ERKKA WESTERLUND • RAIMO SUMMANEN

LET'S BEAT THEM IN ICE HOCKEY

POLAR®

Let's Beat Them In Ice Hockey

Erkka Westerlund - Raimo Summanen

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Foreword

"Faster, faster, faster!" This trend has long affected the development of ice hockey. As the game continuously becomes faster, players increasingly have to make their decisions based on a playing situation, and not according to a system. This means that players must quickly read a situation, react rapidly, and make quick decisions. Today's ice hockey is not played according to a pre-planned system, instead the playing situations determine the players' roles.

No longer are strong muscles the only physical requirement for ice hockey - the new way to play requires extreme endurance. Each player must be able to act and react according to playing situations throughout an entire game. The authors of this booklet, Erkka Westerlund and Raimo Summanen, have found a very illustrative and useful way to present a method for improving physical endurance demanded by today's ice hockey.

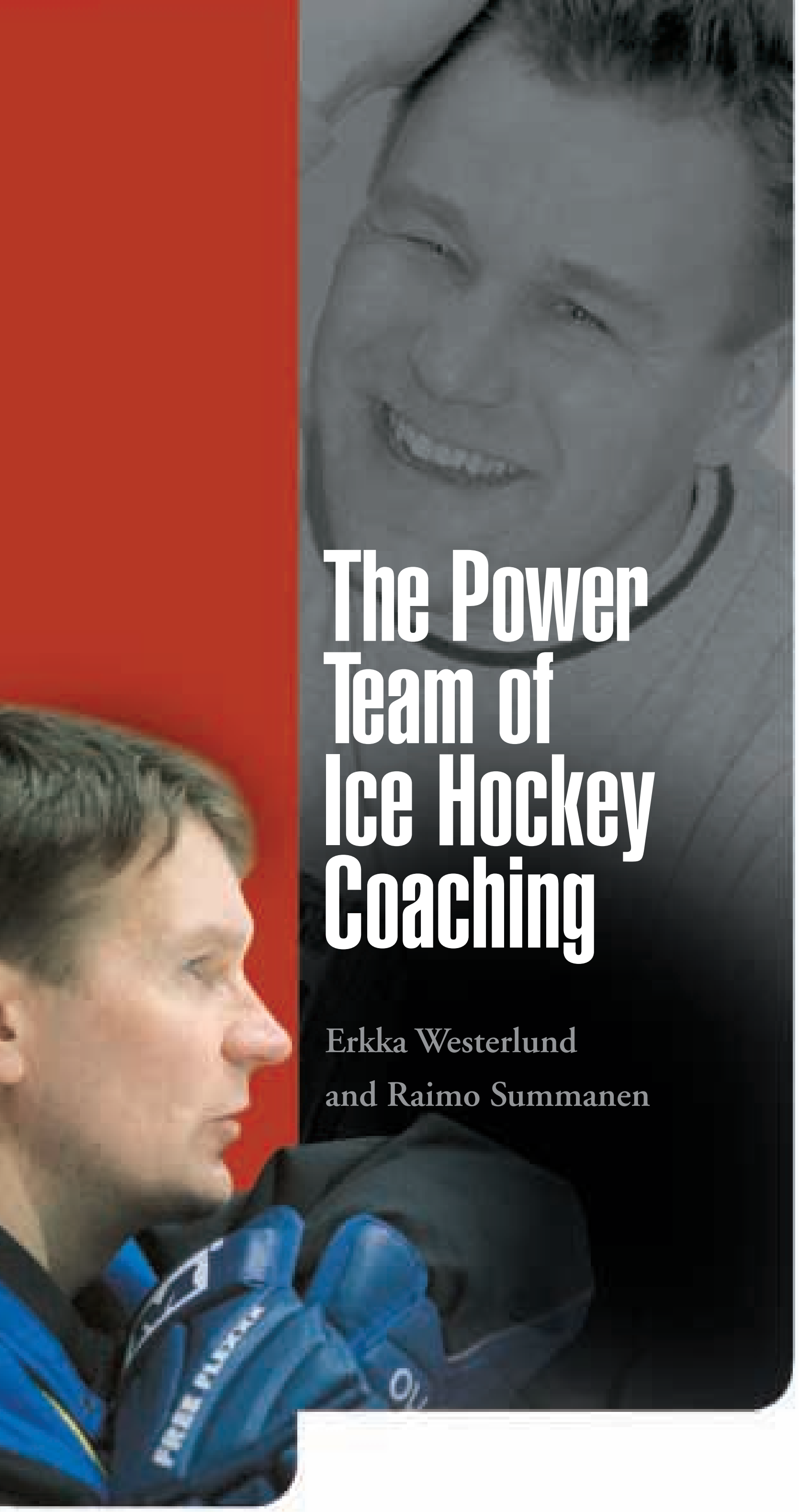
In Finnish ice hockey, the 1970s and 80s were the golden ages of endurance training. In the 1990s, the focus of training shifted to strength while endurance, compared to the increased muscle mass, alarmingly decreased. In today's ice hockey, players not only need fast muscles, but they also need extreme endurance, because they must be able to produce their strength and speed performances repeatedly throughout an entire game. Therefore, strength and endurance training must be well balanced so that the respiratory and circulatory organs also remain in good shape.

Erkka Westerlund and Raimo Summanen have experience on getting top results from a successful combination of physical training and ice hockey training. The Finnish expertise of training methods demanded by today's ice hockey is internationally renown. A case in point is the active international know-how exchange in which NHL teams are particularly interested in sending young players to Finland to train.

