LOWER AND UPPER EXTREMITY COORDINATION PARAMETERS DURING THE FENCING LUNGE

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INTRODUCTION: The fencing lunge executed by a combined action of leg extension and stretching of the arm on the weapon side is one of the most important motion elements of this sport. The lunge is most often used to attack the opponent, hitting the opponent as quickly as possible, and ending by scoring a hit. The translational motion of the weapon during the fencing lunge is determined by muscular properties of the athlete in the force-time domain and by coordination of the actions of the lower and upper extremities. In this study, an attempt is made to obtain objective data about arm and leg actions and their coordination in executing the fencing lunge.

METHODS AND PROCEDURES: A group of four highly skilled female fencers aged 16-17 years took part in the investigations. The subjects performed the fencing lunge from a resting position upon a given command with maximal effort. This experimental situation corresponds to that used in training for the lunge. In this way, the effects of reaction time or the conditions of any fighting situation could be omitted.

In order to gain insight into the repetition capabilities the subjects performed at least 8 trials. The fencing distance to be covered to hit the wall target was chosen individually by each test person. Geometrically, the fencing lunge consists of a change from an initial position of body and weapon to a final position, as shown schematically in Fig.1.

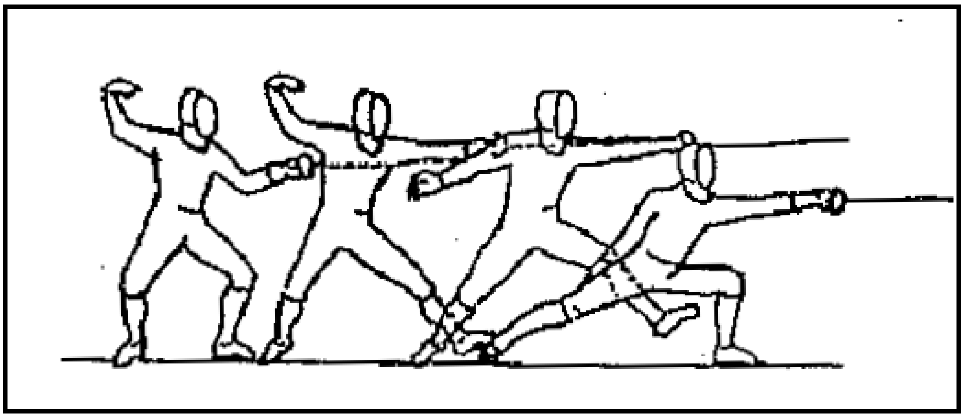


Fig1: Phases of the fencing lunge (Civrny, 1982)

So, the lunge movement is performed executing coordinated stretching movements of the lower and upper extremities in order to pass over the distance of the foil from the initial position to the wall target (or opponent athlete) as fast as possible. A description of the movement can be obtained by measuring the following time dependent data: position of foil (hand), elbow, shoulder, hip, knee, ankle on the weapon's side and determining their linear velocities (horizontal and vertical components. This description can be completed by the determination of angles between body parts (i.e. elbow angle, upper arm/trunk angle, hip angle, knee angle etc.) and their derivatives in time as angular velocities of the joints involved. Since the movement of the hip on the weapon's side summarizes the stretching activity of the lower extremity on the opposite side and the leg swing action effect on the weapon's side, it was regarded as sufficient to restrict the movement analysis to the hip on the weapon's side. Kinematic data for the body points mentioned above were obtained using an infrared optical system (SELSPOT II). Here, the movement of active markers attached to the interesting anatomical landmarks was registered by two cameras looking to the weapon's side of the subjects, each delivering the horizontal and vertical coordinates of the markers as digital information and feeding them into a central computing unit. On the basis of an appropriate calibration process, this unit combines the position coordinates, yielding the spatial coordinates of the interesting points for a 3-dimensional data analysis. A schematic view of the experimental setup is given in Fig. 2.

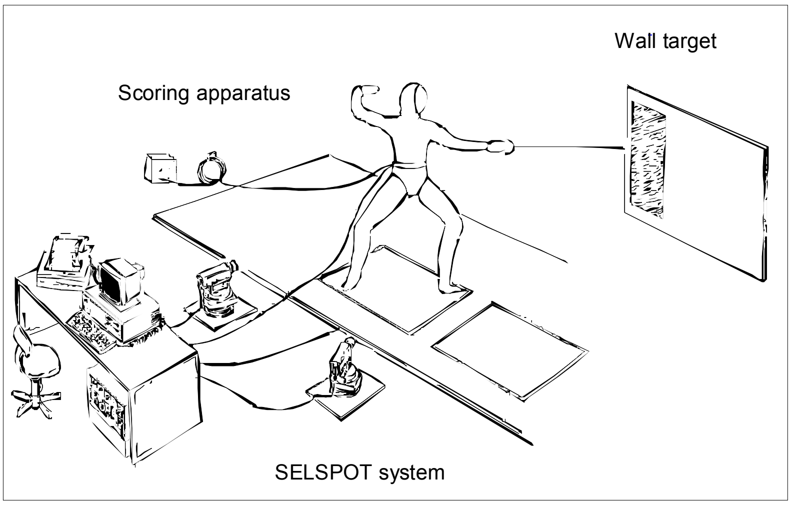


Fig.2: Experimental setup (schematic view)

As can be seen in Fig. 2, a signal was recorded indicating the hitting of the wall target by the foil. This was done in order to gain information about the duration of the lunge as one of the most important parameters in fencing.

