<寄　　稿>
〔ヒューマンパフォーマンス研究班〕

国際学会発表報告 ―― 泳法分析について

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Ⅰ．はじめに

旧トレーニング・コーチング研究班の方針は，①研究計画を重視する，②スポーツ（主に水泳）の世界で経験的に知られていることを科学的に定量化する，③スポーツの現場に有益になる研究をすることである．これまで研究班では研究活動の一部として，1997年より2016年までアメリカスポーツ医学会（ACSM：American College of Sports Medicine）やヨーロッパスポーツ科学学会（ECSS：European College of Sport Science）などの国際学会で16回研究発表した．発表の内容は主に泳法分析である．泳法分析は競技力向上を目標に，泳法の改善と効率のよいストロークパターンを検討するため，泳スピードを計測する競泳用スピードメータを用いて，泳者に無負荷の状態のワイヤを牽引させ，腰のベルトにリールをつけ25mを最大努力で泳がせ，同時に，水中ビデオカメラとPC（映像分析ソフト「ダートフィッシュ・ソフトウェア」内蔵）を用いて測定時の泳ぎを撮影・分析している．

2016年度３月の定年を機にその概要を纏めることとした．

Ⅱ．研究の概要

これまでの国際学会発表のうち水泳に関する発表は，レジスト泳に関する研究２，スピード泳に関する研究８，アシスト泳に関する研究４の合計14である．泳法分析に関する対象については，１人のアスリートに対してデータを取り，その変化（進歩）を分析したもの４，複数のアスリートからデータを取り競技中の動作の傾向を分析したもの８であった．

Ⅲ．水泳に関する発表の概要

1．レジスト泳（泳パワートレーニング）

水泳中のパワーを高めるには，泳ぎ全体に負荷をかけるレジスタンストレーニングが効果を発揮する．

Yoshimura, Y. et al. Development of power processor for swimming, ACSM 44th annual meeting, 1997.

水中パワーを測るために定量可能な機器として，競泳選手のパフォーマンス向上を目的とした牽引泳中に発揮される泳パワー測定装置（Power Processor for Swimming (PPS)）を開発した．PPS の測定結果から，8 kg の負荷のときに最もパワーが発揮され，この 8 kg 負荷時のパワー値と短距離のパフォーマンスとは相関があった．また，負荷の増加に伴って，ストローク長が減少し，負荷の増加に伴って，泳速度が低下したが，ストローク頻度はあまり変化が見られなかったことが示された．

Yoshimura, Y. et al. Effects of the load differences on elite swimmers' perceived ratings for stroke techniques and the actual power outputs during semi-tethered swimming, PRE-OLYMPIC CONGRESS, 2000.

泳者の腰にリールをつけ，PPS を用いて被験者にストローク頻度を一定に保たせた上で負荷を 1 kg ごとに10kg まで漸増した結果，負荷の漸増に伴って，平均速度が減少する傾向が示された．また，被験者の主観からは 2 kg から 8 kg の範囲であればほとんど違和感のないことが示され，泳技術にほとんど影響することなく負荷をかけることが可能であることが推察された．これらの結果から，PPS を利用したレジスタンストレーニングにおいて泳パワーの定量化が可能であることが明らかになり，このようにスポーツパワーを競技のスタイルで測定して，それを基にトレーニングすることがとても重要だということがわかった．

2．スピード泳（泳法分析）

競技力向上を目標に，泳法の改善と効率のよいストロークパターンを検討するため，泳スピードを計測する競泳用スピードメータを用いて，泳者に無負荷の状態のワイヤを牽引させ，腰のベルトにリールをつけ25m を最大努力で泳がせた．同時に，水中ビデオカメラを用いて測定

時の泳ぎを撮影・分析した.

2-1. 背泳ぎの技術分析

Yoshimura, Y. et al. A study of an elite backstroke swimmer who made rapid progress, 11th Annual Congress of the European College of Sport Science, 2006.

記録短縮の原因は，水中ドルフィンキック区間の記録の向上によるところが大きかった．分析では，記録短縮後の水中ドルフィンキック中の速度変化が有意に速くなった．アップキック時の平均速度の前後差は認められなかったが，ダウンキック時の平均速度の前後差においては，

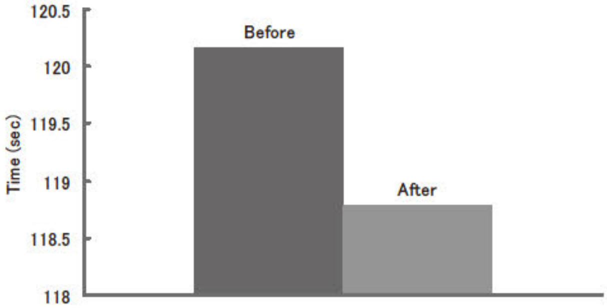


Fig.1 Comparison of 200m backstroke records before and after improvement

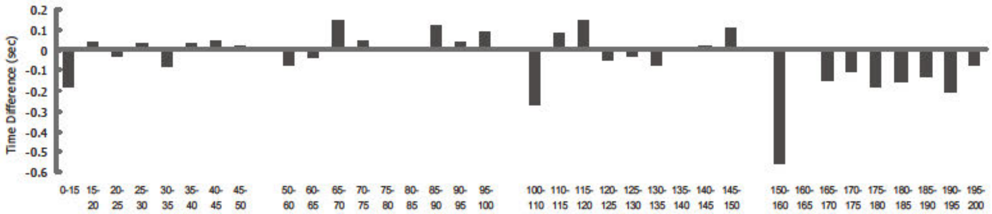
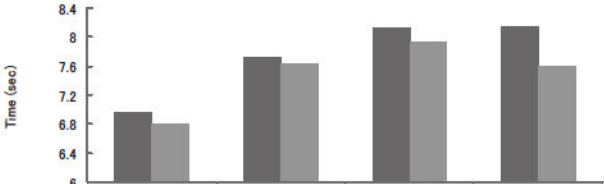


Fig.2 Comparison of time differences of every 5 m in 200m backstroke swimming



	0-15	50-65	100-115	150-165
Before	6.97	7.73	8.12	8.14
After	6.79	7.62	7.93	7.59

Fig.3 Comparison of dolphin kicking performance (15m)

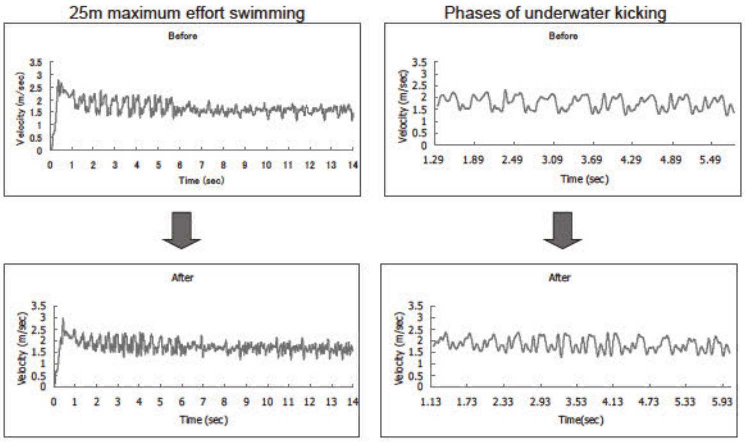
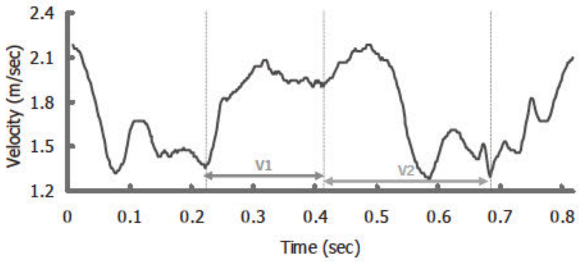


Fig.4 Samples of velocity change curves



- V1: mean velocity during up-kicking
  (before: mean value of 9 samples, after: mean of 12 samples)
- V2: mean velocity during down-kicking
  (before: mean value of 9 samples, after: mean of 12 samples)

