Analysis of the rear leg rotation movement during the fencing lunge

MANUEL SILLO, FRANCISCO SAUCEDO, ENRIQUE LÓPEZ, RAQUEL DE ANTONIO, OSCAR MARTÍNEZ DE QUEL

Universidad Politécnica de Madrid.
Universidad Complutense de Madrid.
Madrid. España.

Correspondence to:
enrique.lopez@upm.es

Keywords:
Biomechanics, fencing, lunge, kinematics

Introduction
The most relevant authors of fencing agree on the extension of the rear leg’s knee from the on guard position, which is the one that provides the real speed to the lunge, and the extension of the arm only serves to drive the points towards the target.

All the authors coincide that it is important to keep the whole sole of the rear foot supported on the floor, keeping the same direction and without sliding it during the movement, being the only one support that assures a really fast and balanced lunge, allowing the return to the on guard position or to continue towards ahead.

Nevertheless, in a competition it may be observed that there are just a few fencers that keep the position of the feet in 90° angle during the lunge, as proposed in the fencing books.

From this situation, we try to know if the rotation movement of the rear leg improve the speed of the Mass Centre and the weapon.

Material and method.
To achieve our objective, a kinematics analysis was carried out. The selected sample was 44 lunges chosen at random, realized by the best Spanish epeeists in two competitions.

The technique used was 3D video. Two fixed cameras were focused to the centre of the fencing court. The distance between them was 12 m.

Previously to filming the matches a 6x2x2m reference system was placed on the court. Once filmed, it was removed. After that, only lunges made inside were chosen for the analysis.
A sample rate of 50 hz was chosen to processing the images, as long as the low speed of the lunge doesn’t need higher frequencies.

To find the kinematics variables values, it is necessary to know the joints and corporal segments positions. On this purpose the lunges images were digitized using the Photo 23D program, which was used for the Clauser (1969) mechanical model of the human body, including 21 points and 2 points added representing the weapon.

The three dimensional coordinates from each one of the 23 points of the model and the Mass Centre, as well as the segment “foot” positions and the speeds of the Mass Centre and the weapon reached during the lunge, were obtained by the BIOMEC software (Navarro, 2000) using the DLT (Direct Linear Transformation) developed by Abdel-Aziz and Karara (1971).

To know the relationship between rotation movement of the rear leg during the lunge and the maximum speed of the Mass Centre and the weapon, a “T” test to mean comparison on independent samples was carried out.

**Discussion and conclusions**

The results show that 40 lunges did an external rotation and only 4 an inward rotation. The “T” test indicates that it doesn’t exist significant differences between lunges with an external or internal rotation, so much for the maximum horizontal speed of the Mass Centre (t = 0.669; p = 0.507), as well as the maximum horizontal speed of the weapon (t = 0.624; p = 0.536). In the Fig. 1, the results are graphically represented.

![Figure 1](image_url)

**Figure 1:** figure shows the maximum speeds of the Mass Centre and the weapon averages, for external and internal rotation of the rear leg.
This rotation movement of the rear leg, during the flight phase of the lunge, is not described by the most relevant texts in fencing. Neither has been studied in the scientific articles dealing with fencing lunge. Only Simonian (1981) contributes about this, affirming that in competition the above mentioned foot rarely remains still during the lunge, not being a problem if a rotation —external or internal— will be done, once the extensors muscles have done already the maximum strength contribution and while the fencer is balanced. The results we have showed confirm this opinion.

As a conclusion, we can affirm the rotation of the rear leg doesn’t improve or damage the reaching of the maximum speed, and in the most of the studied fencers the external rotation movement is the most common.

References