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THE ANALYSIS OF INDIVIDUAL SKILLS OF ICE SLEDGE HOCKEY PLAYERS AT THE TORINO 2006 PARALYMPIC TOURNAMENT

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Ice Sledge Hockey is one of the fastest growing winter Paralympic sports. There has been little research performed on ice sledge hockey and consequently the information on performance parameters is scarce. The purpose of this study is to determine the differences in the level of individual ice sledge hockey skills among players of eight teams participating in Paralympic tournament Torino 2006 using observation protocol for assessment of key technical skills in Ice Sledge Hockey (Beckman, Kudláček & Vanlandewijck, 2007). The players involved in this study were players from Paralympic tournament. Four of the five best players are from Canada and one is from Norway. While we presented clear differences of individual players which are associated with actual standings in the Paralympic tournament we found only significant differences are total scores ($F=5.29$, $p<0.01$) and skating subscale ($F=3.66$, $p<0.05$).

KEYWORDS: Disability sport, skills, observation protocol, skating, passing, shooting, checking.

INTRODUCTION

Sledge hockey was invented in the early 1960s in Stockholm, Sweden at a rehabilitation center for those who where no longer able to compete in traditional ice hockey (Lindstrom, 2002; SLOC, 2001). Ice sledge hockey was offered for the first time in the Lillehammer Paralympic Winter Games in 1994 and is one of the fastest growing winter Paralympic sport.Eight teams competed at the highest level in the 9th Winter Paralympic Games in Torino 2006, Italy (TOROC, 2005a). To this day there has been little research performed on ice sledge hockey and consequently the information is scarce on performance parameters, psychological variables or physiological comparisons. However, there is a significant number of tools being used in clubs and teams all over the world to determine skill level of ice hockey players. Field tests and laboratory tests exist for able bodied ice hockey; the 20m shuttle run has also been adapted for ice sports (Kuises, 2003) as a way to measure aerobic capacity in the most sport specific way and provide more detailed information on ice hockey performance.

While understanding to all components of performance is important for facilitation of training, it is interesting to note that at least half of the components mentioned in the relevant studies are skill related (Doroshuck and Marcotte, 1965; Hermiston, 1975; Merrifield and Walford, 1969; Lafontaine, Lamontagne, Lockwood, nd). Being able to asses game related skills is imperative in any sport, including ice sledge hockey. Skills observational tools can be used for many purposes: (a) Identifying strengths and weaknesses of players; (b) As a coaching tool to enable coaches to break down the skills to better teach their athletes how to perform the skill to the highest level; (c) In identifying talent; (d) To monitor performance (Miller, 2003).

One of the first skills observation protocol in Paralympic sports was developed for wheelchair basketball (Zwakhoven, Evaggelinou, Daly, & Vanlandewijck, 2003).

In 2006 by Beckman, Kudláček and Vanladewijck (2007) have applied the approach of Zwakhoven et al. (2003) and transferred the instrument to ice sledge hockey for evaluating the maturity of skill levels and determination of more and less successful players. All the preliminary games of Torino 2006 were recorded and a pilot evaluation was made on 5 players from each team (Beckman et al., 2007). The validation and the improvement of this instrument could provide a solid base for all coaches and other stakeholders in Ice Sledge Hockey. The purpose of this study is to determine the differences in the level of individual ice sledge hockey skills among players of eight teams participating in Paralympic tournament Torino 2006.

METHOD

Participants

The players involved in this study were ice sledge hockey players playing at the Paralympics in Torino 2006 (Italy). There were 8 teams and a maximum of 13 players in field (excluding goal keepers) per team. Observed players were from teams (listed in ranking order of Paralympic Tournament) Canada (13), Norway (12), United States of America (7), Germany (8), Japan (10), Sweden (7), Great Britain (7) and Italy (9). Ages of the players ranged from 15 years old to 58 years old. From the 40 players whose disability was recorded in the player profiles, over half (22 players) have an amputation, varying from single leg below knee amputation to bilateral hip amputations. Other disabilities that are listed include paraplegia, spina bifida, spondyloschisis and cerebral palsy (TOROC, 2005b). We could not report exact disabilities of all athletes due to administrative obstacles during Paralympic tournament.