Fig.5 Analytical points of velocity curve

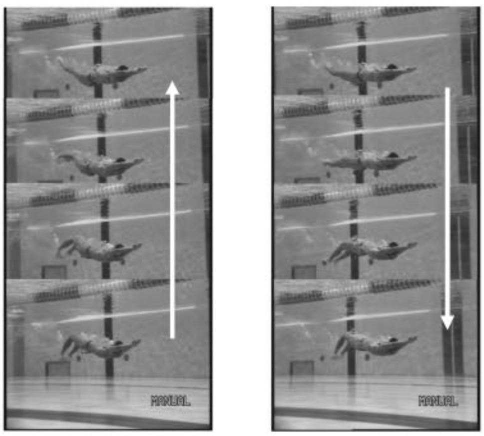


Fig.6 Samples of underwater dolphin kicking

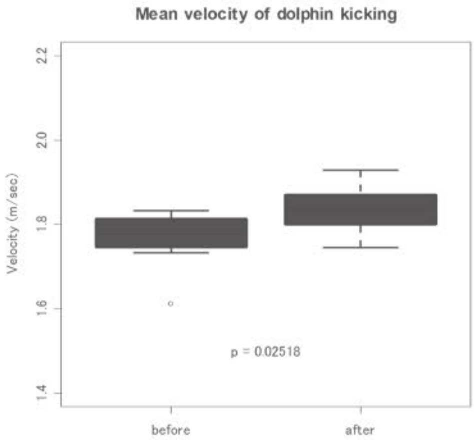


Fig.7 Comparison of mean velocities of dolphin kicking

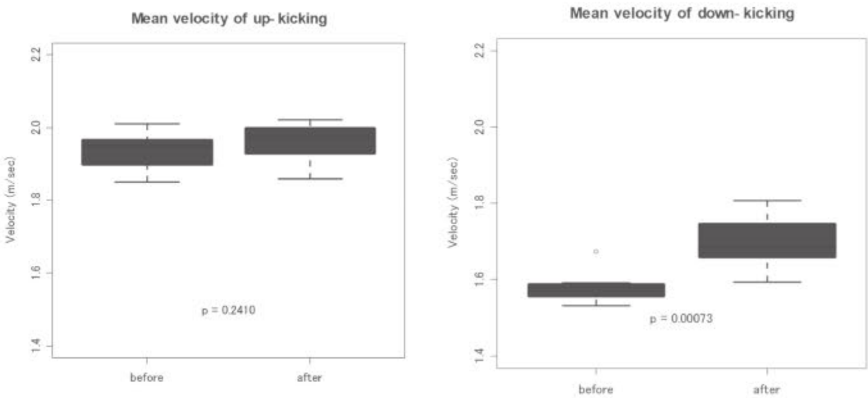


Fig.8 Comparison of mean velocities of dolphin kicking (up and down-kicking)

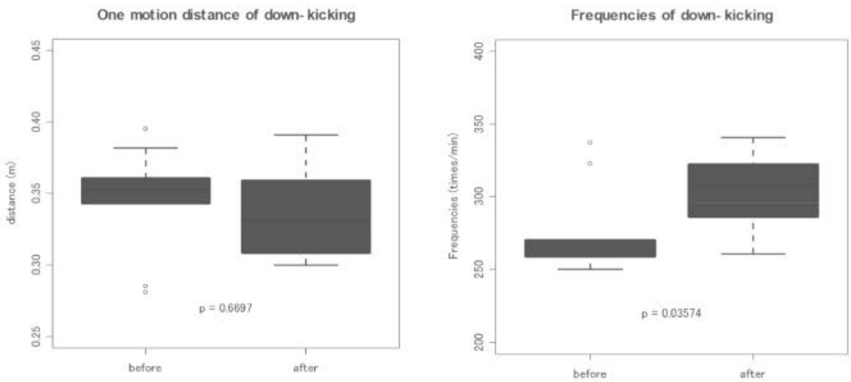


Fig.9 Comparisons of distance and frequencies of down-kicking

記録更新後に有意に高くなった．その要因はダウンキックで進んだ距離よりも頻度の影響が大きかった．その結果，水中ドルフィンキック動作におけるダウンキック時の平均速度が，背泳ぎのパフォーマンスに大きく影響していることが明らかとなった．

Tanaka, T. et al. Skill improvement for an elite backstroke swimmer as determined with a speed meter, 13th Annual Congress of the European College of Sport Science, 2008.

２年間にわたる一流競泳男子選手の技術分析および改善指導を行った結果，特に水中でのストローク動作における第１ダウンスイープ＆アップスイープ局面を改善することによって競技成績に大きく影響していることが明らかとなった．

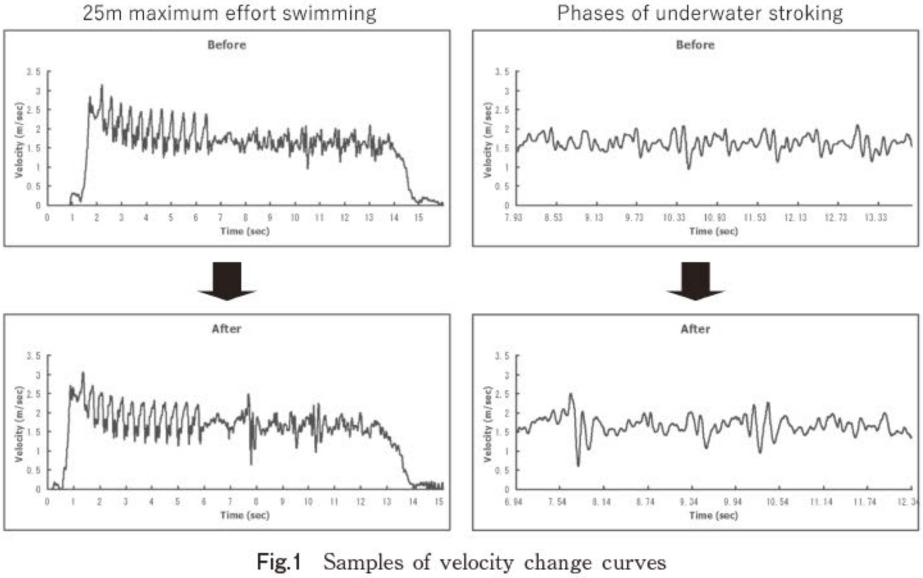


Fig.1 Samples of velocity change curves

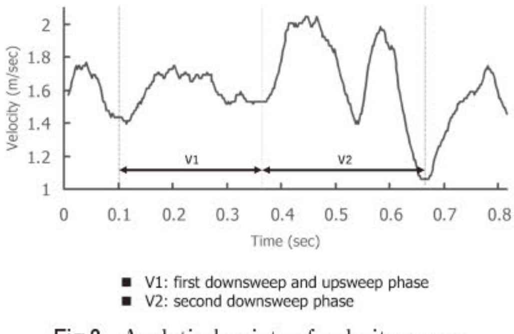


Fig.2 Analytical points of velocity curve

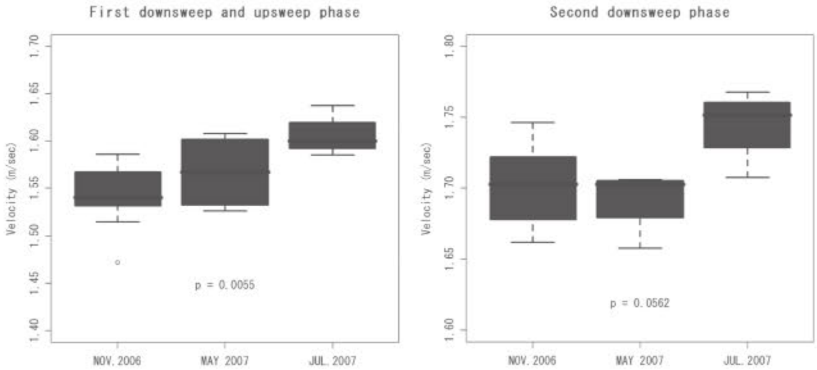


Fig.3 Comparisons of mean velocities of backstroke (first downsweep and upsweep phase, second downsweep phase)

2-2. 平泳ぎの泳法分析

Yoshimura, Y. et al. Characteristics of breaststroke skill in elite swimmers detected by means of a speed meter, 9 th Annual Congress of the European College of Sport Science, 2004.
Yoshimura, Y. et al. Breaststroke skills in male elite swimmers detected by means of a speed meter, ACSM 52th annual meeting, 2005.

