

MOVEMENT OF ICE HOCKEY PLAYERS

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The characteristics of motion in an athletic event may seem obvious, and perhaps are, in individualized activities and certain segments of team sports. Usually, however, the individual movements of team performers are somewhat obscured by the multi-dimensional, rapidly changing, team sport activity. The need to know player movement patterns is nevertheless just as important in team sports as in individualized activities for proper competitive preparation. The purpose of this paper was to ascertain the movement characteristics of Ice Hockey players during a game. This kinematic data then could be employed to improve the design of Ice Hockey skating drills and eventually construct performance criteria and testing batteries.

REVIEW OF LITERATURE

Interest in the demands of Ice Hockey competition has been shown by Green, et. al. (1) in their monitoring of various physiological responses from ten contests. They noted that average playing times were 24.5 minutes and this total was divided into 17.4 shifts of 1.41 minutes each. Uninterrupted play durations averaged 39.7 seconds with average skating velocities of 3.78 meters/second. Montgomery and Vartzbedian (2) continuously monitored heart rate via telemetry during game competition and found heart rate intensities between 80% and 90%. Montgomery (3), in a later study, evaluated the effects of excess fat and equipment weight on Ice Hockey skating performance during an Ice Hockey fitness test. Since additional mass had a detrimental effect on performance, Montgomery recommended that close attention should be given to sources of weight additions in Ice Hockey players. These studies indicated concern for the nature of the events that occur during Ice Hockey games. In order to develop

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better training and testing criteria for the Ice Hockey player, a detailed review of the types of movements must be conducted.

PROCEDURE

Sequences from the 1982 National Sports Festival Ice Hockey Games held in Indianapolis, Indiana were filmed by a research team from the Sports Biomechanics Laboratory of the U.S. Olympic Committee Sports Medicine Division. Three Locam 16mm cameras were positioned at the Ice Hockey arena to provide multiple views of the player movements. View one was from above and behind the left corner of the blue line toward the right corner of the offensive goal. View two was from above and behind the right corner of the blue line toward the left corner of the offensive goal. The third view was from behind the defensive goal toward the offensive goal. In addition to existing points, various markers were placed on the ice to act as control points for converting film measurements to real life three dimensional motion. These points included rubber balls on tripods, corners of the offensive goal and face-off circles. This arrangement allowed for a three-dimensional analysis of the player movement patterns using the Direct Linear Transformation method. Each of the selected players was filmed from a face-off in the offensive end, or as the puck crossed the blue line toward the offensive end.

Film sequences of six Left Wings, five Right Wings, seven Centers, two Left Defensemen and two Right Defensemen were employed in this study. The cameras were operated at 40 frames per second. Every fifth frame was analyzed during a 13.5 second skating sequence due to the extent of the capabilities of the computer program. The center of the skater's hips was digitized to represent total body motion. Statistically smoothed computer print-outs of the lateral velocities, forward-back velocities, resultant velocities and displacements were obtained. The data were statistically smoothed by using the Fast Fourier Transformation developed by Hatze.

RESULTS

Of the 13.5 seconds of skating time by each of the 22 Ice Hockey players, more time, on the average, was devoted to acceleration (6.64 seconds or 49%) than to deceleration (5.47 seconds or 41%) with only 1.39 seconds (10%) being spent "coasting" as shown in Table I. There was very little variation between the offensive and the defensive players although the Right Wings spent the most time accelerating, 7.63 seconds, whereas the Centers spent the most time decelerating, 6.40 seconds. The Centers actually spent more total time decelerating than accelerating (6.40 seconds versus 6.00 seconds, respectively). The Left Defensemen had the largest coasting time (2.80 seconds) while the Right Defensemen only had .60 seconds of coasting time.

TABLE I
DURATION OF ACCELERATION AND DECELERATION PHASES
IN ICE HOCKEY GAMES (*)

Playing Position	N	Total Time	Mean Acceleration Time	Mean Deceleration Time	Mean Time Remaining
<u>Offense</u>					
Left Wing	6	13.5	6.35	5.63	1.58
Right Wing	5	13.5	7.63	4.12	1.75
Center	7	<u>13.5</u>	<u>6.00</u>	<u>6.40</u>	<u>1.10</u>
MEAN		13.5	6.67	5.51	1.32
<u>Defense</u>					
Left	2	13.5	6.20	4.45	2.80
Right	2	<u>13.5</u>	<u>6.80</u>	<u>6.10</u>	<u>.60</u>
MEAN		13.5	6.52	5.28	1.70
<u>Total Averages</u>					
Defense & Offense		13.5	6.64	5.47	1.39