RESULTS: The questions to be answered by our results focus on the contribution of the named body parts to covering the distance of the foil from the starting position to the final position when reaching the wall target to be hit. A first result is obtained by considering the resultant velocity values of hip and foil during the lunge. It can be stated that all test persons showed a very good reproducibility of body positions at the beginning and at the end of the lunge. The same holds true for the velocity-time curves of all body points measured, even if each subject performed in her own individual way. Information about the coordination between upper and lower extremities can be obtained by computing the velocity differences between hand (or foil, respectively) and the hip on the weapon's side. For simplicity, this comparison is made referring the horizontal velocities. An example of executing the lunge following the rules of the International Fencing Federation (FIE) is given in Fig. 3.

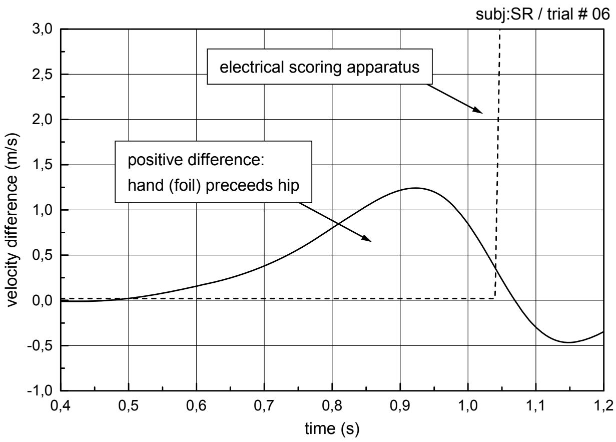
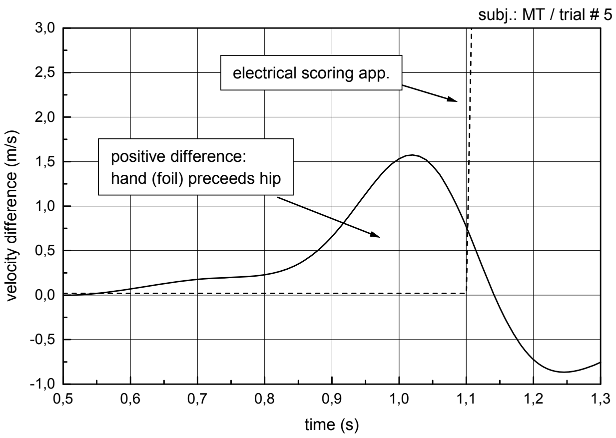


Fig. 3: Upper/lower extremity coordination in the fencing lunge

In the case presented, the hand velocity is always greater than the hip velocity. This means that the rule: "The lunge movement begins with stretching of the arm" is correctly obeyed. The corresponding curves of the other subjects given in Fig. 4 show individual forms whose interpretation presents movement schemes not in accordance with the rules and textbooks (e.g. CIVRNY,1982).



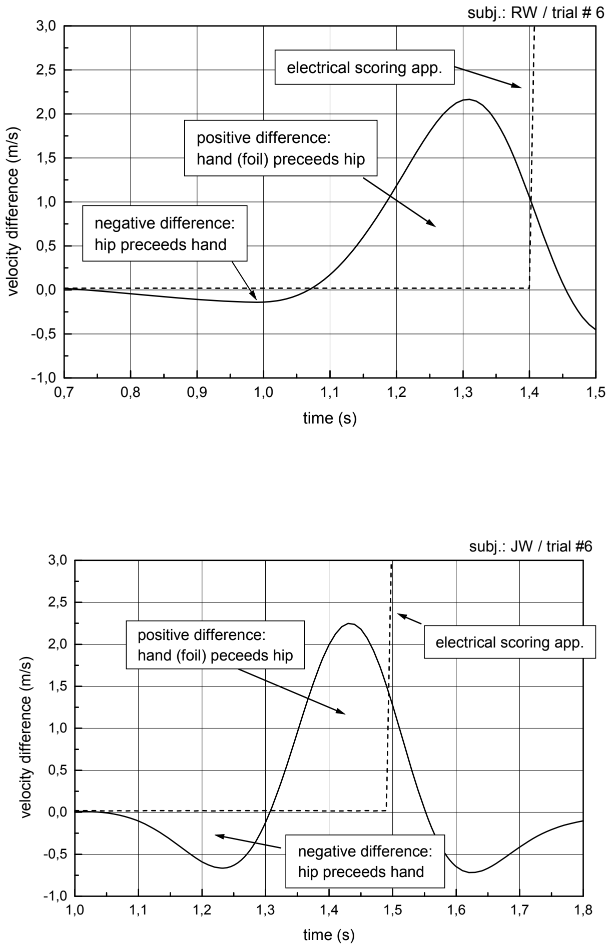


Fig. 4: Individual forms of lower/upper extremity coordination of the fencing lunge.

With respect to the ‘internal’ coordination of the arm stretching movement (i.e., the relations between trunk/upper arm and upper arm/lower arm angles) it can be stated that because of the different initial position of each person - determined by anthropometric data and perhaps by custom - these angles and their derivatives vary greatly. On the other hand, the intra-individual deviations of angles from one trial to another are as small as could be seen from the velocity parameters. Furthermore, the maximal values of the angular velocities of elbow and shoulder coincide with the maximal values of the linear velocities.

REFERENCE:

Civrny, C. (1982). Modernes Sportfechten - Anleitungen für den Übungsleiter. München.