Since the early 1980s, Westerlund has studied the physical stress of ice hockey using heart rate analyses. According to his findings, a player's aerobic capacity decreases regardless of the specific exercise during the league season, thus resulting in a decrease in the player's performance, which has a direct impact on the success of the entire team. According to the authors, endurance can be sustained and developed even during the season with aerobic exercises. A heart rate monitor allows the exercises to be tailored for each player. Levelling team practices are ineffective in improving physical condition - sometimes they even have an adverse effect.

"Let's Beat Them in Ice Hockey" by Westerlund and Summanen presents and describes ice hockey training with heart rate monitors in an illustrative way. The authors emphasise the importance of factual information attained from heart rate monitors, as opposed to the regrettably prevalent "I think" feeling, in developing practices and in actual practice sessions. This booklet is a very useful basic information package for all coaches and players who
who want to develop their ice hockey career.

Helsinki, Finland, February 22, 2000.



The Power Team of Ice Hockey Coaching

Erkka Westerlund
and Raimo Summanen

Erkka Westerlund (42), M.Sc. (Physical Education), gathered his first experiences in ice hockey in Team Lukko in Rauma, Finland, where he went through all the youth ice hockey teams from the ages of 8 to 18 years old. His coaching career started in soccer. As a young man between 1971 – 1979, Westerlund coached ice hockey/soccer, coaching players from the age of 10 all the way to the age of 18.

Westerlund graduated as a physical education instructor from a Sport Institute in Vierumaki, Finland, in 1980. His first job as a head coach was with JYP HT, a Jyvaskyla based team, which lasted seven seasons. In the 1984-85 season, he oversaw JYP qualify to the Finnish Championship League from Division 1. JYP has played in the Finnish Championship League ever since.

In Jyvaskyla, Westerlund also received a Master of Science degree in Physical Education. Both his Bachelor's and Master's theses focused, of course, on ice hockey. Already in the early 1980s Westerlund saw the usefulness of a new Finnish innovation, the heart rate monitor. He has used heart rate information to study the physical stress of ice hockey and player condition, and developed different types of ice hockey practices for today's ice hockey players who require both speed and good physical endurance. These studies, which started back with the JYP team, have been partially used for the writing of this booklet.

In 1989, Westerlund became the head coach for Rauman Lukko at the Finnish national league level, a position he held for 2 seasons. After a coaching career of 10 years, he became the development manager for the Finnish Ice Hockey Association (FiHA). In this capacity, Westerlund could take his 10 years of coaching experience and concentrate on the very essence of Finnish coaching; creating new guidelines for training, conducting and developing research, and closely following the trends and development of international coaching. Westerlund has significant international ice hockey experience. He was invited by the Canadian Hockey Association (CHA) to headline a international ice hockey coaching chair program from 1994-95 in Calgary, Alberta, Canada. In addition, while he was the development manager for FiHA, Westerlund also had head coaching assignments with Finland's national team. One of his most significant coaching achievements, together with Raimo Summanen, include the under-18 European Championship victory in 1997.

At the national league level, the results of Westerlund's work were best highlighted during his two-year coaching period in HIFK in 1997 – 1999. The co-operation with Raimo Summanen, which started from the under 18 EC project, worked smoothly, and it was under their training during that period that HIFK won gold and silver at the Finnish Championships. The studies for the booklet are primarily based on Westerlund's extensive work with HIFK. Erkka Westerlund moved to his new, challenging post as the head coach for the other Helsinki-based team, Jokerit, in the summer of 1999.

The second author of the booklet, physical education instructor and TV commentator, Raimo Summanen (37), was quite the athlete in his youth. Up to the age of 15, Raimo actively played soccer during the summers and ice hockey outdoors during the winters in his hometown of Jyvaskyla, Finland. His sporting hobbies also included track and field.

Summanen played ice hockey actively from the early 1970s until 1995 when Raimo ended his playing career in a historical World Ice Hockey Championship game, where Finland beat Sweden and brought home the championship gold. Summanen's extensive playing career encompasses a total of 400 league games, and 150 international games playing for Finland, five World Ice Hockey Championships, and three Canada Cup tournaments, as well as playing in the NHL between 1984 – 88.

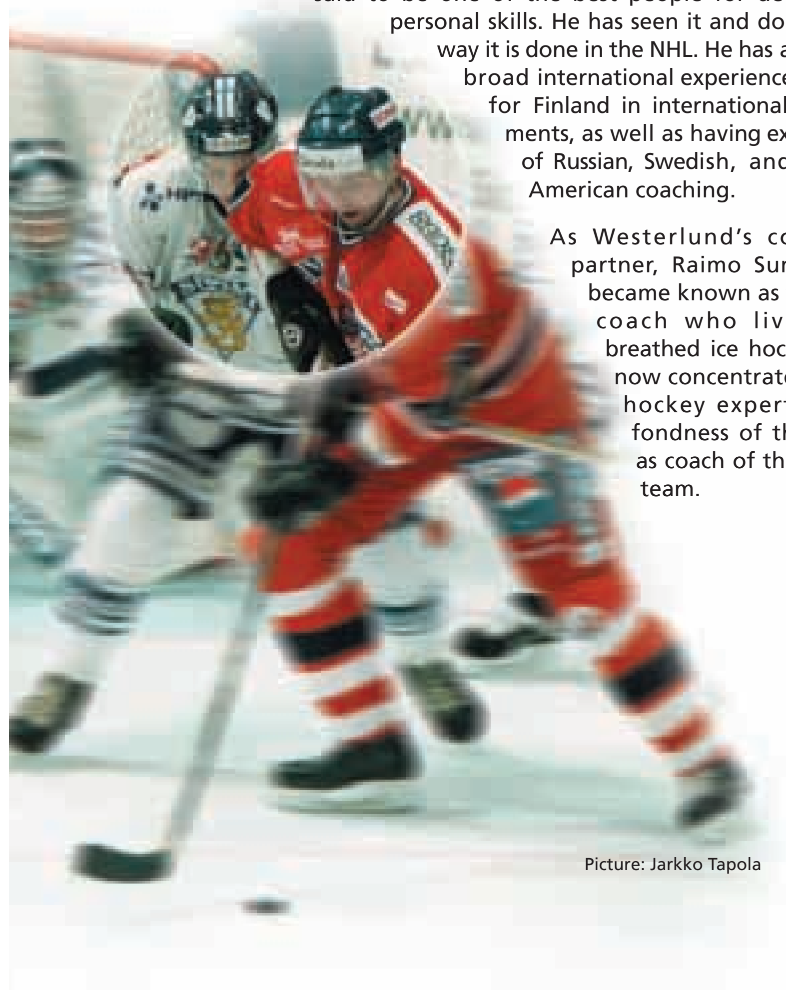
Summanen's interest in coaching started early during his years in Jyvaskyla. Many people, like Erkka Westerlund, remember a young, enthusiastic ice hockey player, who was known for his hard work, disposition for discussion, and interest in seeking new ideas for personal practices in order to develop into a better ice hockey player.