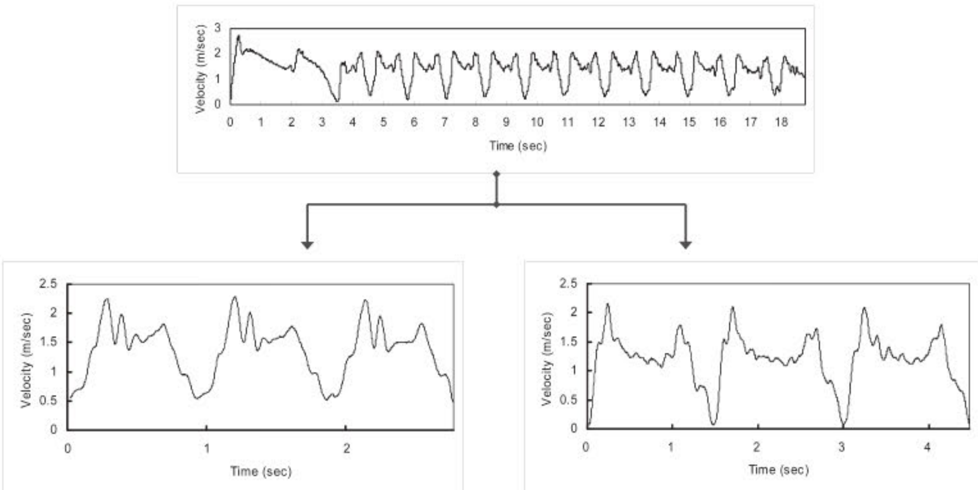


Fig.1 A velocity pattern of stroke cycles for an international level swimmer

Fig.2 A velocity pattern for a collegiate level swimmer

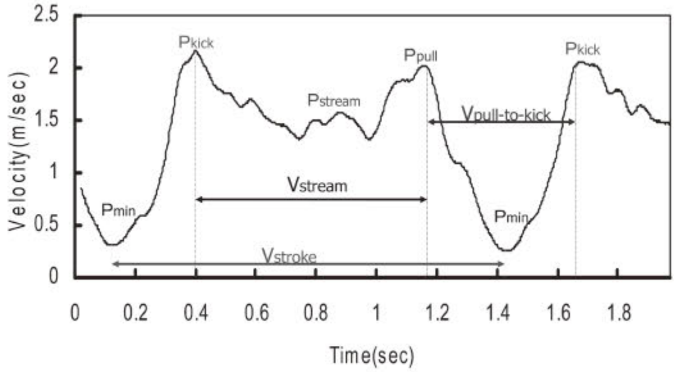
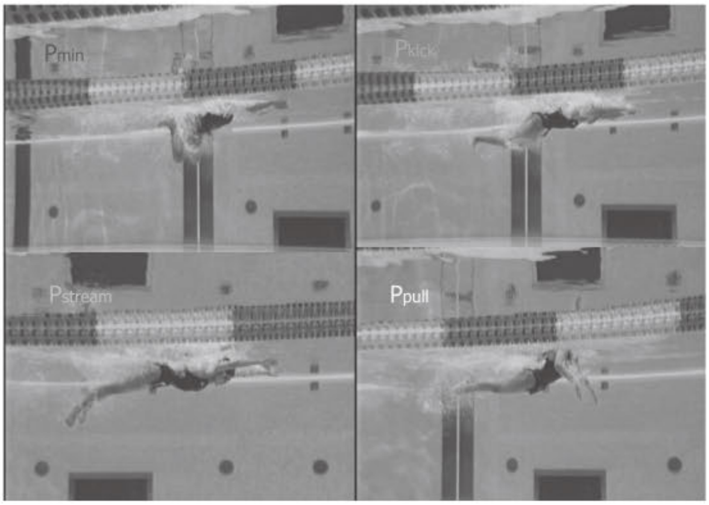


Fig.3 Analytical points of data



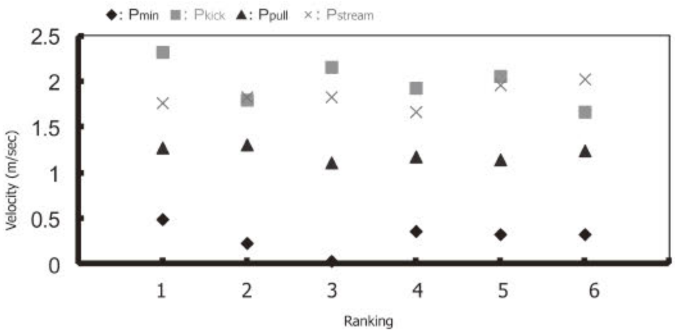


Fig.4 Relations between measurement points (P min, P kick, P pull, P stream) and the ranking in subjects

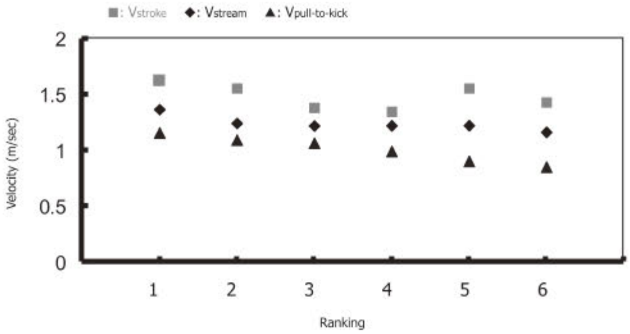
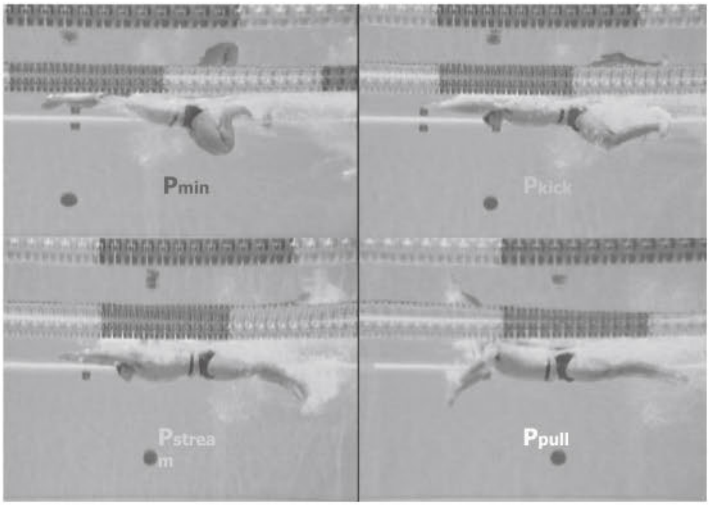


Fig.5 Relations between measurement points (Vstroke, Vstream, Vpull-to-kick) and the ranking in subjects



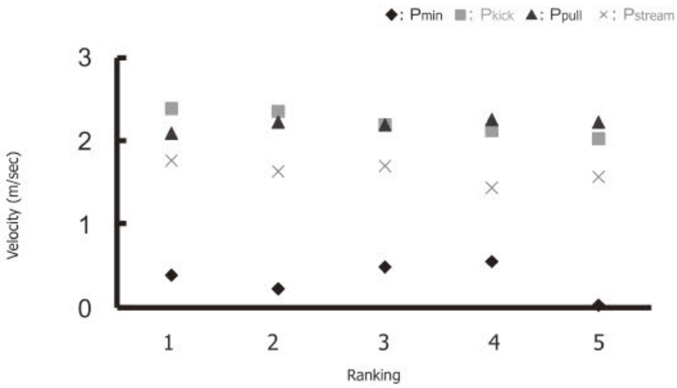


Fig.6 Relations between measurement points (P min, P kick, P pull, P stream) and the ranking in subjects

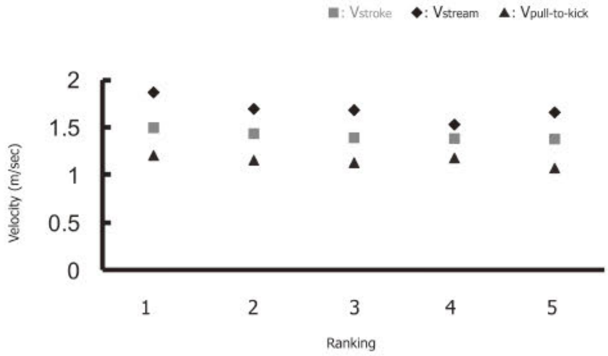


Fig.7 Relations between measurement points (Vstroke, Vstream, Vpull-to-kick) and the ranking in subjects

男女とも，ほとんどの平泳ぎ選手のプルからキックに移る位相の最小速度はゼロにはならず，一定の速度を保持していることが明らかになった．女子では，プルからキックの平均速度と被験者間のランキングに相関が見られたことから，最小速度を高めることが，男子では，キックと被験者間のランキングに相関が見られたことから，キック速度を高めることが，技術の重要な一部分であると推測された．

2-3. バタフライの泳法分析

Yoshimura, Y. et al. Characteristics of butterfly stroking skill in elite swimmers detected by means of a speed meter, Medicine & Science in Sports & Exercise, American College of Sports Medicine, 2007.

