Biomechanik in der Synchronpraxis Teil III:

Kopfsteuerung

Der Titel Kopfsteuerung soll zum Ausdruck bringen, daß die Haltung des Kopfes in Beziehung zum Restkörper die Körperhaltung beeinflussen kann und auch bei der Bewegungssteuerung eine große Rolle spielt. Wenn man bedenkt, daß der Kopf immerhin 7% des Gesamtkörpergewichts ausmacht, kann man sich leicht vorstellen, daß der Kopf Körperpositionen und Bewegungen "steuern" und beeinflussen kann.
Hierbei spielen vielfältige Einflußgrößen eine Rolle: Reflektorische Prozesse, die der Gleichgewichtserhaltung dienen (sogenannte Halte- und Stellreflexe, die als bedingte Reflexe aber unterdrückt sind), muskuläre und knöcherne Hemmungen ("Bewegungsblockaden" durch bestimmte Kopfhaltungen) sowie andere biomechanische Einflußgrößen. Oft sind diese Einflüsse nicht voneinander zu trennen, weil sie gemeinsam auftreten und wirken.
Die Halte- und Stellreflexe beeinflussen zum Beispiel die Muskelspannung im Rumpf und in den Extremitäten, durch Veränderung der Kopfstellung in Bezug zum Restkörper: Bei genügend starker Kopfrückneigung verringert sich z.B. die Muskelspannung der Beinstrecker, was eine "Hohlkreuzhaltung" begünstigt; bei Kopfvorneigung erhöht sich die Muskelspannung der Beinstrecker, sodaß eine "Sitzhaltung" oder "Entenpohaltung" die Folge sein kann. Der Körper folgt auch Bewegungsvorgaben des Kopfes leichter, wogegen Kopfbewegungen Bewegungen hemmen und behindern können: Beispiel Delphinwelle: Wenn der Kopf die Wellenbewegung beginnt, kann der Körper diese Bewegung besser ausführen, als bei geradem Kopf.
Was sind nun die Schlußfolgerungen, die hieraus für das Synchronschwimmen zu ziehen sind?

1. Fehlhaltungen des Kopfes bewirken oft Fehlhaltungen des ganzen Körpers: Beispiel senkrechte Position: Bei Kopfrückneigung steht die Schwimmerin oft im Hohlkreuz, befindet sich der Kopf zu weit vorn auf der Brust, ist eine "Hüftknickhaltung" oder "Entenpohaltung" die Folge. Wenn wir als Trainer bei Körperhaltungsfehlern also zuerst überprüfen, ob die Fehlhaltung durch falsche Kopfhaltung bedingt ist, können wir uns viel unnötige Korrektur ersparen, weil nach der Kopfhaltungskorrektur die Position meistens besser wird (dies gilt in besonderem Maß für Anfänger, die noch nicht so bewußt an ihre Haltungen und Bewegungen denken).

2. Nicht nur bei Positionen, sondern auch bei Bewegungen ist die Kopfhaltung wichtig: Wird z.B. bei Abrollbewegungen der Kopf zur Brust genommen, funktioniert der Anfang des Abrollens zwar besser, gegen Ende blockiert der Kopf dann aber die Hüftöffnung und vollständige Streckung, außerdem wird dadurch das Mitnehmen der Beine (Überziehen) begünstigt. Beim Abrollen mit dem Kopf in der Verlängerung der Wirbelsäule ist es einfacher, die Beine senkrecht zu halten und eine runde, harmonische Abrollbewegung bis in die korrekte Streckung hinein auszuführen.
Für Ausschwünge in die Rückenlage gilt folgendes: Im letzten Teil des Hochkommens nehmen Anfänger oft den Kopf vor, in der Annahme, dann schneller oben zu sein. Das Gegenteil ist der Fall, weil die Hüfte einknickt und der "schwere" Kopf den Auftrieb der Lunge zur Wasseroberfläche behindert.
Auch das Runterziehen aus der Bauchlage in die Hechtposition vorwärts ist eine stark kopfbeeinflußte Bewegung: der Wasserdruck drückt den Kopf etwas in den Nacken, wenn nicht bewußt gegengehalten wird. Das bewirkt ein "Entenpo"-Hohlkreuz das die Bewegung und die Endposition (Hechthaltung vorwärts) behindert. Durch leichtes Vornehmen des Kopfes (Doppelkinnhaltung) kann das behoben werden, der Rücken ist dann gerade. Allerdings darf der Kopf nicht zu stark nach vorn genommen werden, weil sonst ein "Rundrücken" die Folge ist.