"At that time, ice hockey, just like other team games, was only emerging in Jyvaskyla. Many people were interested, but few had the knowledge. You had to find out yourself about everything and think about ways of becoming faster and stronger," he comments about his determination to become a better player.

Westerlund hired Summanen as an assistant coach to the national junior team in 1997. At the same time, Summanen studied to be a physical education instructor in Varala and Pajulahti, Finland, and graduated as a physical education instructor in 1998. Summanen developed rapidly as a coach; his passion was to do things, develop himself and players.

As a result of his extensive playing experience, Summanen is said to be one of the best people for developing personal skills. He has seen it and done it the way it is done in the NHL. He has acquired broad international experience playing for Finland in international tournaments, as well as having experience of Russian, Swedish, and North-American coaching.

As Westerlund's coaching partner, Raimo Summanen became known as the HIFK coach who lived and breathed ice hockey. He now concentrates his ice hockey expertise and fondness of the game as coach of the Jokerit team.



Picture: Jarkko Tapola

Intro-duction

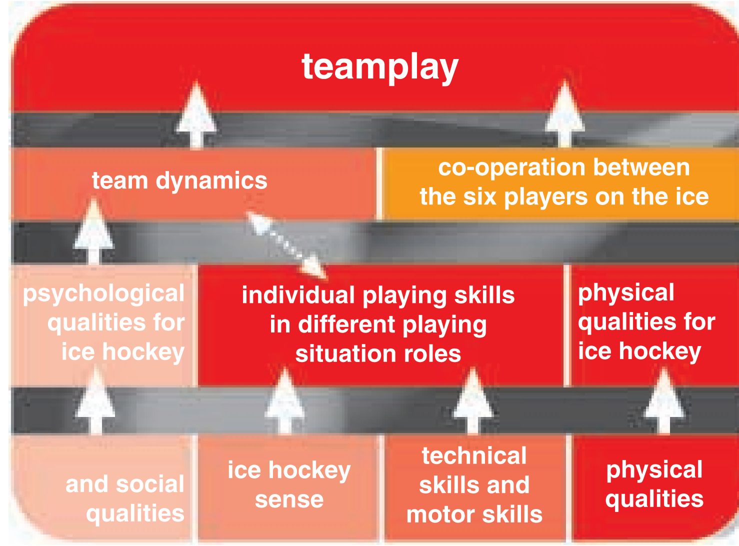
Ice hockey is a miniature of the whole life. The game culminates in an entire life squeezed into a few hours, during which players and coaches alike can experience life's entire range of feelings on the rink.

We know that ice hockey is where we live, where we can best meet and overcome pain and wrong and death. Life is just a place where we spend time between games."

Fred Shero

Picture: Jarkko Tapola

Both in life and in ice hockey, players need to have a number of qualities. These qualities can be affected by training. A player's actions on the ice are manifested as playing skills (Picture 1).



Picture 1. The qualities required of an individual player come down to playing skills, and a player's co-operation down to teamplay.

Playing skills combine qualities from different areas – psychological, tactical, technical and physical – into a single entity. When attempting to develop and exercise a quality, the coach should be aware that all of the qualities are strongly interdependent and all have an impact on the whole.

In physical preparation, the primary objective of speed and strength exercise is to develop a player's skating and 1 on 1 skills. The objective of endurance training is for player to repeat his/her ice hockey skills throughout an entire game without exhaustion. In a game between two equal teams, the outcome is often determined at the end of the game. The team that can retain its game strategy and tempo at the end of the game is closer to winning.

Endurance can be assumed to be a basic quality in preventing exhaustion and, consequently, in making better use of the other qualities. With good ice hockey endurance, you can prevent the different skills from deteriorating, and improve the sustenance of strength and mental toughness. At the same time, good endurance helps sustain a fast tempo during an entire game. It is important that the coach is aware of both the fundamental need for physical preparation in training and development of ice hockey specific player skills.

When planning and implementing training, one must consider the wide range of qualities required in ice hockey, and combine the development of different areas into a single practice session.

Areas to be taken into consideration when planning and implementing training include:

1. *Psychological objectives*
2. *Tactical objectives*
3. *Skill objectives*
4. *Physical stress*

For example, in an ice practice, in which the main objective is to improve individual skills, a coach should know the tactical and psychological objectives, as well as the physical stress of the drill. Physical stress is particularly important in dry land training.