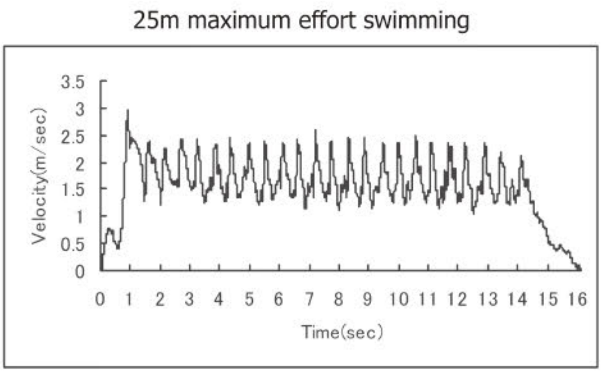
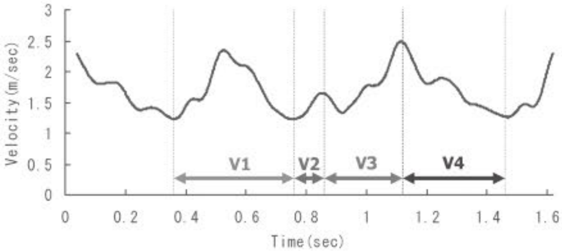


Fig.1 Samples of velocity change curves



- V1 : first kick phase
- V2 : insweep phase
- V3 : upsweep and second kick phase
- V4 : wave phase

Fig.2 Analytical points of velocity curve

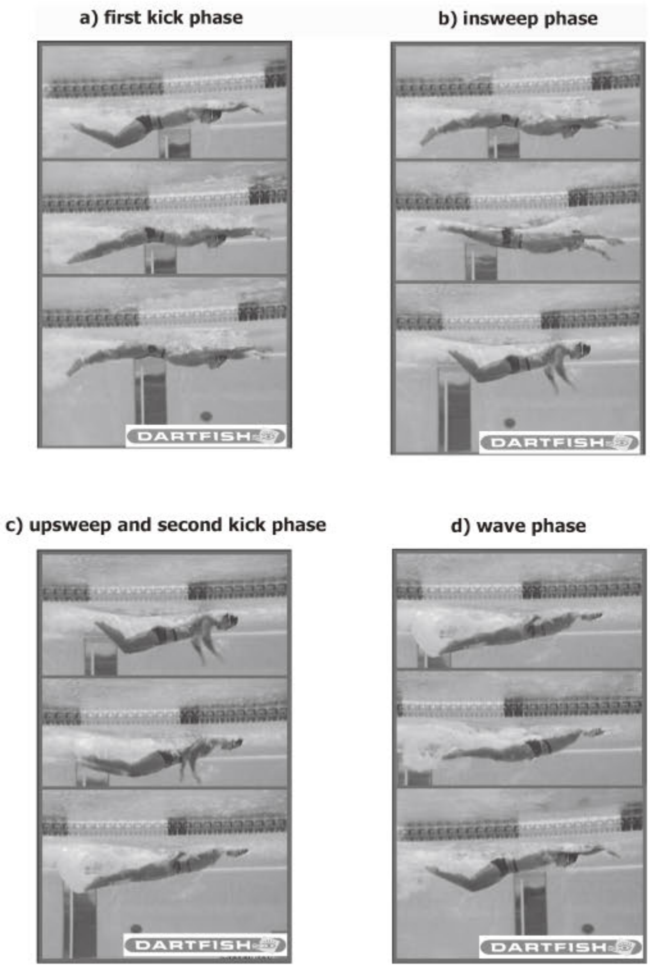


Fig.3 Samples of underwater butterfly stroke

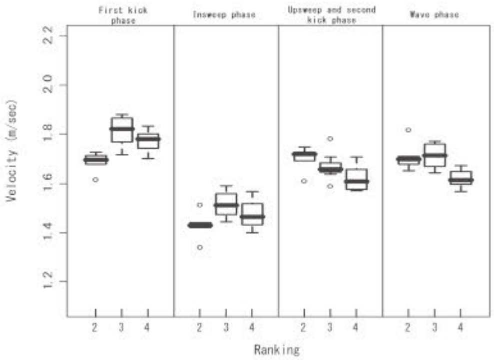


Fig.4 Comparison of mean velocities of butterfly stroke for national level swimmers

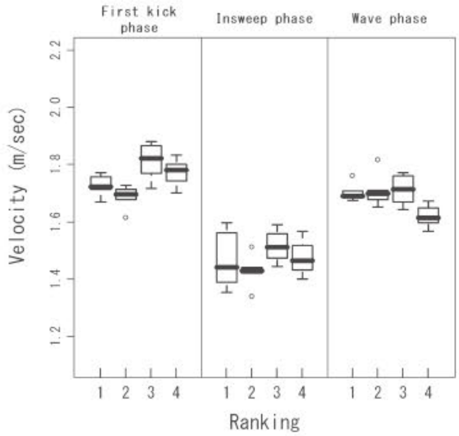


Fig.5 Comparison of mean velocities of butterfly stroke for all swimmers (first kick phase, insweep phase, wave phase)

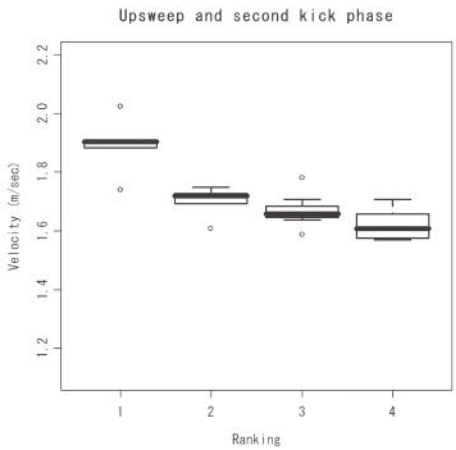


Fig.6 Comparison of mean velocities of butterfly stroke for all swimmers (upsweep and second kick phase)

バタフライのストローク動作から，第1キック局面，インスイープ局面，アップスイープ・第2キック局面，ウェーブ局面の4局面を観測し，スピードメータによって動作の特徴を確認した．その結果，国際的レベルのスイマーと国内トップレベルのスイマーでは，バタフライのストローク動作におけるアップスイープ・第2キック局面において，その平均速度に相関が見られたことから，アップスイープ・第2キック局面の技術を高めることが，技術の重要な一部分であることが推測された．

Tanaka, T. et al. Skill improvement for an elite butterfly swimmer detected by means of a speed meter, 15th Annual Congress of the European College of Sport Science, 2010.

4年間にわたるバタフライ種目の一流競泳選手の技術分析を行った．バタフライ泳法におい

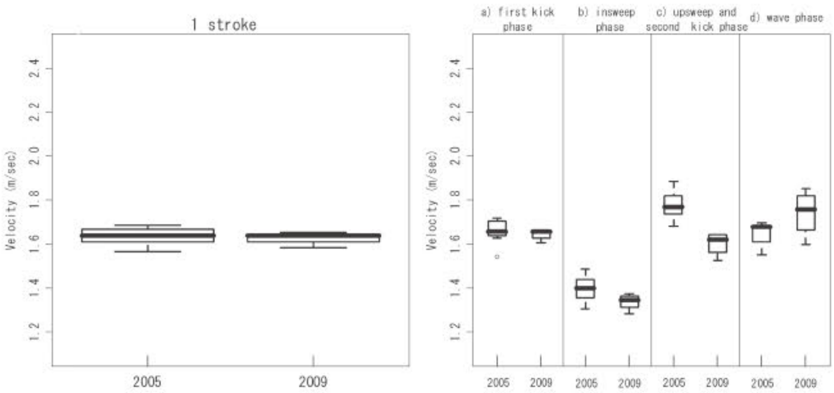


Fig.4　Comparisons of mean velocities for butterfly stroke

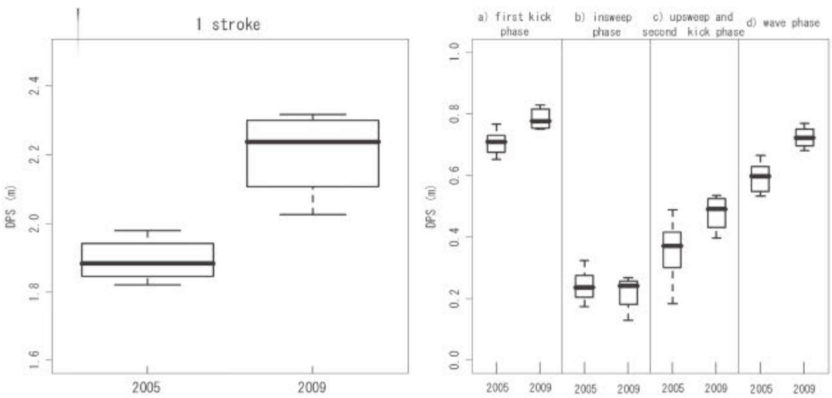


Fig.5　Comparisons of distance per phase (DPP) for butterfly stroke

て第１キック局面（First kick phase）とリカバリー局面（Wave phase）が１ストローク局面中に進む距離（Distance per phase）に大きく影響を及ぼすことが明らかとなった．

