

Introduction

Place kicking is very important moment in rugby match, especially in case of match with uncertain result. In Union Rugby Represent one of two moment to increase score and required concentration, muscular strength and ability. Official data from last rugby world championship (Rugby World Cup, 2007) show 296 kicks at goal during competition. It has been noted many times in earlier reports that the success rates of kicks at goal have improved noticeably since the game went professional. In the 5 decades since 1946, conversion rates were 50%, 61%, 55%, 54% and 47% which reflected a running average of 52/53%. Success rates change in relation to field position. In all major rugby competitions with RWC99 showing a conversion success rate of almost 80%. This level of success was not quite maintained however in RWC 2007 where 71% was achieved. Map of conversion success show a 100% success from central position in front of the goal. training. Many papers about injury, body composition, training, match analysis, nutrition in rugby players are present in scientific literature but few papers concerning place kicking (Bezodis, Trewartha, Wilson, Irwin, 2007; Jackson, 2003). Jackson's data are about cognitive and behavioral processes of performers in the few seconds immediately preceding kicking. Paper of Bezodis regarding biomechanics of arms motion during rugby place kicking while the Baktash's data regards effect of different foot position on ball velocity. Usually each team kickers use one of four described start run up position (position 1: one step back, one step sideways; position 2: two steps back, one step sideways, position 3: three steps back, one step sideways and position 4: four steps back and one step sideways). Each kickers choose his own position but choice isn't made on goal attainment.

As already demonstrated in others sport (waterpolo, handball, soccer ecc) kicking is of major importance in rugby but authors can't find papers about place kicking out come in relation to foot position and ball velocity performed in rugby pitch.

The purpose of the present study was to examine if there is

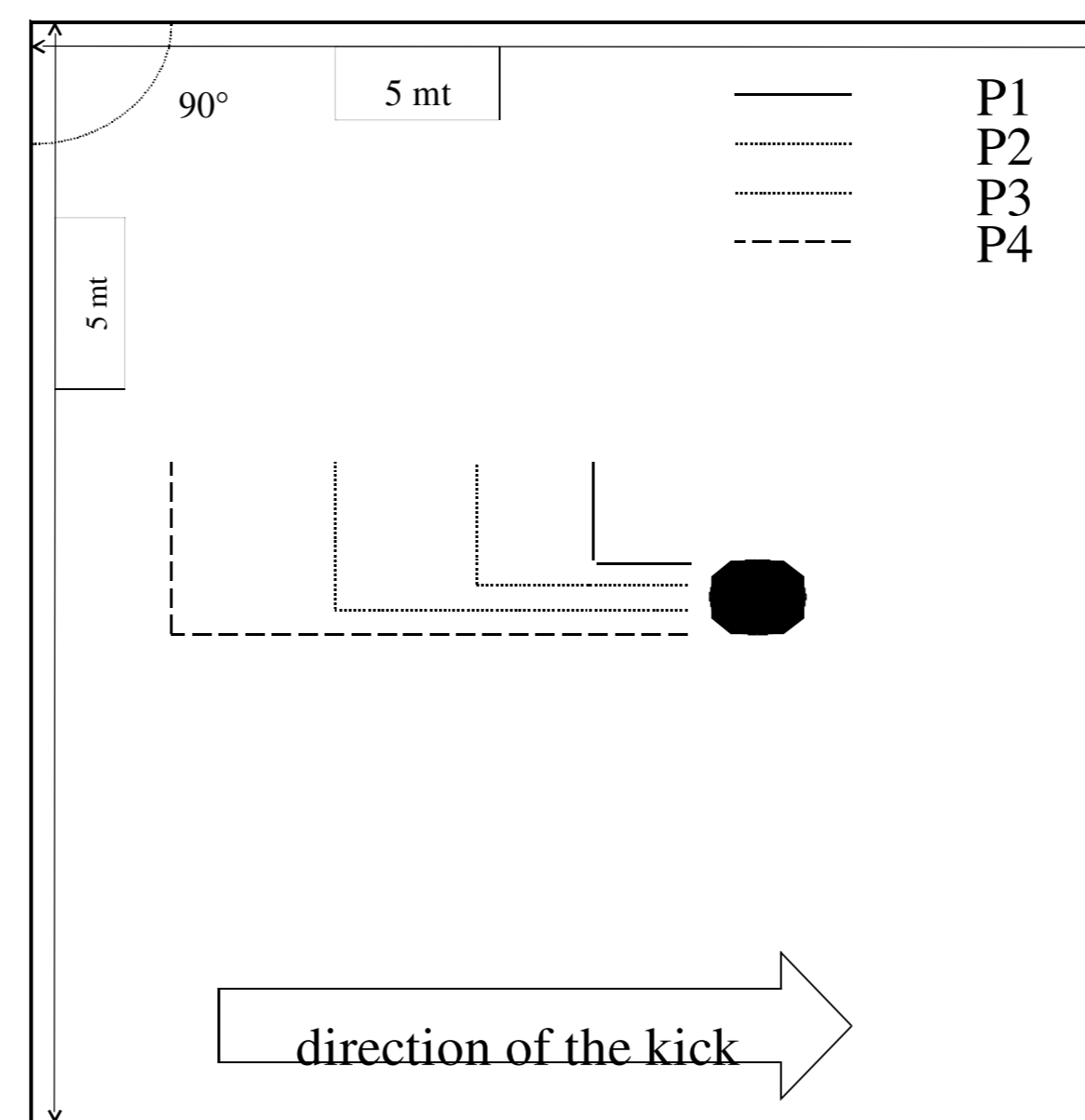
relation between run up start position and kinematics variables as leg on the ground knee degree, hip angle (angle between two legs at ball impact) and ball velocity in rugby place kicking. The second aim of the study was to know relation among run start up position and out come of kicking.