In hockey, endurance means a player's ability to repeat his/her ice hockey skills without exhaustion throughout an entire game, the tournament, and the entire season. Insufficient endurance limits the development and utilisation of a player's other qualities.

Often the estimation of the stress of an exercise is based on a coach's experience and subjective "I think" feeling.

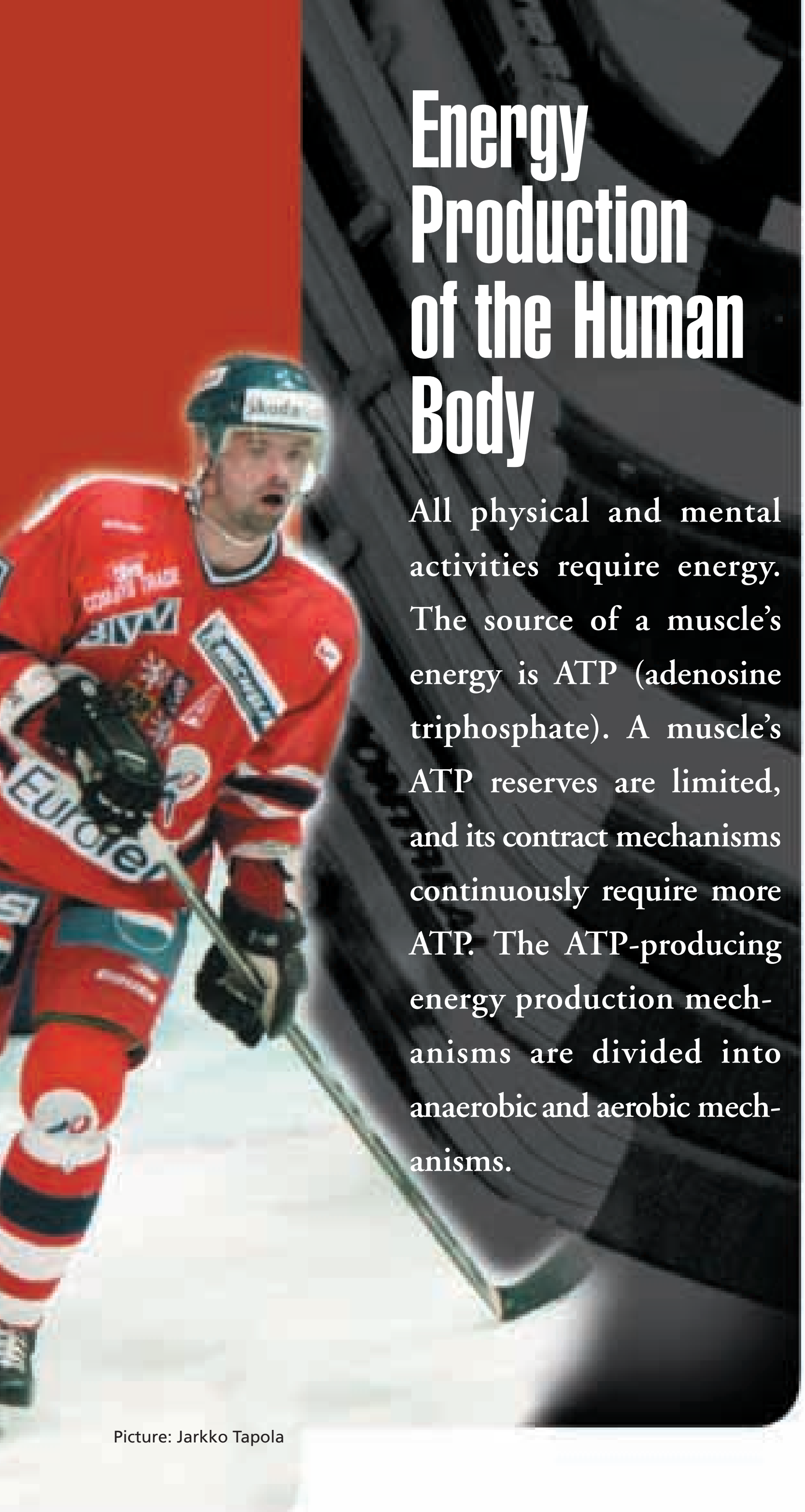
A heart rate monitor is a valuable tool for exercise implementation and stress measurement. A heart rate monitor allows a coach and player to receive immediate feedback about the stress that an exercise imposes.

The coach can then use the feedback in a variety of ways—to make immediate adjustments, develop and adjust drills, and to get to know his/her players. In a team, it is particularly important to know the individual differences of the players.

The objective of this booklet is to describe the essential role of endurance exercise in training a ice hockey team, and to illustrate the effectiveness of heart rate monitors in implementing training sessions.

Picture: Jarkko Tapola

Energy Production of the Human Body



All physical and mental activities require energy. The source of a muscle's energy is ATP (adenosine triphosphate). A muscle's ATP reserves are limited, and its contract mechanisms continuously require more ATP. The ATP-producing energy production mechanisms are divided into anaerobic and aerobic mechanisms.

Picture: Jarkko Tapola

The human body can produce energy aerobically (in a reaction that requires oxygen through breathing, in which fat and carbohydrates are chemically broken down) or anaerobically (without oxygen in a chemical reaction, in which high-energy phosphates (ATP and CP = creatine phosphate, and/or glycogen) stored in the muscle are broken down).

ANAEROBIC ENERGY PRODUCTION

When the energy requirement exceeds the oxygen-based energy production (e.g., in hard muscle work), the cells must rely on anaerobic energy reserves.