Procedure

In order to be able to describe the most mature skill possible, it was necessary to collect data at the most elite level of competition. In Paralympic tournament Torino 2006 (Italy), 8 teams competed in the ice sledge hockey tournament. These preliminary games consisted of 12 games over a period of 3 days. All preliminary games were recorded on four handheld video recorders (50 HZ) positions of the cameras were close to the middle line above the spectator stands, so spectators would not interfere with the recordings. Two cameras were placed on one side of Ice arena and other two were placed on the opposite side. Individual players were filmed on and off for a total time of 10 - 20 minutes over the games they played. The players were followed regardless of the puck position and as closely as possible while still ensuring that the figure remained fully visible in the screen at all times.

The video observations were watched to closely monitor movements and positions of players with respect to their sledges, the puck, and other players, all designed to gain as much information as possible for measured criteria of each skill. Comparison of team was done using the analysis of variance followed by post hoc tests.

Observation Protocol

This observation protocol of Beckman et al. (2007) was used. The observation protocol is set to measure seven individual skills (Skating with the puck, receiving checks, passing, pass receiving, shooting, body checking, stick checking) with between four and six criteria for each skill. This protocol went through pilot evaluation, when twenty selected players from the Torino Paralympic video recordings were analyzed using the protocol (Beckman et al., 2007). These players were evaluated using the protocol to observe any differences. Each skill has four or five performance criteria that describe the mature performance of each particular skill. In order to use the instrument to score a player on skill performance the following steps should be taken: (a) observe the player performing the skill in a game situation and concentrate on the listed criteria; (b) where the player performs the component or criteria correctly, mark a “1” in the appropriate box, where the player does not perform the criteria correctly mark a “0”. Try to observe each item as many times as possible; (c) when some boxes are left open they can be filled at a later time.

Each skill had clearly described criteria of performance and reasoning for evaluation. Bellow we present and example focused on shooting (Table 1). **(a) Sledge is in the right position to take shot (relation to play):** *Why to observe:* player should be in an advantageous position to react to rebounds or other consequences of shot, also the shot will be more accurate if positioning is better. *Observation:* if player is facing in the direction he is shooting and able to move immediately following the shot. **(b) Player is able to shoot at full speed:** *Why to observe:* if the player loses speed before shooting the element of surprise that is often vital to scoring goals is lessened if not lost. *Observation:* no unintentional break in speed before shot is taken. **(c) Preparation, execution and follow through are evident:** *Why to observe:* preparation, execution and follow through are all essential phases of a mature shot, enables the gathering of momentum and increased accuracy. *Observation:* specific and sequential phases of backswing impact and follow through. **(d) Appropriate Shot selection:** *Why to observe:* the player needs to select which shot is more likely to be accurate depend on the open net space and position of sledge, angle and goalie position. *Observation:* shot accuracy heads towards open net.

Table 1
Observation protocol for skill "Shooting"

Sledge is in the right position to take shot (relation to play)									
Player is able to shoot at full speed									
Preparation, execution and follow through are evident									
Appropriate shot selection									

Score sheet

After the game calculate the scores in the following way. When a player did not show performance criteria for a specific skill he will receive a "0" for that criterion. When he performed the criterion one of two times the player receives a "5" for that criterion. If there are three or more observations than a score is calculated by counting all of the "1-s" and "0-s". Then calculate a score from 10 with this result. For example: with the first criterion of shooting, a player is observed 4 times and scores 3 "1-s" and 1 "0". This equals 3 on 4. This will then give the player a score of 7.5 on 10 for the first criterion of shooting.

