

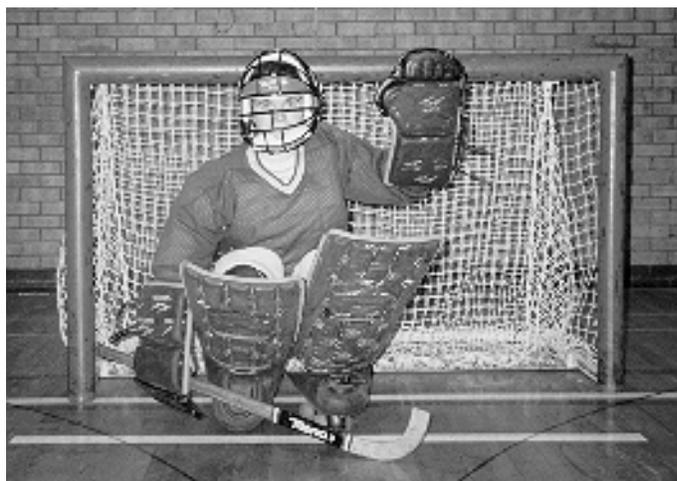
## VIDEO ANALYSIS OF SHOT DISTRIBUTION AND GOALKEEPER MOVEMENT DURING ROLLER HOCKEY MATCH PLAY

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The aim of this investigation was to analyse the position of shots and movement of goalkeepers during roller hockey matches. A video camera recorded the movement of 6 goalkeepers during 6 national roller hockey matches. The position of the goalkeeper and the shots were noted manually from the video recordings. The results showed that, of the 331 shots delivered, the greatest percentage was directed at the bottom corners of the goal. Shots were delivered at a mean interval of 67 s ( $\pm$  79 s) and of the 34 goals scored the greatest percentage were delivered to the top right corner (38%). Goalkeepers displayed a reasonably high number of movements across the goal; however, the greatest duration was spent covering the central area of the goal (69%). Understanding the match play activity of roller hockey goalkeepers enabled greater task specific training.

**KEY WORDS:** roller hockey, goalkeeping, movement analysis, shot, goal

**INTRODUCTION:** Roller hockey is a five-a-side sport, which is technically and tactically similar to ice hockey. This sport is often known as a 'traditional roller hockey'; it is a non-contact game, played on conventional skates ('quads'), with a ball. Roller hockey goalkeeping is an unusual exercise involving quick reactions, flexibility, muscular strength and stamina, all of which are constrained by the weight and size of the protective padding and the position the goalkeeper must adopt. The common playing position for roller hockey goalkeepers is a crouching position as shown in figure 1. These constraints make 'off-rink' training for roller hockey goalkeepers very difficult, it usually involves activities that do not replicate goalkeeping manoeuvres. Before valid training exercises can be developed it is vital to understand the specific movements of the goalkeeper during match play.



**Figure 1 - Roller hockey goalkeeper.**

Roller hockey match play involving Spanish field players has been analysed by Aguado (1991) and Blanco, Ensenat and Balague (1993 and 1994), and Kingman & Dyson (1997a and 1997b) analysed the match play characteristics of English premiere league field players. Only two scientific research articles have been found that mention roller hockey goalkeepers, Rodriguez (1991) and Blanco, Ensenat and Balague (1994). Rodriguez (1991) compared the anthropometric measurements of field players and goalkeepers (of the highest standard in

Spain) and found smaller anthropometric dimensions in goalkeepers than field players. Blanco *et al.* (1994) analysed the activity of top-level Spanish field players and goalkeepers during roller hockey training sessions and competitive matches. The training sessions were divided into categories of activity and blood samples were taken from 1 goalkeeper, 30 s after each training exercise. During 7 competitive matches blood samples were taken from one goalkeeper during time-outs, substitutions and at the end of each half, competitive play was also divided into categories of activity. The results for the goalkeepers showed heart rates of up to 179 beats per minute (bpm) during training, 'one on one' shots at the goal displayed the greatest mean heart rates (154 bpm  $\pm$  SD, 27 bpm) and the highest blood lactate levels (5.7 mmols/l), however during the rest of the training session blood lactate levels were reasonably low. During competition heart rate values for goalkeepers ranged from 110 – 170 bpm with heart rate values remaining below 140 bpm for 71% of the match. The lowest heart rates were recorded when the players were attacking the other goal. The highest heart rates were reported for goalkeepers when they were making direct saves. In general there was a similar blood lactate accumulation during competitive matches for field players and goalkeepers, despite the differences in match play activity.