Anaerobic energy production can be either alactic or lactic. In alactic production, energy can be produced from a muscle's internal energy sources, adenosine triphosphate (ATP) and creatine phosphate (CP). The most important difference between alactic and lactic energy production is that alactic energy production does not produce lactic acid.

A muscle's second, longer-lasting source of energy, glycogen, is the source for lactic energy production. Lactic acid (or lactate, LA), which is a by-product of lactic energy production, is considered to be a toxicant that causes the body to exhaust.

ALACTIC ENERGY PRODUCTION

A muscle's supply of the high-energy phosphates ATP and CP are quite small and only last for a short time in a maximum workout (approx. 3-5 seconds). If the energy production is short-term in nature, the energy sources recover and refill quite rapidly at rest. A full recovery can occur in about two minutes. Exercise can have an impact on the sufficiency of energy production and faster recovery.

LACTIC ENERGY PRODUCTION

Lactic energy production is the main source of energy for maximal stress work between 30 – 60 seconds.

In a high intensity maximum workout, anaerobic glycolysis begins when alactic energy production stops (after 3 – 5 seconds). Anaerobic glycolysis is when energy is produced from the muscle's glycogen, producing lactic acid as a by-product. Lactic acid in itself is harmless to the homeostasis of the cell or body. However, when lactic acid is released, particles are also released in direct proportion to the amount of lactic acid which add to cell acidity and disturb chemical reactions. In practice, lactic acid is considered to be a good indicator for assessing the amount of stress of a drill or practice. Lactic acid diffuses from the cell into the blood circulation, which can be measured in a test or exercise situation. Local muscle exhaustion is extended with the circulation of lactic acid to the brain by disturbing both skills and thoughts. At rest, the blood's lactic acid concentration is approximately 1 – 2 mmol/l in a litre of blood. After an exhausting performance, the concentration of lactic acid can increase to 10 – 20 mmol/l, depending on the individual. Skill performance has been found to diminish significantly at a concentration of 8 mmol. In an interval type of workout such as hockey, the lactic acid production accumulates, and the concentration is higher than in single performances.

After an intensive anaerobic workout, the body's working efficiency may be paralysed for as long as 30 – 60 minutes. Perhaps the best way of estimating the required recovery time is to divide the lactic acid concentration in the blood in half for every 15 minutes. For example, a 10 mmol/l LA concentration decreases down to 5 mmol/l in approximately 15 minutes.

AEROBIC ENERGY PRODUCTION

When a muscle's workout is light, the continuous ATP production required by the muscle cells is met through the respiratory and circulatory organs. Sufficient oxygen supply with sufficient local circulation is a prerequisite for aerobic energy production.

Energy can be aerobically produced from either carbohydrates or fats. When the stress exceeds 70 percent of the maximal oxygen intake, the muscle relies on using its own glycogen.

OXYGEN USAGE AND HEART RATE

Energy requirements for different performances can be estimated with oxygen consumption. In practice, it is difficult to measure the amount of oxygen consumed. In the aerobic zone, the correspondence between oxygen consumption and heart rate is directly proportional. In practice, it is easy to estimate the stress of a performance based on the heart rate.

MAXIMAL OXYGEN UPTAKE (VO_{2max})

Maximal oxygen uptake is considered the best performance indicator for several endurance-type performances. It indicates the power of the respiratory and circulatory organs and the muscles' energy usage. The maximal oxygen uptake values for ice hockey players vary between 45 – 65 ml/kg/min. 60 ml/kg/min can be considered a good and sufficient figure for a ice hockey player. When a player's maximal oxygen uptake is measured or tested, the maximal heart rate is also determined.

ANAEROBIC THRESHOLD

The stress level at which anaerobic metabolism and lactic acid start to strongly affect a muscle's acidity is called the anaerobic threshold. At the anaerobic threshold stress level, the muscle creates lactic acid (approximately 4 mmol/l), but it can be buffered and broken down at the same rate. By using oxygen, the different organs (muscles, heart, and liver) can process lactic acid as it is formed in the muscles.