The skills were then broken up into groups of similar skills giving 4 sub groups. To calculate the scores for the sub groups each skill was given a ratio of how often it generally is used in a game, this was determined from the video observations, the scoring for the sub scores then would look as follows:

Sub score 1 = (0.7 * Skating with the puck total) + (0.3 * receiving checks total).
Sub score 2 = (0.5 * Passing total) + (0.5 * pass receiving total).
Sub score 3 = (Shooting total).
Sub score 4 = (0.8 * Body checks total) + (0.2 * stick checks total).

Sum of sub score 1+ sub score 2 + sub score 3 + sub score 4= TOTAL score.

RESULTS

After the evaluation of the players, the protocol provides very interesting and clear information about the skill level of players in all teams. Differences are evident between the first three teams (12 players performed over 100 points) and the last three teams (only 2 players over 80 points). The results reveal that the most difficult skill to acquire and perform for players from every team is skating with the puck using both hands. From the analyses of video recordings it is evident that Canada, Norway and USA are more offensive teams with more skilled players. The aggressively playing teams greatly influence performance of the less skilled players from weaker teams (for example Italy). These teams are almost always forced to play under pressure and for this reason commit a lot of mistakes in skating with the puck and especially in the passing. In fact, very often the team who defence for a long period of time cares only to throw the puck as far as possible from its goal and not to create an offensive action. In Table 2 we present descriptive statistics from players observation and in subsequent part of results and in Table 3, we present analysis of difference with ANOVA test.

Table 2
Score Sheets for Individual Players (listed in ranking order of Paralympic Tournament)

Team	**Sub score 1**	**Sub score 2**	**Sub score 3**	**Sub score 4**	**Total score**
CANADA	**Skating**	**Passing**	**Shooting**	**Checking**	
N°12	38,50	41,70	37,50	27,20	144,90
N°18	39,00	35,00	36,70	28,00	138,70
N°27	38,80	42,10	40,00	20,00	135,90
N°8	35,00	41,00	37,50	20,00	133,50
N°19	38,50	41,60	15,00	29,70	124,75
N°10	37,30	43,60	20,00	4,00	105,20
N°21	32,70	38,35	-	24,50	95,54
N°3	4,00	37,30	40,00	12,00	93,30
N°17	21,00	33,75	20,00	16,00	90,75
N°7	26,00	36,75	10,00	16,00	88,75
N°29	29,75	34,95	-	16,00	80,70
N°34	21,00	37,50	-	-	58,50
N°9	-	24,00	-	16,00	40,00
NORWAY	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°11	36,50	43,90	40,00	16,00	136,40
N°7	33,90	30,10	20,00	33,40	117,40
N°3	35,70	43,00	30,00	4,00	112,70
N°12	31,40	36,25	15,00	20,00	102,70
N°8	38,70	35,75	20,00	4,00	98,44

N°4	32,40	40,10	15,00	-	87,50
N°13	35,00	30,00	15,00	-	80,00
N°10	28,70	28,35	15,00	4,00	76,10
N°9	37,40	22,50	-	-	59,90
N°16	25,70	33,75	-	-	59,40
N°41	14,00	15,00	10,00	4,00	43,00
N°17	17,50	15,00	-	-	32,00
USA	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°21	39,60	37,50	20,00	12,00	109,10
N°44	28,90	38,95	20,00	16,00	103,85
N°91	24,50	33,65	20,00	7,00	85,15
N°19	32,25	22,35	20,00	20,00	94,60
N°12	34,90	34,50	15,00	7,30	91,70
N°4	17,50	21,25	-	12,00	50,75
N°20	22,00	15,00	-	4,00	41,00
GERMANY	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°99	32,65	33,10	30,00	14,00	109,75
N°10	32,70	35,10	33,40	4,00	105,20
N°77	41,00	27,50	10,00	22,70	101,20
N°55	20,50	33,75	-	18,60	72,85
N°96	17,50	32,10	-	6,70	56,30
N°20	28,00	23,95	-	3,00	54,95
N°13	-	23,50	-	12,00	35,50
N°17	-	22,75	-	4,00	26,75
JAPAN	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°32	34,25	34,50	25,00	26,00	119,75
N°13	31,25	27,30	15,00	32,70	106,25
N°8	24,50	32,60	20,00	16,00	93,10
N°23	32,50	27,35	10,00	20,00	89,85
N°10	29,40	35,15	16,60	4,00	85,15
N°24	25,70	23,00	20,00	16,00	84,70
N°55	28,00	34,50	10,00	4,00	76,50