Der Kopf kann also bewußt bewegungssteuernd eingesetzt werden. Es ließen sich natürlich noch unendlich viele Beispiele für "Kopfsteuerung" finden, was den Rahmen dieses Artikels jedoch sprengen würde. Ich hoffe aber, daß Aktiven und Trainern jetzt bewußt ist, welchen großen Einfluß die Kopfhaltung im Synchronschwimmen besitzt und daß jeder in der Trainingspraxis verstärkt darauf achtet. Der Lohn daraus ist das schnellere Erkennen von Fehlerursachen und das kreativere Umgehen bei Technikumwandlungen und -neuerungen, frei nach dem Motto: "Kopfsteuerung mit Köpfchen."

Birgit Leipner

A KINEMATIC ANALYSIS OF THE BODY BOOST OF JAPANESE ELITE SYNCHRONISED SWIMMERS

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INTRODUCTION

The body boost, a maneuver to propel the swimmer's body from the water, is one of the most fundamental and important techniques in synchronised swimming. It is achieved normally with the eggbeater kick or the straight downward kick. The better a swimmer executes the body boost, the higher her body will rise from the water and the longer she will remain elevated from the surface. The purpose of this study was to estimate the kinematic parameters of the body boost by using a three-dimensional video analysis, and to identify the factors required to execute an excellent body boost.

METHODS

Nine female synchronised swimmers served as subjects for this study. All subjects were Japan national B team members. Each subject performed the body boost with the catch, which is a maneuver by which the swimmer kicks downward in order to sustain an elevated position as soon as maximum height is reached. Each swimmer's body boost motion was recorded by four video cameras (30fps): two above the water surface and two below. The DLT method was used to obtain 3-D space coordination of all body segments.

RESULTS

There was no great difference among the subjects in the height of the vertex of the head. However, great differences were found in support time (defined as the time beginning when the navel rises above the surface to the time it falls back under the surface): namely, the maximum support time was almost twice the minimum.

DISCUSSION

Among the subjects with shorter support times, the navel was already below the surface by the time the knee joint angle was flexed for the body boost (that is, as the knee is lifted in order to kick downward in the catch motion). This meant that the catch motion of these subjects was ineffective for keeping the body elevated. On the other hand, for the subjects who achieved longer support times, the knee flexion and extension were observed before the navel level was submerged. Since the timing of knee flexion is a basic element of the catch motion, the difference in the timing of knee flexion between these two subjects was considered to determine the catch motion's effectiveness or ineffectiveness.

ANALYSIS OF THE VERTICAL SCULLING TECHNIQUE

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Using Athletes of Varing Levels of Proficiency

Within those sports which possess a varied structure of movements at each stage of coming into being and development of the sport skill, technical preparation is an important aspect of the training process.

Mastery of the techniques of synchronized swimming and its development is linked to sculling movements which ensure the possibility of performing elements and figures. Perfection of the sculling technique is one of the methods of raising the technical skills of synchronized swimmers.

The most complicated stroke in synchronized swimming is the "support scull" which holds the body in a vertical position. Opinions differ greatly among trainers and specialists as to what is the most effective hand movement trajectory for the support scull:

40% favor the Figure Eight stroke;
35% the Loop;
15% the Ellipse, and
10% favor the Rectilinear.

And so, to one of the most important questions affecting the sculling technique, there appears to be a wide range of conflicting opinions based on the trainers own personal observations.

Reserach Needed

It was decided to research the problem, to study the kinetic characteristics of the Support Scull performed vertically by athletes of varying degrees of proficiency.

In order to study sculling movements, a double view filming method was used. This enabled the movement techniques to be seen both in the vertical and horizontal planes. Analysis of the material thus obtained helped the study of the kinetic characteristics of sculling among synchronized swimmers. Thirty athletes of varying levels of proficiency took part.