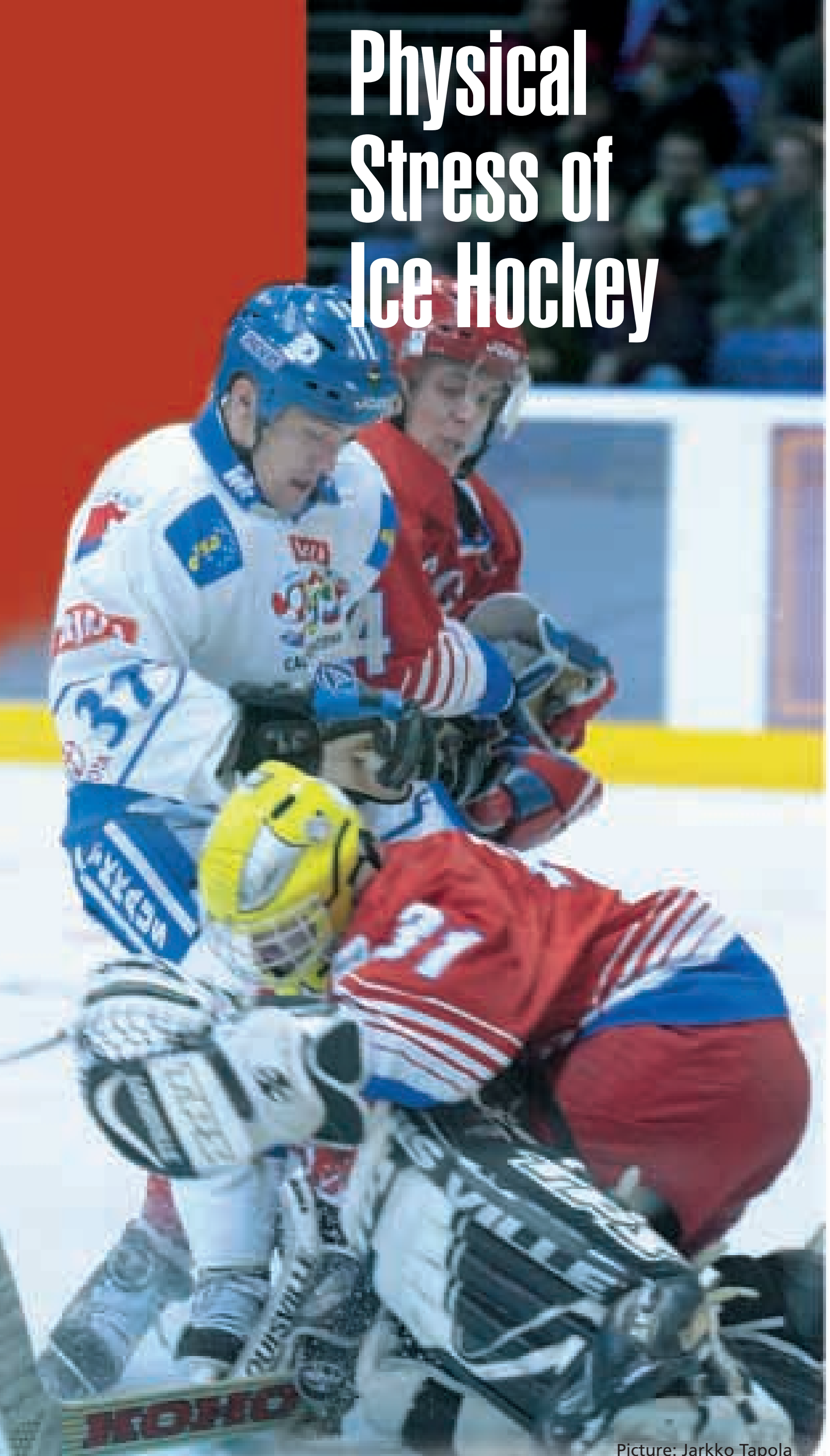
In hockey, performance is high-powered, thus, excess formation of lactic acid should be avoided. As such, the anaerobic threshold is a good performance indicator for a ice hockey player. A ice hockey player's anaerobic threshold levels vary between 70 – 80% of the maximal oxygen uptake.

AEROBIC THRESHOLD

The stress level at which the blood's lactic acid concentration rises above the resting level (approximately 2 mmol/l), and the anaerobic energy production starts, is called the aerobic threshold.

The aerobic threshold is an important level for developing purely aerobic basic endurance (50 – 65% of VO_{2max}). The effect of training is focused more on fat metabolism rather than on carbohydrate metabolism.

Physical Stress of Ice Hockey



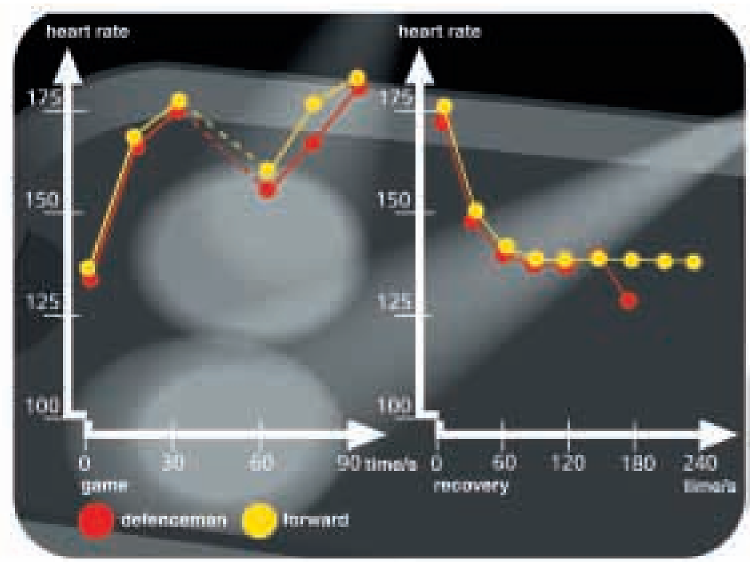
Picture: Jarkko Tapola

WORK PERIOD = ONE SHIFT

In hockey, the duration of one shift, or work period, is on average 30 – 60 seconds. During a shift, a player skates approximately 250 – 300 meters, and 5 – 7 kilometres during an entire game. A long term trend has been that game intensity during a single shift has been increasing, i.e., a player must be more and more efficient during the work period.

Speed, strength, and power of muscle work rise to such high levels that the body cannot supply enough oxygen to further transport it to the muscle tissue. The game itself and skill performances involve short-term, maximum power efforts. In ice hockey, speed, in addition to meaning skating speed, also refers to changes of rhythm and direction, fakes, reaction speed, and agility. The energy required for the muscle contractions of these short-term strength and speed efforts is supplied to the muscle tissue directly from the muscle's adenosine triphosphate (ATP) and creatine phosphate (CP) sources. These reserves last only for a few seconds in a maximum performance, and therefore, the energy required to continue the work is then acquired through anaerobic glycolysis.