N°9	34,80	21,00	20,00	-	75,80
N°16	17,00	23,75	15,00	12,00	67,75
N°27	3,00	25,00	-	12,00	37,00
SWEDEN	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°21	34,90	24,50	20,00	-	79,40
N°13	17,50	25,00	-	24,00	66,50
N°5	21,00	34,15	-	4,00	59,15
N°3	17,00	33,30	-	5,40	55,70
N°2	14,00	27,10	-	12,00	53,10
N°10	19,00	35,00	-	-	54,00
N°7	-	5,00	-	-	5,00
G.Britain	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°88	19,00	26,25	20,00	16,00	81,50
N°19	14,00	25,00	15,00	26,10	80,10
N°14	18,70	26,70	-	26,00	71,40
N°6	-	24,20	20,00	7,50	55,70
N°11	17,50	24,50	-	12,00	54,00
N°13	21,00	22,00	-	10,00	53,00
N°7	10,50	20,00	-	19,00	49,50
ITALY	**Skating**	**Passing**	**Shooting**	**Checking**	**Total**
N°16	25,60	36,25	15,00	3,00	79,90
N°73	10,50	2,50	-	28,00	63,50
N°57	28,00	31,70	-	-	59,70
N°22	10,00	20,00	-	8,00	38,00
N°6	17,50	14,00	-	4,00	35,50
N°68	10,50	15,00	-	-	25,50
N°11	-	15,00	-	9,00	24,00
N°12	14,00	7,50	-	-	21,50
N°7	-	-	-	12,00	12,00

Note:

All the players were recorded during the preliminary games of the Winter Paralympics in Torino 2006. The order of the teams above is based on the final position in the tournament. Missing scores of athletes are in cases when we were not able to observe target behaviour.

According to the results four of the five best players are from Canada and one is from Norway. The differences between these two teams are in the sub score 3 (shooting) and 4 (body check and stick check). For the first difference the reason could be that four of the five best Canadian players are forwards (higher score) while four of the five best Norwegian players are defenders (lower score). It is also interesting to compare the results of American and German players, the two team competing for the third place. From the results Germany appears to be stronger team and indeed in preliminary games Germany was placed higher then USA, which on the other hand has more cohesive team and in the game for third place showed great deal of maturity of game tactics. Japan is very solid team, which in 2004 they won the Ice Sledge Hockey World Championships (Japan Ice Sledge Hockey Committee, 2004) and in this Paralympics tournament lost only against USA (TOROC, 2006). If team Japan would be able to play more aggressive game, they could also compete for the first places. Sweden and Great Britain are also teams placed closely together. In preliminary rounds Great Britain appeared to be stronger team with two players scored over 80 points. On the other hand Sweden was playing in tougher group, which caused limited shooting opportunities with non-observable shooting scores. In final game Swedish team showed greater tactical skills and was able to place before Great Britain. In this case, we can see two of the greatest limitation of application of this observation protocol: (a) protocol focuses strictly on game skills and can not take in account strategy; (b) the level of performed skills is greatly influenced by opposing team.

From the descriptive statistics of results of individual players we could assume that we can predict the strengths and weaknesses of individual players. The next step would be to explore if we can use this observation protocol for prediction of team success in the tournament. For this purpose we have decided to compare the results using analysis of variance (Table 3) followed by post hoc tests.