Materials and Methods

Six senior Italian Men's Rugby Union athletes (age $24,83 \pm 5,19$ years, body mass $91,17 \pm 4,62$ kg, height $177,2 \pm 0,04$ cm), BMI (kg/m^2) $29,8 \pm 2,1$ training experience (years) 10, participated to the study. Participants were healthy with no self-reported history of neurological disorders or surgery to the lower limbs. A medical examinations exclude present of muscle skeletal injury. The study was conformed to the Declaration of Helsinki. And to the local ethics committee guidelines and approved by the Institutional Research Board of the Italian Rugby Federation (FIR). After explanation of the procedure risks and goals subjects signed and informed consent

Fig.1



We use four position for place kicking. Position one (P1) is one step back one step lateral to the ball; position two (P2) is two step back one step lateral to the ball; the third position (P3) consist of three step back one step lateral to the ball while position four (P4) is four step back one step lateral to the ball (Fig.1). Changing in start position modify length and direction of run-up. Players perform place kicking at best power, between trials they have four minute of rest. After 15' minutes of codified warming with running, stretching and free throwing. In according to four described position athletes perform random place kicking in according to a Latin square experimental design. Subjects repeated the test in the same condition four times (total 16 throwing for each athlete). Nobody interrupted the procedure and non injury occur to the athlete.

All subjects were healthy at the time of the study and studied in the same moment of seasons. In Table 1 are reported msec of time of the shooting (728 ± 166 sec., $1,099 \pm 151$ sec., 1362 ± 269 and 1569 ± 424 respectively for P1, P2, P3 and P4). As it was hypothesized time increase when players was longer to the ball and it is major in P4 position. Success of throw is not in positive relation whit time spent in run up. Success in place kicking was classified as goal (success) and out the goal (no success) and reported in the table as percent of success for each position. In P1 we record 71,5% in P2 82,5% in P3 74% and P4 67,5%; a statistic significant difference was found among all value. Ball velocity in P1 we record $23,7 \pm 2,3$, in P2 $24,6 \pm 2,3$ in P3 $25,1 \pm 2,7$ and P4 $25,4 \pm 2,4$, a statistic significant difference was found among all value. It is remarkable e statistical difference between position with best value in P2 position. Ball velocity was reported in relation to four described position and data show best speed in P4 position. Increasing when run up distance improve the ball velocity. Relation among speed ball, start run up position and success in kicking are described in Fig 2.

Conclusions

This work demonstrates that the starting position of the shot may further affect the percentage of success. Studies on the kick over the years have been broadened always trying to find the key that explains the intended effect since the issues muscle coordinators (Anderson & Sidaway, 1994b). Several authors have sought the explanation of the phenomenon through the analysis of kinematic (Barfield, 1998). Other authors has investigated the release angle that maximises the distance attained in a long soccer throw-in (Linthorne & Everett, 2006). Interestingly, the study ball impact technique is essential for successful in instep soccer kicking, as some authors illustrate the three-dimensional motion of the foot (plantar/dorsal flexion, abduction/adduction, inversion/eversion) and the motion of center of gravity of the ball during ball impact, examine the interaction between the motion of the foot and the ball behavior during ball impact (Shinkai, Nunome, Isokawa, Ikegami, 2009). Although rugby is a very popular game, there was very little information regarding the analysis of the structure of football. This study presented a training program in detail that can be applied as part of pre-season training of soccer players. It seems that the current program significantly improved several parameters of physical conditioning (speed, strength) and, more importantly, these improvements have been transferred to the performance of Rugby Union athletes in terms of ball speed and technique. These results extend previous suggestions that as specific training program for action sports, the most efficient. Therefore, the application of force and calcium-specific training programs as part of pre-season training for Rugby Union athletes is recommended.

Experimental set-up

Each tested athlete has a own characteristic place kicking position. One subject prefer T2 position, four uses T3 and last one T4. A MITRE CROWN G-spin technology Max 460 Sez.5, 0,6 Bar was used. All subjects use rugby shoes. In a official rugby field the ball was placed 40 meters far to the try line in front of the goal. Colored spot taking place skin on knee, hip and foot bone protuberance. Two high-speed digital camera (Casio Exilim FH020 Hispeed, 210 fps) placed to 0 e 90° was used to videos recording. Dartfish 5.5Pro (Dartfish, Fribourg, CH) was used to video analysis. (Fig.1). Place kick space was delimited by 5.0 x 5.0 m area used as a calibration frame and subjects perform the kick in this space

Procedures

Results