Results of the Research

A graphic prepresentation of the Support Scull, taken in the vertical plane (side view) showed that the sculling trajectory of the skilled athletes takes the form of an ellipse, while in the front view, the figure eight shape is assumed. The hand performs a movement in an ellipsical-figure eight trajectory. At first, it moves sidewards and backwards to a position lateral to the body, then, as it falls, it goes through lower layers of water before returning to the starting position, having formed an ellipse. (diagram 1A)

Unlike better qualified athletes, those of lower skill levels, produce a trajectory both in the lateral and horizontal planes resembling the figure eight. Moreover, while the hand movement of the skilled athletes in the horizontal plane covered an extended figure eight trajectory with flat hands, the less skilled athletes performed the sculling movement in a bulging trajectory, drawing out the lower part of the figure eight. In this stroke, the hand moved from the upper to the lower part of the figure eight, and on reaching its lowest point, it returns in the opposite direction, completing the trajectory (diagram 1B).

Graphic analysis has revealed much about the complicated and multi-plained character of the hand movement of synchronized swimmers. The trajectory of the sculling stroke in the spatial representation has a pronounced figure eight shape, however, the orientation of the loop among higher and lower skilled athletes differs. The sculling stroke of the skilled athletes originates in the horizontal plane, whereas those less skilled perform the stroke primarily in the frontal plane. Consequently, the lower skilled athletes commit such errors as vibration, loss of height and deviation from vertical.

The level of skill in synchronized swimmers is mutually-linked to variations in the use of strokes being employed. The study of sculling movements is held to be impossible without a structured approach to the complex entirety of the stroke as well as its division into separate phases.

The Sculling Stroke Phases

The separation into phases was carried out with regard to the movement of the hand at specific moments and at various points during the trajectory of the stroke. The analysis of two hydro-dynamic forces, the lifting force and the frontal resistance force, as well as the study of the changes in their relationship during the sculling cycle have allowed for a division of the stroke into four phases: primary, restraining, return and transitional. The limits of the phases are represented in diagram 2.

Primary Phase

In the primary phase, the hand moves outside, with a relatively slight angle of attack of a 10-15% grade, and the hand has a greater lifting strength with little forward resistance. This permits the extremities to be supported high above the surface of the water.

Restraining Phase

In the restraining phase, the hand performs a sideways, downward movement. The resistant force is directed vertically upward while the horizontal force is zero. The fraction strength is created only at the expense of forward resistance strength. The position of the hand, opened up at an angle of a 90 degree grade in the direction of its movement, is not optimal since a disruption in the flow from the hand surface takes place, which obstructs the smooth flow of the hand.

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SCULLING ANALYSIS Continued. . .

Return Phase

In the return phase, the hand moves inwards in the opposite direction and the reaction values of both the forward resistance force and the lifting force become equal
The hand thus performs a supportive function.

Transitional Phase

In the transitional phase, the hand moves upward, turning at the same time, so that the flow of water runs against the edge of the hand. The resultant force is directed downward and the hand changes its position, turning through 90 degrees gradually to complete the sculling cycle.

Temporary characteristics link separate movement elements into one complete movement. The general duration of the sculling cycle among athletes of higher and lower skill levels does not differ greatly: 0.70 ± 0.09 for the former and 0.65 ± 0.06 for the latter.

A basic perculiarity of the phased cycle structure of senior ranked athletes is improvement of the duration of the primary and return phases at the expense of a reduction of the restraining and transitional phases (diagram 3). The reason for such a change in the time relationship of the phases lies in the nature of the supportive interaction of the hand with the flow of water.