Table 3
Results of ANOVA for mean scores of sledge hockey teams

		Sum of Squares	df	Mean Square	F	Sig.
Skating	Between Groups	1848,66	7	264,09	3,66	<0,05
	Within Groups	4184,81	58	72,15		
	Total	6033,47	65			
Passing	Between Groups	1136,83	7	162,41	1,76	0,11
	Within Groups	5891,90	64	92,06		
	Total	7028,73	71			
Shooting	Between Groups	786,94	7	112,42	1,49	0,21
	Within Groups	2416,05	32	75,50		
	Total	3202,99	39			
Checking	Between Groups	1262,91	7	180,42	0,69	0,67
	Within Groups	13440,87	52	258,48		
	Total	14703,77	59			
Total score	Between Groups	27203,25	7	3886,18	5,29	<0,01
	Within Groups	47759,20	65	734,76		
	Total	74962,45	72			

While we presented clear differences of individual players which are clearly associated with actual standings in the Paralympic tournament we do not see significant differences on average team scores. While there are differences, the only significant differences are total scores ($F=5.29$, $p<0.01$) and skating subscale ($F=3.66$, $p<0.05$). Follow up Tukey post hoc tests we have discovered significant differences in skating subscale between team of Italy and Canada ($p=0.03$), Italy and Norway ($p=0.02$), Great Britain and Canada ($p=0.05$), and Great Britain and Norway ($p=0.03$). We also found significant differences in total scores between winning team of Canada in comparison with Sweden ($p<0.01$), Great Britain ($p=0.05$), and Italy ($p<0.01$). When we compare second team of Paralympic tournament Norway, we find significant differences only with team Italy ($p<0.05$). However there are clear differences among players in all skill subscales and presented observation protocol can help us to detect and describe strength and weaknesses of individual players.

DISCUSSION

The application of the first skill observation protocol shows a lot of important information. The tool has many advantages but also some disadvantages. Among the advantages are: (a) The mean score of the teams, as in the previous pilot evaluation, followed closely to the results of the tournament, with the exception of the Sweden (sixth) that scored less than Great Britain (seventh); (b) There are big difference between the score of the Canadian (first) and Italian (last) players; (c) This should means that it's easily recognisable the top players and those who are less skilled (In fact, especially for some skills, as for example "skating with the puck", the video recorder of an individual player is a very good solution for discover many details and underline the gaps).

The protocol is easy to apply, but observer needs some practise before being able to administer it. The scores are not difficult to calculate and compare. Still there are problems to clearly evaluate the performance of all the single players. In some cases the video recording of single player is a substantial limitation. In order to evaluate skills such as "passing", it is needed to observe larger field of play. Sometimes the length of the video recording is not long enough because the player is not involved in the game. This was the example of Italian players in the game against Canada, when some of them spend most of the time skating without the puck with no possibility to play and therefore no possibilities to observe the level of their skills.

On the other hand, as also the previous study of Beckman et al. (2007) showed, it was clearly that Norway (2^{nd} place) in particular, played differently when playing a team like Italy (8^{th} place) than a team like Canada (1^{st} place). When opposing Italy, the Norwegian players recovered from checks more slowly, skated less aggressively and were less protective of their puck handling. It is evident that some of them could perform higher or lower scores in other circumstances (training, national league...). Therefore it would be interesting in future to apply the observation protocol in different situations (playing weaker vs. stronger opponents; preliminary vs. playoff games) and compare the results.