2-4．クロールの泳法分析

Tanaka, T. et al. Skill differences of freestyle competitive swimmers detected by means of a speed meter, 14th Annual Congress of the European College of Sport Science, 2009.

クロールのストローク動作から，ダウンスイープ，インスイープ，アップスイープの３局面に分けて観測し，それぞれの局面をスピードメータの平均速度から選手の特徴を確認した．その結果，国内トップスイマーと他の選手間では，ダウンスイープ局面（p＝0.0287）において有意差が確認されたことから，クロールのストローク動作におけるダウンスイープ局面の技術を高めることが技術の重要な一部分であることが推測された．

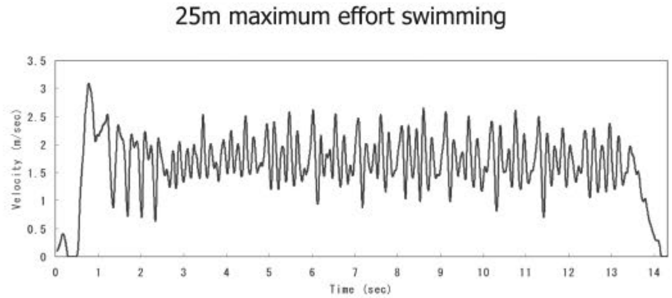


Fig.1　Samples of velocity change curves

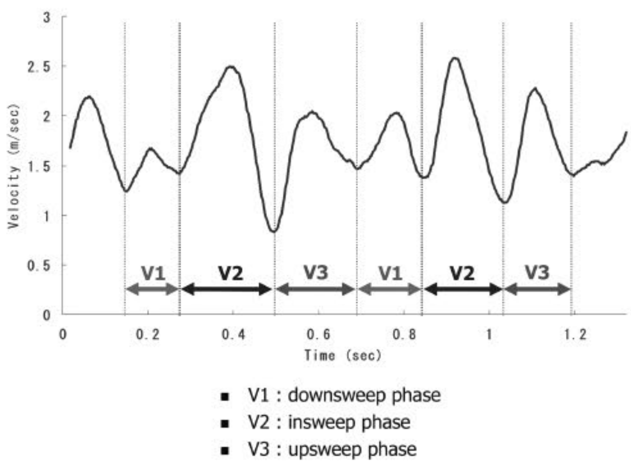


Fig.2　Analytical points of velocity curve

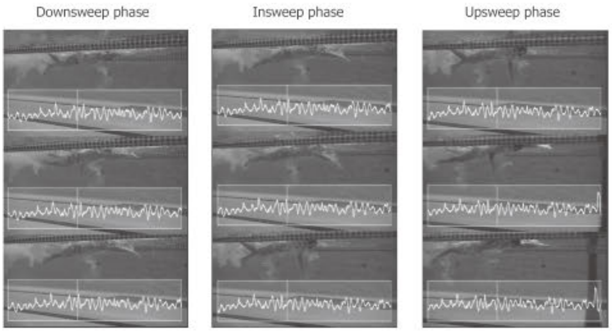


Fig.3 Samples of underwater stroking

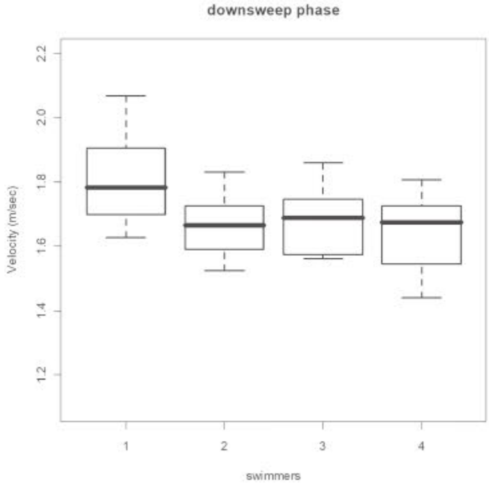


Fig.4 Comparison of mean velocities of freestyle for all swimmers (downsweep phase)

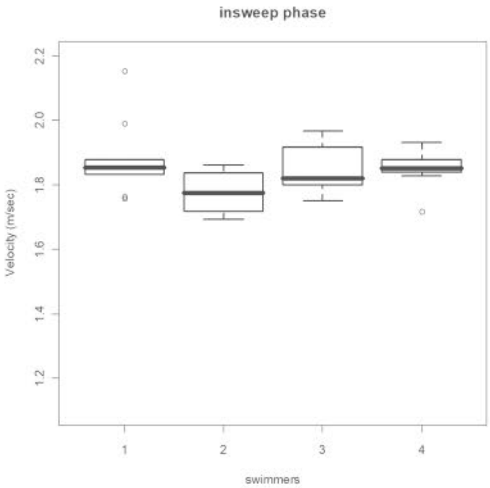


Fig.5 Comparison of mean velocities of freestyle for all swimmers (insweep phase)

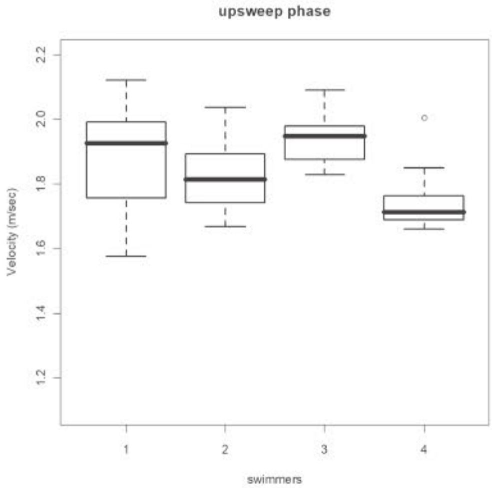
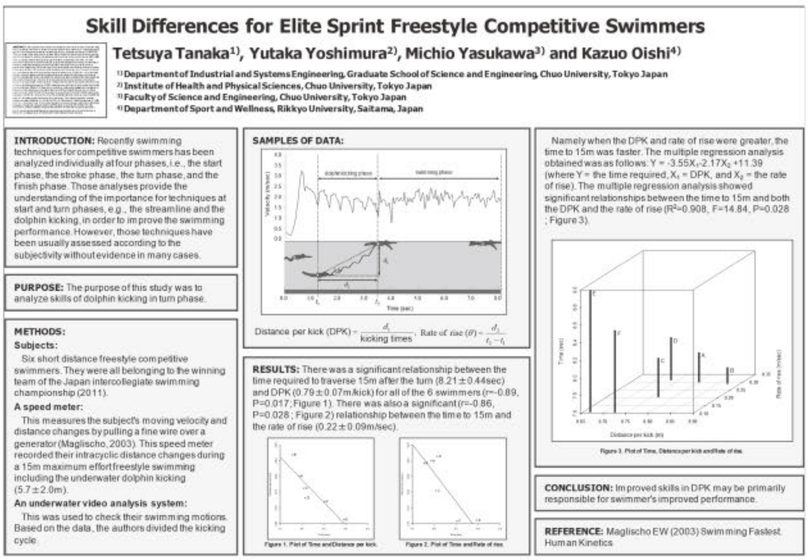


Fig.6 Comparison of mean velocities of freestyle for all swimmers (upsweep phase)

Tanaka, T. et al. Skill differences for elite sprint freestyle competitive swimmers. ACSM 59th Annual Meeting and 3rd World Congress on Exercise is Medicine, 2012.