The aim of this investigation was to analyse the position of shots and the movement of the goalkeeper across the goal during six roller hockey matches.

**METHODS:** The England roller hockey team and five national Premier League teams participated in this study. A Panasonic SVHS AGDP800E video camera was positioned in the spectators stand at one end of the rink, 5 m from the sideline and 5 m above the rink. The camera had a stationary field of view and recorded the activity of the goalkeeper at the other end of the rink. Video recordings of the six national level matches of 40 minutes, 'stop-clock' (this means that the clock is stopped every time the referee blows the whistle and started again when play resumes) were subsequently analysed and the position and time of shots on the goal were manually recorded. To establish the position of the shots the goal was divided into 6 areas (see figure 2), these areas were numbered 1–6 enabling the information to statistically be compared. The time of each shot was recorded to the nearest second. The goal was also divided into left, centre and right (see figure 2) and the duration that the goalkeeper spent in each area was manually recorded.

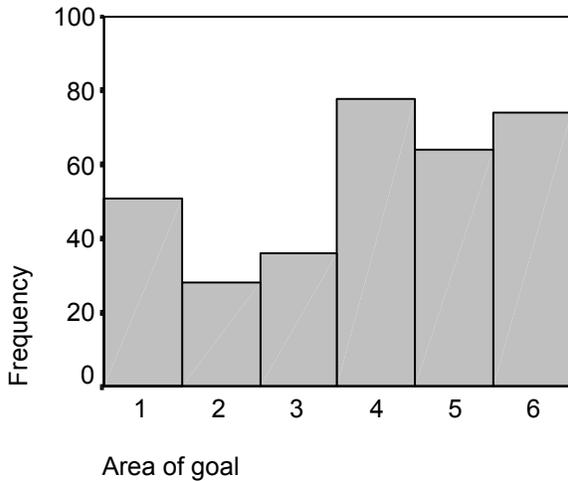
1 Top left	2 Top centre	3 Top right
4 Bottom left	5 Bottom centre	6 Bottom right

**Figure 2 - Areas of the roller hockey goal.**

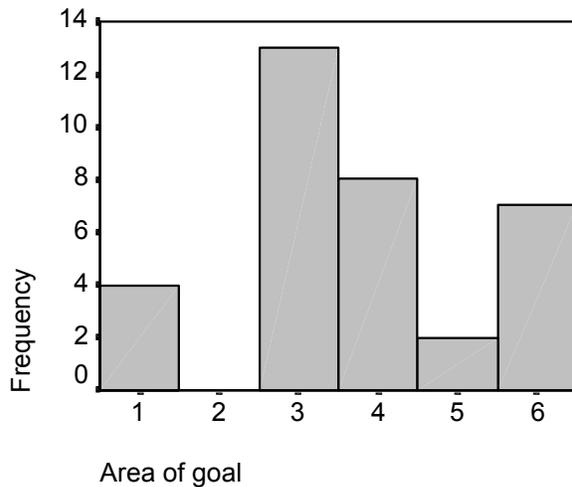
**RESULTS AND DISCUSSION:** In the six roller hockey matches that were analysed there were 331 'on-target' shots; this gave an average of 55 shots ( $\pm$  SD, 20.4) per match. The shots were distributed between all areas of the goal (see figure 3) with 15.4% of shots to the top left corner of the goal (area 1), 8.5% to the top centre (area 2), 10.9% to the top right corner (area 3), 23.6% to the bottom left corner (area 4), 19.3% to the bottom centre (area 5) and finally 22.4% to the bottom right corner (area 6). Statistical analysis using Chi-Squared showed that the 'on-target' shots were not equally distributed between the 6 areas of the goal ( $\chi^2_{(5)} = 37.6$ ,  $p < 0.0001$ ). Analysis of the time of each shot showed that the average duration between 'on-target' shots was 66.7 s ( $\pm$  SD, 78.6 s).