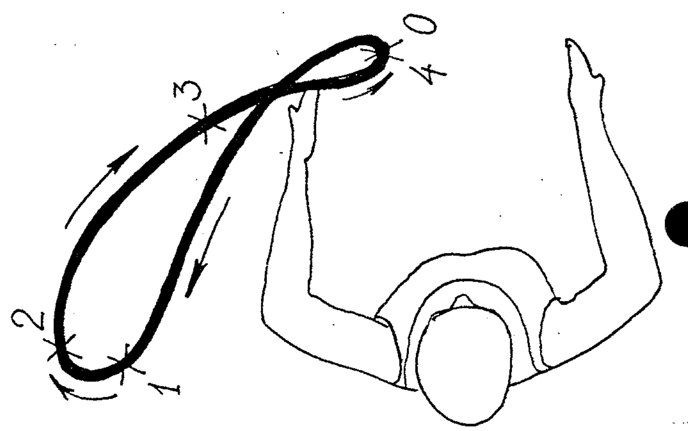
Diagram 2
(below and to right)

Movement of the hand at specific moments and various points during the trajectory

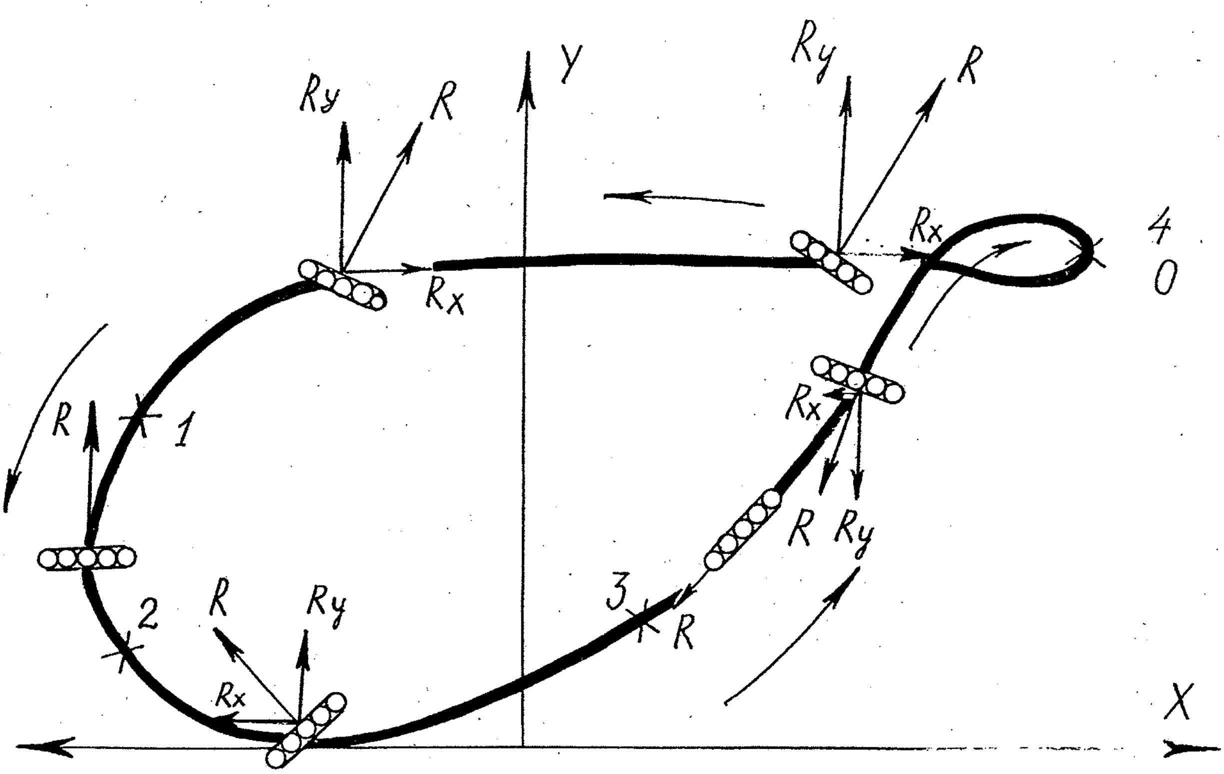
Speed of the Sculling Movement

In studying sculling movement techniques, it is also important to establish the speed of the hand movements. analysis has shown that the speed of the hand movement throughout the stroke is not uniform. Towards the end of the sculling movement, the hand picks up speed, reaching a maximum speed in the return phase (diagram 4).

Research of the average hand speed movement among athletes of higher and lower skill levels has established that greater skill does not mean an increase in the speed of the movement.



Horizontal Plane



Vertical Plane

Frontal Plane