

The Comparative Characteristic Indicators of the Kinematics of the Flèche Skill in Foil Fencing

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Abstract

This research aims at identifying the comparative characteristic indicators of the kinematics of the Flèche skill in foil fencing. The descriptive method was used, being suitable for this type of research. The study sample consisted of 2 fencers: 1 high-level fencer, and 1 under 15 years old ordinary fencer. Video shooting and kinematographic analysis were conducted on the kinematical variables (time – horizontal and vertical speeds of joints – speed achieved – angular speed and velocity of the body centre of gravity) in the main positions taken for analysis, including the on guard position, losing balance with the back foot leaving the floor, flying with the leading foot leaving the floor, landing (balance recovery). Results of the research showed an increase in the vertical speeds and velocities in the ordinary fencer, an undesirable increase because of the direction of the movement, and an increase in the horizontal speed in the high-level fencer. It is recommended to develop the kinematical variables that could help improve the performance level of fencers.

Introduction and research problem

Studying the ideal technical style in sports activity greatly contributes to the improvement of performance and helps athletes exploit their potential and individual abilities to attain the highest levels of championship, while economizing efforts exerted. This is only possible through the conscious understanding of mechanic and technical foundations and components. According to Gamal Zaher (2007), success in winning fencing championships in international competitions depends on several physical and skillful factors which must be upgraded side by side to win championships and realize sport achievements. (4 – 65).

Abbas El-Ramly (1981) (13) suggested that the analysis of skillful performance in fencing using cinematographic shooting and kinematographic analysis represents an important step in preparing the fencer and honing his/her skills when training for competition or championship. The Flèche skill is one of the major factors leading to winning competitions, because it

involves the quick, surprising attack on the opponent using the weapon and the body together. It is used in all fencing schools and in two types of fencing: the foil and the sabre. The skill was officially abolished from the saber fencing in accordance with the amendment of the 1995 Law of the Egyptian Fencing Federation.

D. Gordon, E. Robertson, Graham Caldwell, Joseph Hamill and Sauders N. Whittlesey (2004) (14) stated that the Flèche is used when the opponent is far from the reach of the fencer with the aim of gaining time and distance. The skill requires speed, strong performance and choosing the appropriate time to touch the targeted point in the opponent's body. It is a skill to be mastered by the fencer for its genuine effect on the result of the game and because it helps the fencer control the fencing distance. To be successful, the Flèche depends on surprise and quick performance.

According to Gamal Abdin (1989) (5), Nancy (1989) (16), Mahrousa Aly Hassan (1999) (11),

the Flèche skill can be divided into three phases as follows:

- ❖ The preparatory phase, including:
 - The on guard position
 - The arm extending position, while stepping forward
- ❖ The main phase, including:
 - Losing balance
 - Flight
 - Effecting the touch
- ❖ The final phase, including:
 - Balance recovery
 - landing

A review of fencing international competitions played in the recent years as recorded on compact discs, with a view to tracking the Egyptian performance, showed a high level of technical performance in the teams of Germany, Hungary and Belgium compared to that of the Egyptian team. The former reflected speed, strong performance and high connectivity between skilful, technical and physical performances. Analysis of the Flèche skill as illustrated through replay of 102 matches, using the three techniques of display (slow, normal level and still), and excluding matches uncompleted due to injuries, proved that the teams of the three European countries used the Flèche skill more often, compared to Egyptian team. This was the underlying cause of conducting this study to identify the comparative distinctive indicators of the kinematics of the Flèche skill in foil fencing.

Objective of the study

Identifying the comparative distinctive indicators of the kinematics of the Flèche skill in foil fencing.

Hypotheses

There are differences in the comparative distinctive indicators of the kinematics of the Flèche skill in foil fencing between the following phases:

- The on guard position
- Losing balance

- Flight
- Landing and recovery

Research procedures

Methodology

The descriptive method was used, being suitable for this type of research.

Research sample

The study sample was intentionally selected and consisted of 2 fencers classified as follows: 1 high-level fencer, and 1 under 15 years old ordinary fencer. Each fencer performed three Flèche movements. Fencers were selected according to the following criteria: registration in the records of Alexandria Fencing District; a period of practicing fencing no less than 5 years for the high-level fencer, and no less than 3 years for the normal level fencer under 15 years old. Distinctive indicators of the skill were analyzed to detect points of weakness.

Research scopes

Time scope

The study was conducted in the period 06/11/2009 – 08/01/2010

Geographical scope

Alexandria Fencing Club

Data collecting tools

Video-tapes

The video clips were shot from a vertical level (90°), so that the fencer would be displayed in a size that is easy to analyze and the angle between fencer and lens covers performance limits.