競技力向上にはスタート局面やターン局面のストリームラインや水中ドルフィンキック技術が重要である．本研究は，水泳時の速度曲線が記録できるスピードメータおよび動作パターン分析装置を用い，一流競泳自由形短距離選手の技術分析を行った．その結果，ターン局面にお



Skill Differences for Elite Sprint Freestyle Competitive Swimmers

Tetsuya Tanaka[1)], Yutaka Yoshimura[2)], Michio Yasukawa[3)] and Kazuo Oishi[4)]

[1)] Department of Industrial and Systems Engineering, Graduate School of Science and Engineering, Chuo University, Tokyo Japan
[2)] Institute of Health and Physical Sciences, Chuo University, Tokyo Japan
[3)] Faculty of Science and Engineering, Chuo University, Tokyo Japan
[4)] Department of Sport and Wellness, Rikkyo University, Saitama, Japan

INTRODUCTION: Recently swimming techniques for competitive swimmers has been analyzed individually at four phases, i.e., the start phase, the stroke phase, the turn phase, and the finish phase. Those analyses provide the understanding of the importance for techniques at start and turn phases, e.g., the streamline and the dolphin kicking, in order to improve the swimming performance. However, those techniques have been usually assessed according to the subjectivity without evidence in many cases.

PURPOSE: The purpose of this study was to analyze skills of dolphin kicking in turn phase.

METHODS:

Subjects:

Six short distance freestyle competitive swimmers. They were all belonging to the winning team of the Japan intercollegiate swimming championship (2011).

A speed meter:

This measures the subject's moving velocity and distance changes by pulling a fine wire over a generator (Maglischo, 2003). This speed meter recorded their intracyclic distance changes during a 15m maximum effort freestyle swimming including the underwater dolphin kicking (5.7±2.0m).

An underwater video analysis system:

This was used to check their swimming motions. Based on the data, the authors divided the kicking cycle.

SAMPLES OF DATA:

Time (sec)

Distance per kick (DPK) = $\frac{d_1}{\text{kicking times}}$, Rate of rise ($\theta$) = $\frac{d_2}{t_2 - t_1}$

RESULTS: There was a significant relationship between the time required to traverse 15m after the turn (8.21±0.44sec) and DPK (0.79±0.07m/kick) for all of the 6 swimmers (r=-0.89, P=0.017; Figure 1). There was also a significant (r=-0.86, P=0.028; Figure 2) relationship between the time to 15m and the rate of rise (0.22±0.09m/sec).

Figure 1. Plot of Time and Distance per kick.

Figure 2. Plot of Time and Rate of rise.

Namely when the DPK and rate of rise were greater, the time to 15m was faster. The multiple regression analysis obtained was as follows: $Y = -3.55X_1 - 2.17X_2 + 11.39$ (where Y = the time required, X_1 = DPK, and X_2 = the rate of rise). The multiple regression analysis showed significant relationships between the time to 15m and both the DPK and the rate of rise (R^2=0.908, F=14.84, P=0.028; Figure 3).

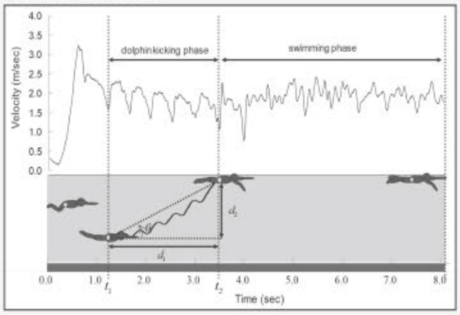
Distance per kick (m)

Figure 3. Plot of Time, Distance per kick and Rate of rise.

CONCLUSION: Improved skills in DPK may be primarily responsible for swimmer's improved performance.

REFERENCE: Maglischo EW (2003) Swimming Fastest. Human Kinetics

SAMPLES OF DATA:



$$\text{Distance per kick (DPK)} = \frac{d_1}{\text{kicking times}},\quad \text{Rate of rise } (\theta) = \frac{d_2}{t_2 - t_1}$$

RESULTS: There was a significant relationship between the time required to traverse 15m after the turn (8.21±0.44sec) and DPK (0.79±0.07m/kick) for all of the 6 swimmers ($r=-0.89$, $P=0.017$; Figure 1). There was also a significant ($r=-0.86$, $P=0.028$; Figure 2) relationship between the time to 15m and the rate of rise (0.22±0.09m/sec).

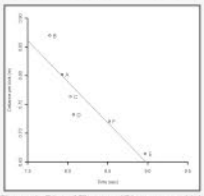


Figure 1. Plot of Time and Distance per kick.

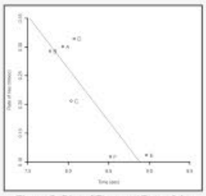


Figure 2. Plot of Time and Rate of rise.

Namely when the DPK and rate of rise were greater, the time to 15m was faster. The multiple regression analysis obtained was as follows: $Y = -3.55X_1 - 2.17X_2 + 11.39$ (where Y = the time required, X_1 = DPK, and X_2 = the rate of rise). The multiple regression analysis showed significant relationships between the time to 15m and both the DPK and the rate of rise ($R^2=0.908$, $F=14.84$, $P=0.028$; Figure 3).

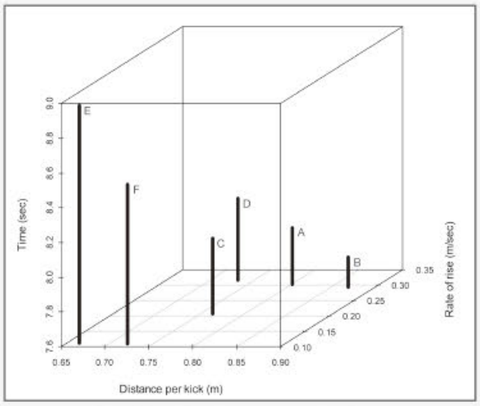


Figure 3. Plot of Time, Distance per kick and Rate of rise.

ける水面浮上角度およびDPKなどの泳技術は，競技成績に大きく影響を及ぼすことが明らかとなった．

3. アシスト泳（牽引アシスト泳の分析）

競技力向上を目標に，パワーの発揮の仕方や効率のよい泳ぎの感覚を学習するため，牽引アシストシステムを用いて，パワープロセッサーの外的牽引力によって自分で泳ぐスピード以上の状態で25mを全力で泳がせ速度と抵抗を計測した．それらの計測と同時に，水中ビデオカメラを用いて測定時の泳ぎを，ダートフィッシュソフトを使い撮影し，比較・分析した．研究では選手を定量的に牽引し，アシストデータを分析した．

水深レベルとストリームライン姿勢の変化

Tanaka, T. et al. Changes of the streamline posture by a difference of the water depth among college swimmers, 16th Annual Congress of the European College of Sport Science, 2011.

本研究では，水中でのストリームラインを保持した状態で，牽引アシストシステムを用いて一定の外的牽引力（6.5N）で25m間牽引した．この際，水深を２段階（水深約35cm，および約90cm）に変えて牽引アシストシステムで速度変化を測定し，かつ水中ビデオカメラを用いて水中姿勢の変化を分析した．被験者はナショナルレベル，カレッジレベルの短距離競泳選手11名（バタフライ２名，自由形８名，個人メドレー１名）であった．その結果，25mの牽引中，スタートおよびフィニッシュ時点からそれぞれ５mを除いた15m間の平均速度を水深の深い所と浅い所で比較したところ，２名の被験者は両者に差はなかったが，他の９名の被験者においては水深の浅い所での方が速度の低下が見られた（Wilcoxon rank sum test, $p<0.01$）．水深の違いでの速度に大きな差が出た被験者は，水中姿勢が大きく変化する傾向にあった（$r=0.53$）．また水中姿勢，特に腰を中心にした上体と下肢の角度を測定すると，この角度が大きな被験者は水深の違いでの速度の変化に大きな差を示す傾向にあった．その結果，水深が浅い所では水の受動的抵抗が大きくなり，速度の低下が大きくなったものと考えられた．水深の浅い所で相対的に速度が低下した被験者は，姿勢変化，特に上体と下肢の角度の変化を小さくすることで競技成績を向上させられる可能性がある．