(*) time presented in seconds

The number of accelerations displayed in Table II for each playing position over the 13.5 seconds of skating time ranged between 3.14 and 4.0 with an average of 3.36. The number of accelerations of the small sample (N=4) of Defensemen exceeded the accelerations of the offensive players by .47 (3.75 to 3.28). Table III reveals a slightly smaller average number of decelerations (3.23) with all values falling between 3.0 and 3.5. There was very little difference in the number of decelerations between the offense and the defense. Table II displays an average overall time per acceleration of 2.08

TABLE II
ICE HOCKEY GAME SKATING ACCELERATIONS

Playing Position	N	Mean Total Time(s)	Mean Number of Accelerations	Mean Time(s) per Acceleration
<u>Offense</u>				
Left Wing	6	13.5	3.33	2.16
Right Wing	5	13.5	3.40	2.47
Center	7	<u>13.5</u>	<u>3.14</u>	<u>1.91</u>
MEAN		13.5	3.28	2.15
<u>Defense</u>				
Left	2	13.5	3.50	1.86
Right	2	<u>13.5</u>	<u>4.00</u>	<u>1.68</u>
MEAN		13.5	3.75	1.77
<u>Total Averages</u>				
Defense & Offense		13.5	3.36	2.08

seconds with an offensive average of 2.15 seconds, and a defensive average of 1.77 seconds. The average overall time per deceleration in Table III is 2.00 seconds with the offense averaging 2.08 seconds per deceleration and the defense averaging 1.65 seconds per deceleration. It appears that average acceleration and deceleration phases were quite comparable and consistent. Table IV indicates the average distances skated and the resulting displacements. The Right Wing players covered 65.43 meters of ice to head the offensive values which averaged 58.14 meters. This was a greater average distance than the four defensemen's mean by 7.39 meters. The total

TABLE III
ICE HOCKEY GAME SKATING DECELERATIONS

Playing Position	N	Mean Total Time(s)	Mean Number of Decelerations	Mean Time(s) per Deceleration
<u>Offense</u>				
Left Wing	6	13.5	3.00	2.83
Right Wing	5	13.5	3.40	1.23
Center	7	<u>13.5</u>	<u>3.29</u>	<u>2.05</u>
MEAN		13.5	3.22	2.08
<u>Defense</u>				
Left	2	13.5	3.00	1.44
Right	2	<u>13.5</u>	<u>3.50</u>	<u>1.86</u>
MEAN		13.5	3.25	1.65
<u>Total Averages</u>				
Defense & Offense		13.5	3.23	2.00

TABLE IV
ICE HOCKEY GAME SKATING DISTANCES AND DISPLACEMENTS

Playing Position	N	Total Time(s)	Mean Distance (m)	Mean Displacement
<u>Offense</u>				
Left Wing	6	13.5	58.89	13.57
Right Wing	5	13.5	65.43	13.45
Center	7	<u>13.5</u>	<u>51.43</u>	<u>11.91</u>
MEAN		13.5	58.14	12.89
<u>Defense</u>				
Left & Right	4	13.5	50.75	7.53
<u>Total Averages</u>				
Defense & Offense		13.5	56.79	11.92

player average distance skated was 56.79 meters and the total average displacement was 11.92 meters. Table V indicates that the average skating velocity for all positions was 4.21 meters/second with the Right Wings having the high velocity average of 4.84 meters/second and the defenseman achieving an average velocity of 3.76 meters/second. These velocity averages are comparable to those found by Green, et. al. (1) of 3.78 meters/second.

TABLE V
ICE HOCKEY GAME SKATING VELOCITIES

Playing Position	N	Mean Velocity	Mean Peak Velocity (m/s)	Mean Low Velocity (m/s)
<u>Offense</u>				
Left Wing	6	4.36	5.64	1.65
Right Wing	5	4.84	5.16	1.92
Center	7	<u>3.81</u>	<u>4.44</u>	<u>1.53</u>
MEAN		4.31	5.04	1.68
<u>Defense</u>				
Left & Right	4	3.76	4.86	1.33
<u>Total Averages</u>				
Defense & Offense		4.21	5.01	1.62

The mean peak skating velocities averaged 5.04 meters per second for the offense and 4.86 meters per second for the defense. The Centers reached a mean peak velocity of only 4.44 meters/second as compared to 5.64 meters/second for the Left Wings. The mean high velocity for the twenty-two players was 5.01 meters per second and the mean low velocity was 1.62 meters per second.

CONCLUSIONS

In conclusion, although the sampling is limited, there are strong indications from this data that Ice Hockey players perform frequent speed changes and attain marked accelerations and decelerations in a short period of time. Ice Hockey athletes are also capable of reaching relatively high skating velocities during the course of a game. These findings indicate that the acceleration and deceleration phases are shorter than believed. Based on this evidence, it would seem desirable to develop practice drills and tests for Ice Hockey skaters that are of high intensities and short durations and that these bursts of speed should incorporate rapid and frequent directional changes.

References:

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