Kinematographic analysis

The best successful of the three attempts by each fencer was chosen for analysis using the computer and analysis software. Analysis determined the major phases of the skill which were:

- the on guard position,
- losing balance with the back foot leaving the floor,
- flying with the leading foot leaving the floor,
- landing (balance recovery).

Kinematical variables

The time for each phase and the total time taken;

The horizontal and vertical speeds of the fingers, the wrist, the elbow, the shoulder, the ankle, the knee and the thigh in each position taken for analysis;

The speed achieved, and the angular speed and velocity of the body centre of gravity in each position taken for analysis.

Presentation of the study results

Figure (1) the sketch of the Flèche skill in high level fencers

Figure (2) the sketch of the Flèche skill in normal level fencers

Table (1)

The time frame of the Flèche skill in high level and normal level fencers

Skillful performance phases	High level fencer	Normal level fencer
On guard position	.49	.61
Losing balance	.21	.17
Flight	.12	.07
Landing	.12	.163
Total time of the skill	.94	1.013

Table (1) shows that although the total time taken by the high level fencer (.94 s) is very close to the time taken by the normal level fencer (1.013s), there are still differences in the time taken in different phases.

Table (2)

Horizontal speed and velocity of the Flèche skill in the on guard phase for high level and normal level fencers

Anatomy parts	Horizontal speed		Horizontal velocity	
	High level	Normal level	High level	Normal level
Fingers	80.1	0	965.6	732.1
Wrist	47.9	32.7	482.7	395.4
Elbow	65.8	48.9	- 240.2	- 214.5
Shoulder	16.4	14.8	- 240.3	- 235.4
Thigh	15.9	12.7	482.7	395.4
Knee	47.5	32.1	1691.9	964.8
Ankle	- 16.2	14.3	241.3	213.9

Table (2) compares the values of horizontal speed and velocity in the two levels in the on guard phase

Table (3)

Horizontal speed and velocity of the Flèche skill in the losing balance phase for high level and normal level fencers

Anatomy parts	Horizontal speed		Horizontal velocity	
	High level	Normal level	High level	Normal level
Fingers	323.2	- 154.7	- 484.7	- 8842.3
Wrist	259.9	1030.9	- 1449.1	- 8843.4
Elbow	309.1	1267.3	4350.8	7735.9
Shoulder	256.4	1276.9	485.3	- 7366.9
Thigh	162.1	635.8	- 2655.8	4789.8
Knee	47.6	415.7	1932,6	5527.5
Ankle	-	97.8	- 5154.	- 2213.0

Table (3) compares the values of horizontal speed and velocity in the two levels in the losing balance phase

Table (4)

Horizontal speed and velocity of the Flèche skill in the flight phase for high level and normal level fencers

Anatomy parts	Horizontal speed		Horizontal velocity	
	High level	Normal level	High level	Normal level
Fingers	288.9	144.7	-	- 364.8
Wrist	323.2	128.2	- 1691.2	738.6
Elbow	302.6	179.1	1454.0	738.6
Shoulder	334.8	195.6	- 2176.5	1101.5
Thigh	377.0	179.1	969.6	- 1101.5
Knee	289.0	364.8	485.3	2577.8
Ankle	173.7	92.8	2176.5	2213.0

Table (4) compares the values of horizontal speed and velocity in the two levels in the flight phase.

Table (5)

Horizontal speed and velocity of the Flèche skill in the landing phase for high level and normal level fencers

Anatomy parts	Horizontal speed		Horizontal velocity	
	High level	Normal level	High level	Normal level
Fingers	131.7	182.2	- 453.8	- 2230.1
Wrist	265.2	201.2	735.4	- 1115.0
Elbow	210.9	265.4	- 3334.8	- 348.6
Shoulder	492.0	395.0	- 1612.9	1115.0
Thigh	- 259.	265.4	1278.0	2230.1
Knee	348.3	348.6	2519.6	1094.2
Ankle	396.7	339.1	2234.8	4460.2

Table (5) compares the values of horizontal speed and velocity in the two levels in the landing phase.

