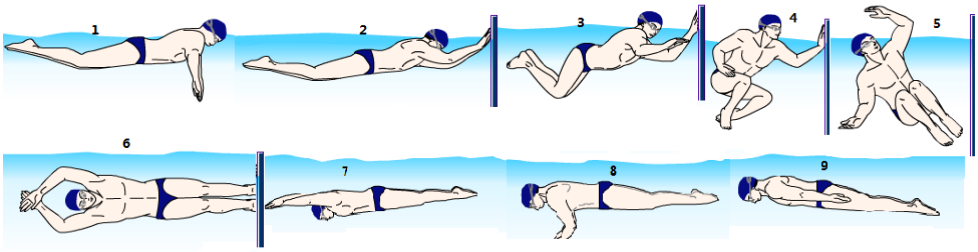

Figure 5 : Swimming athlete turning movement schematic diagram

When body upper limbs or lower limbs touch pool wall, human body gravity center momentum changes, in bending and stretching process, human body just likes a spring, firstly store energy and then release.

TABLE 4 : Different events turning time data statistics table (T±SD)unit:s

Gender	Turning time		
	100m butterfly	100m breast stroke	100m free stroke
Woman	1.20±0.03	1.19±0.02	0.86±0.03
Man	1.11±0.02	1.12±0.03	0.79±0.01

As TABLE 4 shows research results find the free stroke turning consumed time is least, man average consumed time is 0.79±0.01s,woman average consumed time is 0.86±0.03s,and because breast stroke and butterfly adopt same turning technical movement, so the two have no significant differences. According to above table, it can find that butterfly and breast stroke event consumed time in turning is more than free stroke event, there are two causes for the case :a) arms touching pool wall time is too long; b) Body flipping and turning speed are not fast enough. When turning, body moment is generated by body gravity center forward movement inertia and hand touching wall instant supporting points is not in the same straight line.

According to mechanical formula, Q=F.L, from which F is acting force, L is the arm of force.

The formula has common impacts on athlete turning time fast or slow. In a good part, when carry on body turning movement, because athlete bending knees and abdomen curling movement is not sufficient, corresponding enlarge his body flipping radius, and meanwhile increase body flipping moment water resistance, and flipping speed also corresponding slows down.

TABLE 5 : Man and woman different events turning leaving wall speeds data statistical table

Swimming course number of meters	Gender	100m breast stroke	100m butterfly	100m free stroke	200m breast stroke	200m butterfly	200m free stroke
50 meters area	woman	2.94±0.02	2.95±0.03	3.17±0.02	2.85±0.03	2.87±0.02	3.03±0.02
	man	3.28±0.02	3.26±0.01	3.56±0.03	3.14±0.02	3.12±0.03	3.34±0.04
100 meters area	woman				2.84±0.03	2.74±0.02**	2.95±0.02*
	man				3.07±0.03*	3.05±0.04*	3.22±0.02**
150 meters area	woman				2.69±0.02*	2.68±0.03*	2.88±0.02*
	man				2.99±0.02*	2.97±0.03**	3.14±0.02

Note : **represents have very significant difference in 0.01 level; *represents have significant differences in 0.05level

A key technical indicator in measuring swimming turning technique is turning and leaving wall instant speed. From TABLE 5, in 100 meters event, we can see that free stroke is event with fastest leaving wall instant speed after turning, woman average speed is 3.17±0.02m/s, man average speed is 3.56±0.03m/s; while the slowest is women 100 meters breast stroke, average speed is only 2.94±0.02 m/s, and 100 meters men butterfly is the slowest, speed is 3.26±0.01 m/s.

When athlete is going to turn, he should ensure not to reduce speed when gets closer to pool wall, remains body maximum inertia; when hand touches wall, athlete should deflect from body gravity center and keep proper distance in forward direction to increase arm of force, and meanwhile should correct estimate self swimming speed and movement, try to do best in touching movement to improve turning and leaving wall speed, so that can further improve athlete underwater sliding average speed. And turning and leaving wall speed is up to athlete body postures, pushoff opportunity selection and athlete core strength after turning.

In analyzing and researching on free stroke event, due to athlete turns in advance that leads to body to be far from pool wall after turning, causes knee joint angle increases, and leads to leg pedaling and extending effects to be not significant, and meanwhile some athletes cannot keep body horizontally after turning technical movement, body each part is not in the same horizontal line, so that cause body forward direction and force direction are inconsistent, which causes force functions consumption because of scattering and increases body resistance underwater, so that reduces pushoff efficiency after turning. And after athlete flipping, human body and pool wall distance decides pushoff efficiency, after flipping excessive long distance or short distance will cause poor pushoff efficiency, current stage research analysis gets that when swimming athlete thigh and shank included angle as 60°,pushoff efficiency is best.

CONCLUSION

Through national swimming team obtained huge achievements in recent years, it fully shows competitive athletes technical diagnosis and optimization can provide strong theory, data and technical support for competitive swimming athlete training method and strategies. It provides scientific and effective practical methods for athlete improving and perfecting technical movements, and be able to let him to faster and better implement self potential maximization.

In the paper, it focuses on stating and analyzing competitive swimming’s turning and starting technical features and each kind of time factors that affect turning and starting techniques performing.

By consulting and comparing domestic and foreign turning and starting techniques experiment data, swimming track style starting technique has advantages in starting reaction time, perching block time as well as leaving instant body gravity center horizontal initial speed and else three aspects over grab style starting technique.

By researching and comparing man and woman different swimming events turning technical experiment data, competitive swimming turning and starting techniques mainly rely on human body legs pedaling and extending movements, so that let human body to get horizontal direction initial speed. And legs strength and explosive power decide athlete leaving wall instant initial speed, which is also key factor in turning and staring techniques that man and woman in different swimming events.

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