During the six matches 34 goals were scored, 11.8% in the top left area, none in the top centre area, 38.2% in the top right area, 25.5% in the bottom left area, 5.9% in the bottom centre area and 20.6% in the bottom right area (see figure 4). Chi-squared statistical test revealed that these differences were significant ( $\chi_{(4)}^2 = 10.4, p = 0.034$ ).

Results also showed that the six goalkeepers made a total of 1722 movements between the left, centre and right of the goal giving an average of 287 movements in a match. Table 1 shows the mean duration of time that a goalkeeper spent in one area before moving to the next.



**Figure 3 - Shot distribution to six areas of the goal during six roller hockey matches.**



**Figure 4 - Goal distribution to six areas of the goal during six roller hockey matches.**

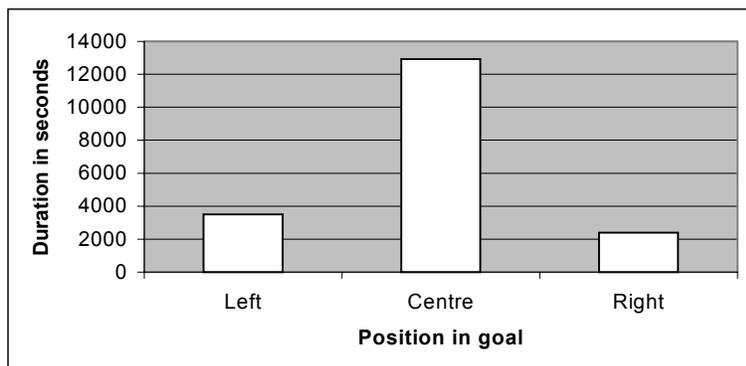
**Table 1 Mean Duration (in seconds) of Individual Movements of the Goalkeeper**

Area	Mean	Standard Deviation	Standard Error
Left	6.27	7.47	0.32
Centre	18.02	17.06	0.64
Right	5.36	5.99	0.28
Overall	10.92	13.58	0.33

The total time the goalkeepers spent in each area of the goal is shown in figure 5; goalkeepers spent substantially longer positioned in the centre of the goal (68.7%), while only 18.6% of time

was spent on the left side of the goal and 12.7% on the right. Statistical analysis using Kruskal Wallis Test revealed that these differences were significant ( $\chi_{(2)} = 262$ ,  $p < 0.0001$ ).

This investigation reported a reasonably high number of shots per match (55) and 65% of these shots were delivered to the lower areas of the goal. Only 28% of shots were delivered to the centre sections (areas 2 and 5), while 39% of shots went to the left of the goal and 33% to the right. This study also reported that goalkeepers should expect a shot on goal every 67 s. Goalkeepers displayed a reasonably large amount of movement across the goal, remaining in one area for only 11 s before moving onto the next area.



**Figure 5 - Duration (seconds) spent in each horizontal area of the goal in 6 matches.**

Analysis of successful shots revealed that no goals were scored in the top centre area of the goal and only 6% in the bottom centre, these were areas that the goalkeepers covered for a greater percentage of match play, however, there were also fewer shots delivered to these areas. The greatest number of goals was scored in the top right area of the goal. This area corresponds with all the goalkeepers 'glove hand' (not the hand they hold their stick in). This is an unusual and interesting result as anecdotally goalkeepers are thought to be weaker in the left top corner, the side in which they hold their stick, because they are thought to be less mobile on this side.

**CONCLUSION:** Understanding the frequency and positioning of shots on goal should enable roller hockey goalkeepers training to be more match specific. The results of this investigation suggest that to simulate match play, shots should be directed to all areas of the goal, with particular attention to the bottom left and right corners. Shots should be at a frequency of approximately 67 s or faster and should include a number of shots in quick succession. Goalkeepers should be encouraged to maintain mobility, with lots of movements across the goal. During goalkeeper training particular attention should be made to saving shots directed at the top right area of the goal.

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