Table (6)

Vertical speed and velocity of the Flèche skill in the on guard phase for high level and normal level fencers

Anatomy parts	vertical speed		vertical velocity	
	High level	Normal level	High level	Normal level
Fingers	15.9	18.7	1932.7	1978.4
Wrist	15.9	18.7	965.8	987.3
Elbow	15.9	18.7	239.3	283.6
Shoulder	- 159.9	- 166.4	- 1449.2	- 1503.4
Thigh	15.9	18.7	719.7	783.3
Knee	15.9	18.7	- 718.6	- 794.5
Ankle	15.9	18.7	- 719.5	- 782.0

Table (6) compares the values of vertical speed and velocity in the two levels in the on guard phase

Table (7)

Vertical speed and velocity of the Flèche skill in the losing balance phase for high level and normal level fencers

Anatomy parts	vertical speed		vertical velocity	
	High level	Normal level 1	High level	Normal level
Fingers	15.9	186.9	271.4	- 3305.1
Wrist	31.4	309.1	271.4	- 2586.7
Elbow	31.4	382.9	- 735.7	- 746.3
Shoulder	-	- 76.5	996.6	-746.3
Thigh	15.9	27.9	- 1198.8	- 1483.7
Knee	15.9	- 76.5	996.6	- 3674.8
Ankle	15.9	76.5	735.7	- 746.3

Table (7) compares the values of vertical speed and velocity in the two levels in the losing balance phase.

Table (8)

Vertical speed and velocity of the Flèche skill in the flight phase for high level and normal level fencers

Anatomy parts	vertical speed		vertical velocity	
	High level	Normal level 1	High level	Normal level
Fingers	76.7	146.3	- 1197,5	1461.3
Wrist	76.7	169.8	- 1937.8	1069.8
Elbow	31.9	129.8	473.2	359.6
Shoulder	15.9	129.8	- 231.4	759.6
Thigh	- 31.9	- 169.8	- 2648.5	359.6
Knee	89.5	- 89.6	- 2405.3	- 2209.1
Ankle	287.9	18.4	- 2405.3	1452.7

Table (8) compares the values of vertical speed and velocity in the two levels in the flight phase

Table (9)

Vertical speed and velocity of the Flèche skill in the landing phase for high level and normal level fencers

Anatomy parts	vertical speed		vertical velocity	
	High level	Normal level 1	High level	Normal level
Fingers	72.5	- 726.4	269.7	-
Wrist	15,9	- 230.9	246.5	- 735.7
Elbow	142.3	- 965.7	145.6	- 367.6
Shoulder	142.3	- 230.9	72.9	- 2575.9
Thigh	- 131.7	- 1931.7	48.9	3303.6
Knee	- 229.6	- 1931.7	- 48.9	-
ankle	142.3	- 4343.4	173.6	1475.3

Table (9) compares the values of vertical speed and velocity in the two levels in the landing phase

Table (10)

Speed achieved of the body center of gravity in phases of performing the Flèche skill by high level and normal level fencers

Performance phase	Speed achieved	
	High level fencer	Normal level fencer
On guard	72.5	77.0
Losing balance	41.3	37.3
Flight	320.8	303.0
Landing	291.5	116.9

Table (10) compares the values of speed achieved by the body center of gravity in the different phases of performing the Flèche skill.

Table (11)

Angular speed of the body center of gravity in phases of performing the Flèche skill by high level and normal level fencers

Performance phase	Angular speed	
	High level fencer	Normal level fencer
On guard	- 2.915	1.768
Losing balance	1.574	- 3.372
Flight	- 4.553	- 3.879
Landing	- 6.397	4.156

Table (11) compares the values of angular speed of the body center of gravity in the different phases of performing the Flèche skill.

Table (12)

Angular velocity of the body center of gravity in phases of performing the Flèche skill by high level and normal level fencers

Performance phase	Angular velocity	
	High level fencer	Normal level fencer
On guard	- 2.915	1.768
Losing balance	1.574	- 3.372
Flight	- 4.553	- 3.879
Landing	- 6.397	4.156

Table (12) compares the values of angular velocity of the body center of gravity in the different phases of performing the Flèche skill.

Discussion of the results

Table (1) shows that although the total time taken by the high level fencer (.94 s) is very close to the time taken by the normal level fencer (1.013s), there are still differences in the time taken in different phases. While the on guard phase took the high level fencer .49 s, the normal fencer took .61 s to do it. This may be due to the fact that the fencer should fully extend his/her arm in the on guard position because the blade is in a horizontal position. This result agrees with the findings of L. R. William, and A. W. Almsley (2000), i.e., the reaction time of skillful fencers was shorter, leading to a statistically significant shorter total time of response.

The losing balance phase took the high level fencer longer time to finish (.21 s) than the normal fencer (.17). As shown in Tables (3) and (7), values of the horizontal and vertical speeds of the ankle in normal level fencer (97.7 and 76.5 cm/s) were higher than their counterparts in high level fencer (0 and 15.9 cm/s). This also agrees with findings of the previous study according to which movement time after reaction time was shorter in skillful fencers.