CONCLUSION

In our study we have found most of the differences in skating with puck skills, which is clearly fundamental skill, which should be one developed at the very beginning of player developments. Other researchers have also pointed out that much of an ice hockey game is spent "waiting for the puck or skating without the puck" (Lafontaine et al., nd) and this was also clearly evident in the observation of ice sledge hockey. Future research could find a way to include them in an observation protocol. In this research there is still the problem with the reliability because in the pilot evaluation there no indications about which player performed which score so

it is possible to compare only the mean of the teams and not the single players. Also is not clear the relationship between technical skill level and sport performance. There are many components that influence whether a player is "good" or not. This study has made a general assumption based upon research that indicates skill level has a high level of correlation with performance of ice sledge hockey players. As there is still so much to learn about the sport it was necessary to assume that those players in the winning teams at the Paralympics would have better skill levels that teams the finished in last and second last place. Finally in the future, the researchers could try to apply other skill testing programs (for example the Domino's Skill Standards and Testing Program - DSST-) to ice sledge hockey and compare the results obtained with this protocol to create a very good tool for coaches, trainers and athletes. The results showed significant differences in observable skills between the teams and the evaluation reflect the results of the tournament. On the other hand there were some problems in the use of the observation protocol, which could influence the evaluation of performance. Future researches should: (a) determine the reliability of this protocol; (b) use the protocol in different environments; (c) record also the whole match and not only make a close range video; (d) try to include more skills such as skating without the puck and checking without contact.

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ANALYSE INDIVIDUELLER FÄHIGKEITEN VON ICE-SLEDGE HOCKEY (SCHLITTEN-EISHOCKEY)-SPIELERN BEIM PARALYMPISCHEN TURNIER IN TURIN 2006

(Resümee)

Unter der Annahme dass die Analyse von Fähig- und Fertigkeiten eine der wichtigen Leistungskomponenten darstellt, müssen Trainer geeignete Mittel zur Erkennung und Korrektur von technischen Fehlern zur Verfügung haben. Es gibt bisher nur wenig Forschung über Schlitten-Eishockey und folgedessen sind Informationen über Leistungsparameter rar. Während des Paralympischen Eishockey Turniers in Turin 2006 entwickelten Beckman, Kudláček und Vanlandewijck (2007) das erste Beobachtungsprotokoll zur Erfassung von Schlüssel-Techniken im Schlitten-Eishockey. Die Pilot-Evaluation wurde an 20 Spielern gemacht und die Resultate zeigten, dass dieses Erfassungsinstrument erfolgreich zwischen mehr oder weniger geübten Spielern unterscheiden konnte. Die Absicht dieser Studie ist es, Unterschiede im Niveau der individuellen Schlitten-Eishockey Fertigkeiten unter den acht Teams, die im Paralympischen Turnier in Turin 2006 teilgenommen hatten, festzustellen.

SCHLÜSSELWÖRTER: Behindertensport, Fertigkeiten, Beobachtungsprotokoll, Eislaufen, Passen, Schießen, Checking.

L'ANALYSE DES HABILETES INDIVIDUELLES DE JOUEURS DE HOCKEY SUR LUGE AU TOURNOI PARALYMPIQUE DE TURIN 2006

(Résumé)

D'après le constat qu'une composante majeure de la performance est l'analyse des habiletés, les entraîneurs doivent donc avoir les outils appropriés pour évaluer et corriger les erreurs techniques. Le hockey sur luge est un des sports d'hiver Paralympique connaissant la plus forte croissance. Peu de recherche a été mené sur le hockey sur luge et conséquemment, l'information sur la paramètres de performance est rare. Durant le tournoi Paralympique de hockey sur luge à Turin 2006, Beckman, Kudláček et Vanlandewijck (2007) ont crée le premier protocole d'observation pour la détermination d'habiletés motrices centrales dans le hockey sur luge. Une évaluation expérimentale a été menée sur 20 joueurs et les résultats démontrent que cet outil pourrait différencier les joueurs plus et moins habiles. L'objectif de cette étude est de déterminer les différences de niveaux d'habiletés individuelles de hockey sur luge au sein de joueurs dans huit équipes participants au tournoi Paralympique Turin 2006.

MOTS CLEFS: handisport, habiletés, protocole d'observation, patiner, faire des passes, tirer, mise en échec.