

## **Mean movements and strategy in sport climbing: determinant variables and performance factors**

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### **Introduction**

Climbing, in all its disciplines, is an emergent sport with an increasing number of athletes involved in competition. The major discipline is the leading, characterized by strength and endurance movements on overhanging artificial structures. Score depends on the height reached by athletes. The ascent needs physical, technical and interpretation ability. Increasing performances and specializations need well specified training programs but, at the moment, this kind of sports lacks in scientific studies about kinematics variables and movement strategy. The aim of this study is to collect preliminary kinematics data to identify mean movements and strategy in sport climbing and to verify if it's possible to find determinant variables and performance factors.

### **Methods**

Data of kinematics variables were extracted from a video analysis of 8 female athletes who participated at 2007 Lombardia Regional Cup match. The athletes (20±4 years old, 49±5 kg, 162±4 cm) involved in this study are all well experienced climbers with at least 2 years of competition participation. Following variables were collected: total time, number of holds, speed (mean time for hold), number and time of rests, number and time of clipping, number of hands and feet movements, contraction type (concentric or isometric) time per holds, support type (on holds or on structure) time, technical movements (frontal, lateral, etc) used. All these variables were extrapolated by the digital video analysis frame per frame with "final cut pro" software. Data were imported in excel file format which ensures simple charts vision and different manipulations to identify differences among athletes on the same route or between different routes climbed by one athlete. For each athlete, data were analyzed on the entire height climbed. For interindividual analysis, data were compared normalizing the minimum height reached among all climbers. These information were related with the difficulties of any segments of the routes.

### **Results**

The 2 matches analyzed were characterized by overhanging structures where a lot of endurance movements interrupted by two bouldery sections with strength and technical needing. In both competitions the best results were reached by the fastest athletes with less per cent time spent in concentric phases and clipping. We see that the best athletes are more time in double feet support than the worst ones, and use less movements to reach the same height. Different climbing styles (dominant movements and rhythms) demonstrate to be efficacy at the same way. Comparison between the 2 routes climbed by the same athletes shows that, when it is possible, they choose the climbing style according to their technical and conditioning characteristics.

### **Discussion**

It seems that technical and conditional characteristics are the major variables and their influence is dominant on kinematics data. Total climbing time and technical movements choice are not statistically correlated with results because they depend by individual muscular characteristics, specific technique awareness and routes interpretation. The variables related with results are: clipping time, concentric phase time, mean holding time, movements number and support type time. Finally this analysis method can help to have a better view of athletes profile and to find out weakness points in respect of the racing routes. Interpretation of kinematics data related with physiological aspects is the way to discover determinant results factors and to improve training technique.