The flight time was longer in the high level fencer (.12 s) than in the normal level fencer (.07 s). This complies with the data in Table (10) where the speed achieved was 320.8 cm/s for the high level fencer and – 303 cm/s for normal level fencer. In Table (4), the horizontal speed of the thigh joint was – 377.0 cm/s for the

normal level fencer, and 179.1 cm/s for the high level fencer. This agrees with the mechanical relationship, i.e., flight time increases with the increase in horizontal speed in the flight phase of the skill. Although the total time taken by the high level fencer is very close to the total time taken by the normal level fencer, there are still differences in details of the skill phases, and the time variable plays an important role here.

According to table (2), illustrating values of the kinematical variables addressed in this paper, the high level fencer recorded the highest values of the horizontal speed of the elbow of the working arm in the on guard phase (65.8 cm/s), compared to the normal level fencer who recorded 48.9 cm/s. The value for the horizontal speed of the fingers was also higher in the high level fencer (80.1 cm/s), compared to that of the normal level fencer (0.0 cm/s). This is attributed to the fact that the aim of the Flèche skill is to achieve the touch in the shortest time possible, while applying the principle of surprise. L. W. (1996)(15) stated that performance must combine speed with the accuracy of attack, bearing in mind the relationship between accuracy and speed. In order to achieve this, rules of mechanics must be appropriately complied with.

Based on the previous discussion, horizontal parameters were more important than vertical parameters. The high level fencer achieved a higher horizontal speed of the working arm than the normal level fencer who recorded higher vertical speeds (which are not required in view of the direction of movement).

Regarding the losing balance phase, tables (3) and (7) indicate a great and sharp increase in the

kinematical variables of horizontal and vertical speeds in normal level fencer, compared to the high level fencer, sometimes reaching double the value.

The kinematical parameters of the flight phase showed higher horizontal speed values in most of the anatomical points measured in the high level fencer than in the normal level fencer, and lower vertical speeds in the high level fencer, compared to the normal level fencer. The time taken by the high level fencer was .21 s, compared to the time taken by the normal level fencer, which was .17 s. This means that performance of the Flèche skill does not require increasing the flight time, but a speedy movement forwards where the body movement is not affected by gravity, regardless of the air resistance.

Based on the previous discussion, horizontal parameters were more important than vertical parameters. Tables (5) and (9) show that the high level fencer achieved higher horizontal and vertical speeds in the landing phase, compared to the normal level fencer. This means higher values of the speed achieved, a fact supported by results of Tables (10) and (1), where the high level fencer achieved a shorter time of landing than the normal level fencer, and where the high level fencer recorded higher values of the speed achieved by the body center of gravity, compared to the normal level fencer. This may be attributed to the fact that the high level fencer has more experience and more training years, leading to a better performance of the skill. This agrees with the findings of Osama Abdel Rahman (2008)(2) who suggested that distance, timing and rhythm are major factors that contribute to a successful attack (2: 196).

The values for the angular speed in the on guard phase in Table (11) were higher in the high level fencer compared to the normal level fencer, thus affecting the speed of the whole body, so that the speed achieved by the body center of gravity was 72.5 cm/s in the high level fencer and – 77.0 cm/s in the normal level fencer.

It was also noted that the high level fencer achieved a higher speed of the body center of gravity, compared to the normal level fencer, which was obvious in the flight phase, because the speed achieved depends on the speed of the

working joints, a fact supported by the data in Table (10). Such an increase in the kinematical variable leads to an improvement of the performance of the Flèche skill in the on guard and flight phases. Thus the hypothesis of the research is proved to be true.

Conclusions

Although the time structure of the skill as a whole is almost the same, there are differences in details of each phase.

The on guard phase: regarding the values for speeds and velocities, the high level fencer achieved a higher horizontal speed of the working arm than the normal level fencer who recorded higher vertical speeds (which are not required in view of the direction of movement).

The losing balance phase: the values for horizontal and vertical speeds are higher in the normal level fencer than in the high level fencer.

The flight phase: the high level fencer achieved higher values for the horizontal speeds and velocities of the arm and leg than their vertical counterparts.

The landing phase: there was an increase in the values for the kinematical variables of the center of gravity in the high level and normal level fencers in the losing balance, flight and landing phases.

Recommendations

- More attention should be given to the kinematical analysis in evaluating the kinetic performance of all types of fencing and of sport activities in general.
- The kinematical variables that help improve the performance level of fencers should be developed.
- Focusing on the horizontal speed of the fencer to achieve the aim of the skill.

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