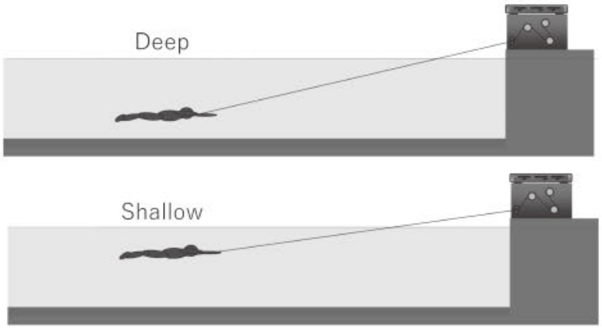


Fig.1　Two water depths

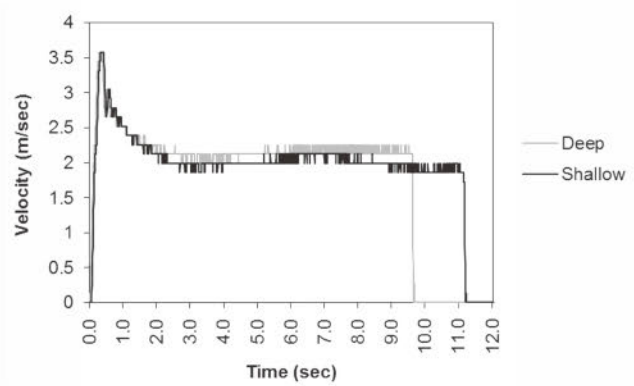


Fig.2　Samples of velocity change curve

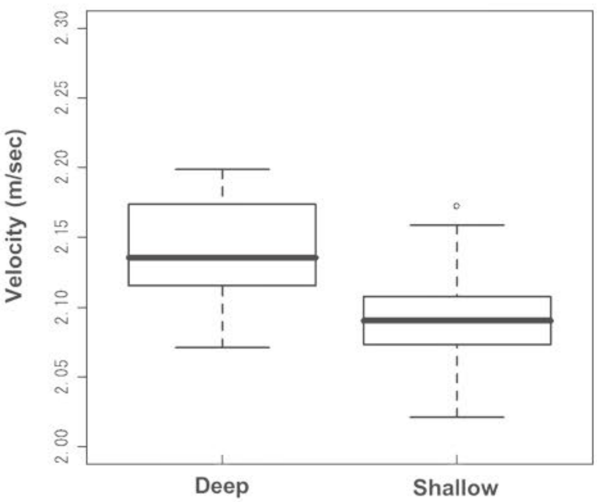


Fig.3　Comparison of mean velocity

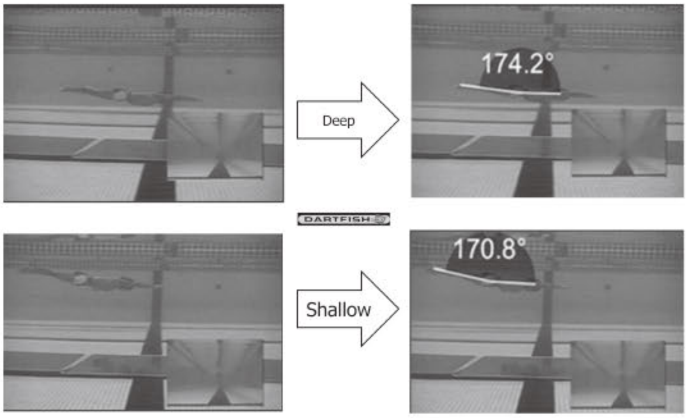
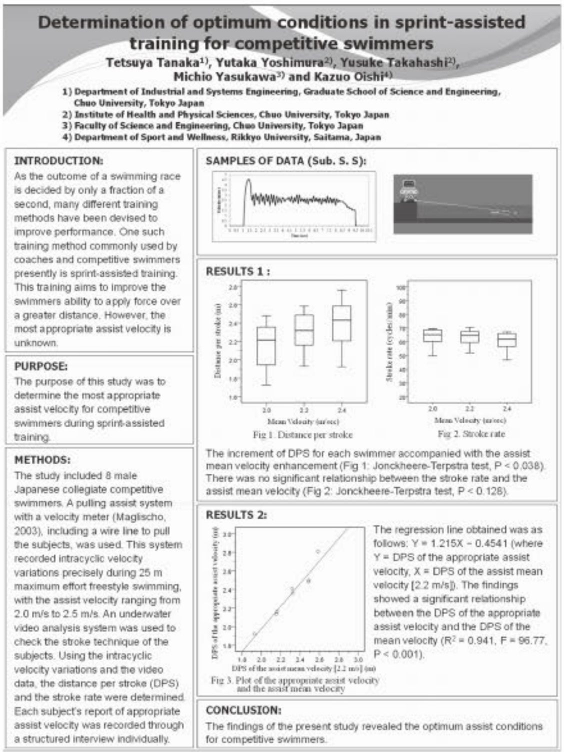


Fig.4 The angles between the upper body and the legs

Tanaka, T. et al. Determination of optimum conditions in sprint-assisted training for competitive swimmers, X11th International Symposium on Biomechanics and Medicine in Swimming, BMS, 2014.



Determination of optimum conditions in sprint-assisted training for competitive swimmers

Tetsuya Tanaka[1)], Yutaka Yoshimura[2)], Yusuke Takahashi[2)], Michio Yasukawa[3)] and Kazuo Oishi[4)]

1) Department of Industrial and Systems Engineering, Graduate School of Science and Engineering, Chuo University, Tokyo Japan
2) Institute of Health and Physical Sciences, Chuo University, Tokyo Japan
3) Faculty of Science and Engineering, Chuo University, Tokyo Japan
4) Department of Sport and Wellness, Rikkyo University, Saitama, Japan

INTRODUCTION:
As the outcome of a swimming race is decided by only a fraction of a second, many different training methods have been devised to improve performance. One such training method commonly used by coaches and competitive swimmers presently is sprint-assisted training. This training aims to improve the swimmers ability to apply force over a greater distance. However, the most appropriate assist velocity is unknown.

PURPOSE:
The purpose of this study was to determine the most appropriate assist velocity for competitive swimmers during sprint-assisted training.

METHODS:
The study included 8 male Japanese collegiate competitive swimmers. A pulling assist system with a velocity meter (Maglischo, 2003), including a wire line to pull the subjects, was used. This system recorded intracyclic velocity variations precisely during 25 m maximum effort freestyle swimming, with the assist velocity ranging from 2.0 m/s to 2.5 m/s. An underwater video analysis system was used to check the stroke technique of the subjects. Using the intracyclic velocity variations and the video data, the distance per stroke (DPS) and the stroke rate were determined. Each subject's report of appropriate assist velocity was recorded through a structured interview individually.

SAMPLES OF DATA (Sub. S. S):

RESULTS 1 :

Mean Velocity (m/sec)
Fig 1. Distance per stroke

Mean Velocity (m/sec)
Fig 2. Stroke rate

The increment of DPS for each swimmer accompanied with the assist mean velocity enhancement (Fig 1: Jonckheere-Terpstra test, $P < 0.038$). There was no significant relationship between the stroke rate and the assist mean velocity (Fig 2: Jonckheere-Terpstra test, $P < 0.128$).

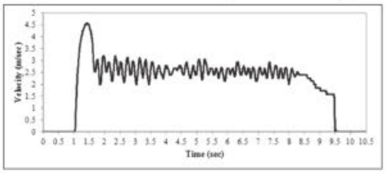
RESULTS 2:

Fig 3. Plot of the appropriate assist velocity and the assist mean velocity

The regression line obtained was as follows: $Y = 1.215X - 0.4541$ (where Y = DPS of the appropriate assist velocity, X = DPS of the assist mean velocity [2.2 m/s]). The findings showed a significant relationship between the DPS of the appropriate assist velocity and the DPS of the mean velocity ($R^2 = 0.941$, $F = 96.77$, $P < 0.001$).

CONCLUSION:
The findings of the present study revealed the optimum assist conditions for competitive swimmers.

SAMPLES OF DATA (Sub. S. S):



RESULTS 1 :

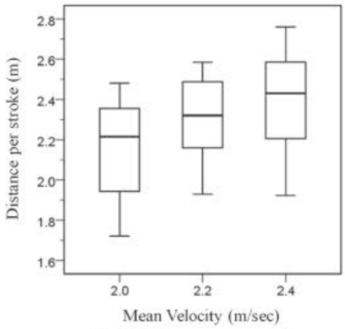


Fig 1. Distance per stroke

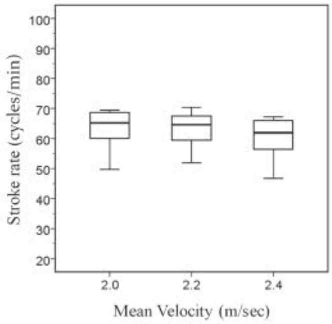


Fig 2. Stroke rate

The increment of DPS for each swimmer accompanied with the assist mean velocity enhancement (Fig 1: Jonckheere-Terpstra test, $P < 0.038$). There was no significant relationship between the stroke rate and the assist mean velocity (Fig 2: Jonckheere-Terpstra test, $P < 0.128$).