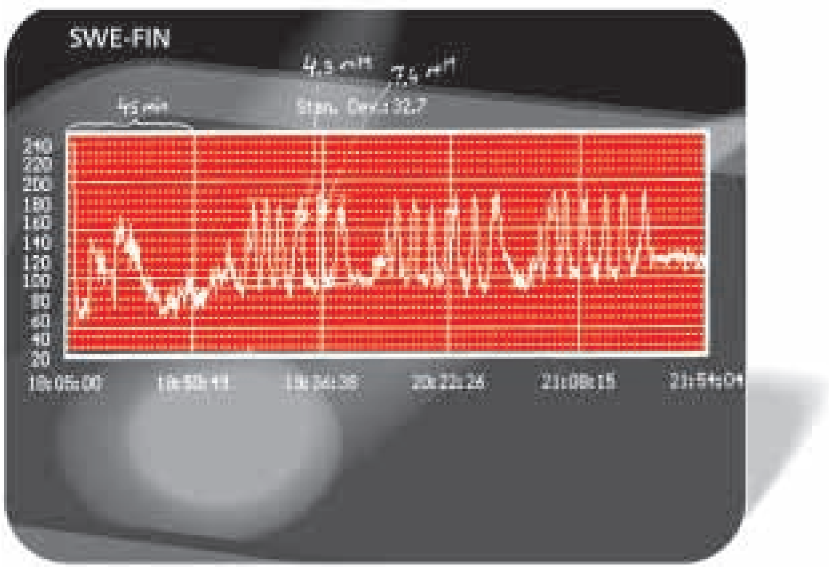
Anaerobic glycolysis is the main source of energy for a single shift, accounting for 60 – 70 percent of the entire energy production of a work period. The limitation of this mechanism is the exhaustion



Picture 2. The picture below shows the typical heart rate at work and rest periods for forwards and defencemen. (Green et al. 1976)

toxicant, lactic acid, created as a by-product of the reaction. When lactic acid accumulates in the muscles or is transported through blood circulation to the brain, a player's concentration, skill performance, and tactical reactions are adversely affected.

During a ice hockey game, lactic acid concentrations vary between 3 – 14 mmol/l depending on the individual and the playing position. The most recent measurements were made during the 1993 Swedish national team's games against Canada and Finland. The lactic acid concentrations ranged on average between 5 – 7 mmol/l.

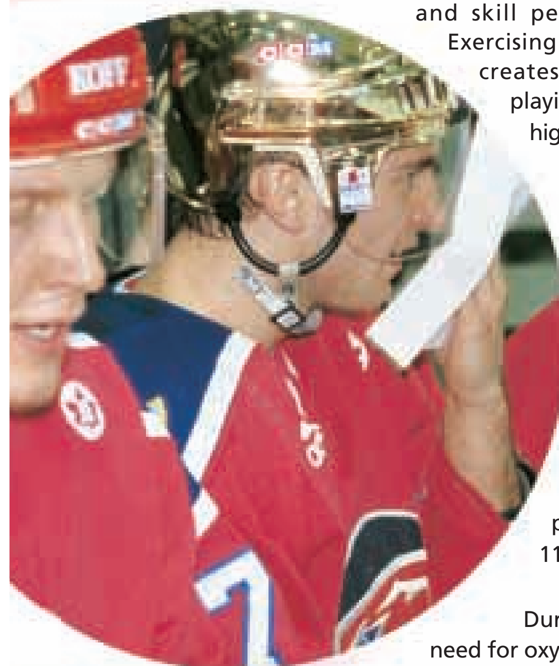


Picture 3. A forward's heart rate curve and lactic acid amounts in the Sweden-Finland game in 1993.

The stress of a game has also been studied by monitoring heart rates. The heart rate provides an overall picture of stress level and, in particular, the level at which aerobic energy production occurs. In a ice hockey game, the average working heart rates of the players vary between 170 – 174 bpm (beats per minute). For defensemen, the working heart rates are on average 10 – 15 bpm less than those for forwards (Picture 2).

The heart rates of the Swedish national team players in 1993 during work periods rose on average up to 175 to 180 bpm. These measurements are interesting, because the duration of shifts has decreased from 60 to 45 seconds, and the number of players has increased from three to four units (see Picture 3,). The heart rates indicate that the stress level rises to or slightly above the anaerobic threshold.

The primary factor of during-work aerobic energy production that needs to be increased is the anaerobic threshold. This helps postpone anaerobic glycolysis and the development of lactic acid in the muscle. Increasing the anaerobic threshold involves the improvement of local metabolism in addition to the respiratory and circulatory organs. The higher the anaerobic threshold, the more likely a player will be able to maintain a high tempo and skill performance during a game. Exercising at the anaerobic threshold creates a foundation for developing playing skills and coordination at a high speed.



RESTING PERIOD ON THE BENCH

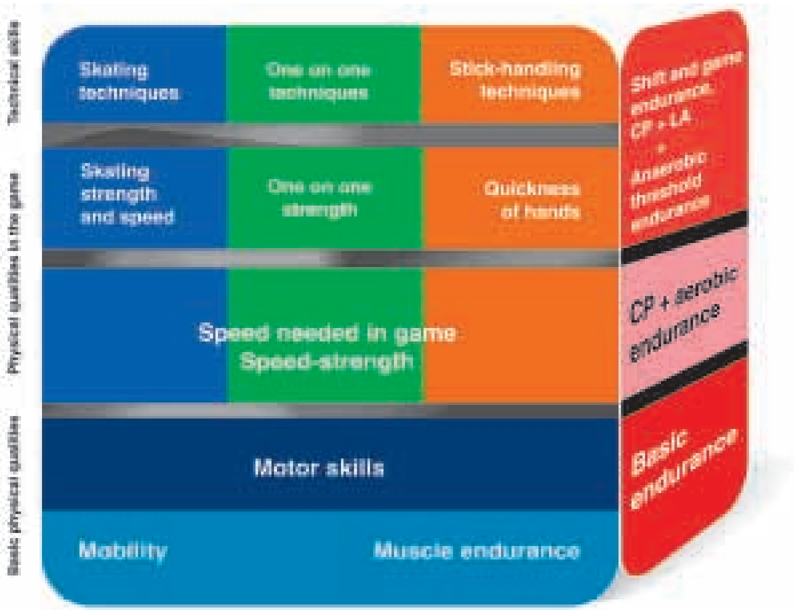
The recovery time after a 30 to 60 second work period varies between 3 – 5 minutes on average. The duration of the rest period is highly individual, and can vary a great deal between different players. During the resting period, heart rates can drop to 110 – 120 bpm.