RESULTS 2:

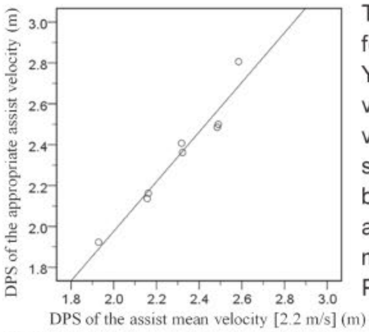


Fig 3. Plot of the appropriate assist velocity and the assist mean velocity

The regression line obtained was as follows: $Y = 1.215X - 0.4541$ (where Y = DPS of the appropriate assist velocity, X = DPS of the assist mean velocity [2.2 m/s]). The findings showed a significant relationship between the DPS of the appropriate assist velocity and the DPS of the mean velocity ($R^2 = 0.941$, $F = 96.77$, $P < 0.001$).

Tanaka, T. et al. Elbow angle changes during the underwater stroke phase in sprint-assisted training for competitive swimmers, 20th Annual Congress of the European College of Sport Science, 2015.

Elbow angle changes during the underwater stroke phase in sprint-assisted training for competitive swimmers

Tetsuya TANAKA, Ryosuke HOSHINO, Yutaka YOSHIMURA,
Michio YASUKAWA and Kazuo OISHI

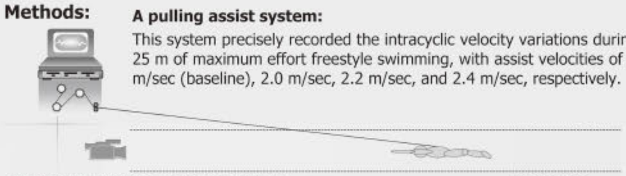
Purpose:

To investigate the effects of changes in the assist velocity on freestyle swimmers' form, with a focus on their elbow movement during the underwater stroke phase.

Methods:

A pulling assist system:

This system precisely recorded the intracyclic velocity variations during 25 m of maximum effort freestyle swimming, with assist velocities of 0 m/sec (baseline), 2.0 m/sec, 2.2 m/sec, and 2.4 m/sec, respectively.



Underwater video analysis system:

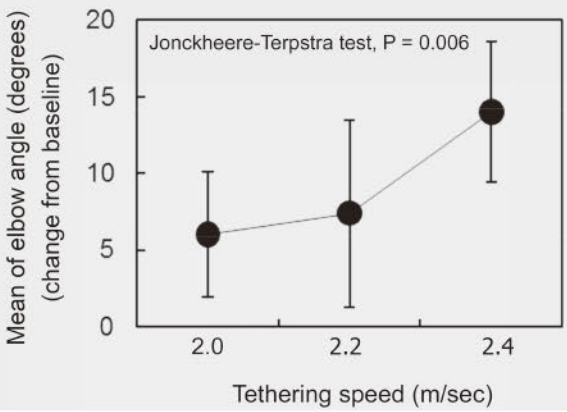
This system was used to monitor the subjects' elbow movement forms in front of the subjects. Using the video data, the elbow angles (degrees of elbow flexion at end of the first half during underwater stroke phase) were determined for each subject.

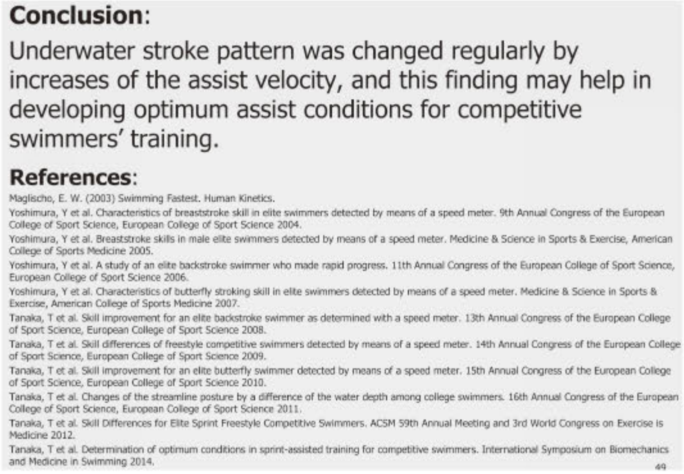
Subjects:

Seven male Japanese freestyle competitive collegiate swimmers.

0 m/sec (baseline) 2.0 m/sec 2.2 m/sec 2.4 m/sec

Results:





謝辞　これまでの国際学会発表の概要をまとめさせて頂きました．最初に述べたように，トレーニング・コーチング研究班は，研究計画を重視する，経験的に知られていることを科学的に定量化する，スポーツの現場に有益になる研究を行ってきたと思います．これまでお世話になった共同研究者，安川通雄研究員，大石和男客員研究員，田中哲也客員研究員に心から感謝申し上げます．最後になりますが，このような執筆の機会を頂いたことにお礼申し上げます．有難うございました．

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4. Characteristics of breaststroke skill in elite swimmers detected by means of a speed meter; Yutaka Yoshimura, Tetsuya Tanaka, Kazuo Oishi, Michio Yasukawa and Kazuo Funato; 9th Annual Congress of the European College of Sport Science, Clermont-Ferrand – France, 2004.
5. Breaststroke skills in male elite swimmers detected by means of a speed meter; Yutaka Yoshimura, Tetsuya Tanaka, Kazuo Oishi, Michio Yasukawa and Kazuo Funato; ACSM 52th annual meeting, 2005.
6. A study of an elite backstroke swimmer who made rapid progress; Yutaka Yoshimura, Tetsuya Tanaka, Kazuo Oishi, Michio Yasukawa and Akifumi Matsuo; 11th Annual Congress of the European College of Sport Science, Lausanne Swiss, 2006.

7. Characteristics of butterfly stroking skill in elite swimmers detected by means of a speed meter; Yutaka Yoshimura, Tetsuya Tanaka, Kazuo Oishi, Michio Yasukawa and Akifumi Matsuo; ACSM 54th Annual Meeting, New Orleans Louisiana, 2007.
8. Skill Improvement for an elite backstroke swimmer as determined with a speed meter; Tetsuya Tanaka, Yutaka Yoshimura, Michio Yasukawa and Kazuo Oishi; 13th Annual Congress of the European College of Sport Science, 2008.
9. Skill differences of freestyle competitive swimmers detected by means of a speed meter; 14th Annual Congress of the European College of Sport Science, 2009.
10. Skill improvement for an elite butterfly swimmer detected by means of a speed meter; 15th Annual Congress of the European College of Sport Science, 2010.
11. Changes of the streamline posture by a difference of the water depth among college swimmers; Tetsuya Tanaka, Yutaka Yoshimura, Yusuke Takahashi, Michio Yasukawa and Kazuo Oishi; 16th Annual Congress of the European College of Sport Science, 2011.
12. Skill differences for elite sprint freestyle competitive swimmers; Tetsuya Tanaka, Yutaka Yoshimura, Michio Yasukawa and Kazuo Oishi; ACSM 59th Annual Meeting; San Francisco California, 2012.
13. Relationship between sports injury and landing step pattern in male long-distance runners; Tetsuya Tanaka, Yutaka Yoshimura, Michio Yasukawa and Kazuo Oishi; 18th Annual Congress of the European College of Sport Science, 2013.
14. Determination of optimum conditions in sprint-assisted training for competitive swimmers; Tetsuya Tanaka, Yutaka Yoshimura, Michio Yasukawa and Kazuo Oishi; 11th International Symposium on Biomechanics and Medicine in Swimming; BMS, AIS Canberra, 2014.
15. Elbow angle changes during the underwater stroke phase in sprint-assisted training for competitive swimmers; Tetsuya Tanaka, Ryosuke Hoshino, Yutaka Yoshimura, Michio Yasukawa and Kazuo Oishi: 20th Annual Congress of the European College of Sport Science, Malmo-Sweden, 2015.
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