During a work period, the body's need for oxygen exceeds its oxygen uptake, hence creating an oxygen deficit. During the recovery period, this deficit is paid back. For faster recovery, a player needs to have a good aerobic condition. Faster recovery is important since a player needs to repeat several working periods during a game.

SUMMARY OF ENDURANCE REQUIREMENTS IN ICE HOCKEY

The interval-type nature of the game is highlighted when the physical character of ice hockey is described. Intervals are inherent even within a single work period, in addition, a game consists of 20 – 25 work periods which last between 30 – 60 seconds and include a 3 – 5 minute rest period after each shift.

As stated earlier, 60 – 70 percent of the energy production during a single shift is attained from anaerobic glycolysis, and therefore, a player's anaerobic performance must be good. He/she must be able to produce anaerobic energy and simultaneously tolerate the reaction's by-product, lactic acid, without affecting skill performance.



Picture 4. Physical performance in ice hockey.

The production of energy from anaerobic glycolysis is inevitable when playing ice hockey. Therefore, players must exercise to tolerate increased acidity in their bodies.

At the same time, there is another option of developing other energy production mechanisms in order to reduce the amount of energy produced by anaerobic glycolysis. This would means increasing alactic energy production, on the one hand, and raising the anaerobic threshold on the other.

Picture 4 illustrates the overall physical requirements of ice hockey. The right side of the picture describes the energy requirements of a ice hockey game, and consequently, endurance requirements. Good alactic energy production, anaerobic glycolysis, and aerobic energy

production at the anaerobic threshold level are the sources of energy for one shift and for enduring a game. The significant energy requirements for a game are attained from anaerobic glycolysis, thereby making the overall stress of ice hockey extremely high. Therefore, exercises, for dry land training, in particular, should focus on constructive energy sources (CP and aerobic energy), as is shown in Picture 4.

The main source of energy for strength and speed training is CP, and correspondingly, the aerobic energy production determines the duration of a practice session and the endurance of a player. Consequently, good aerobic conditioning is key for a successful season. Good ice hockey endurance means the ability to play 20 – 25 shifts during a game, play 3 – 4 league games per week, exercising simultaneously, and play tournaments and playoffs, all under a tight schedule.

Although ice hockey emphasises the portion of anaerobic energy production, aerobic energy production is the foundation for a player's performance. Good aerobic fitness allows a player to save the anaerobic energy production mechanism and prevent the formation of tiring lactic acid. The higher the aerobic capacity, the faster lactic acid can be eliminated from the blood. Furthermore, with good aerobic endurance, the faster a player can refill his/her short-term energy reserves (ATP and CP) on the bench.

The bottom part of Picture 4 can be used as a beginners' exercise. Before concentrating on the game endurance of ice hockey, one must create a good and complex physical condition. Permanent structural changes in the body are attained through a varied exercise program and the loading of large muscle groups and the respiratory and circulatory organs. These changes include the formation of new blood vessels in the muscles and increased heart size and ventricular septum thickness.

The structural effect of exercise weakens and decelerates during adulthood. The physical foundation for ice hockey and top-level sporting is created during youth.

A vision of Ice Hockey's Development

Faster! Faster! FASTER! This trend has long affected the development of ice hockey, and continues to prevail, being apparent in current game strategies. We are returning to the roots of ice hockey when players learned through playing. As the game becomes faster, players increasingly have to make their decisions based on a playing situation, and not according to a system. The game strategy, therefore, must become faster and more flexible.

At the beginning of ice hockey, the respective roles of the players were simple: the defencemen defended and the forwards attacked. As the game has evolved, the tasks of the positional roles have converged, and tasks are increasingly assigned according to a game plan. With a game plan, players can be placed in advance in the most suitable role, and co-operation can be created between players.

However, in rapidly changing playing situations, co-operation within a system is difficult. Winning a playing situation is often based on being quicker than the opponent. As playing situations change very rapidly, players must react according to continuously changing playing situations. For players to be able to co-operate smoothly on the ice, they must share common objectives even in different playing situations. A players' decision-making and co-operation increasingly occurs based on a game situation and mutually agreed upon playing situation objectives. Co-operation according to a playing situation enables fast, creative, and efficient decision-making.

Rapid decision-making and co-operation is possible because of different playing situation roles:

1. *In offensive role with the puck.*
2. *In offensive role without the puck.*
3. *In defensive role covering the opponent with the puck.*
4. *In defensive role covering the opponent without the puck.*

Picture 5 illustrates the player's playing situation roles during one shift. The picture also describes the player's average playing time (in parentheses) in each of the playing situation roles.

The player is always in some role according to the playing situation. Picture 5 gives the player simple instructions on working in different roles and making rapid decisions. A player's playing situation roles change rapidly according to the playing situation.

Let us think about a situation where the player is *covering the opponent without the puck*. The opponent receives a pass and the player's role changes to covering an *opponent with the puck.* He checks the opponent, takes the puck, and becomes a *player with the puck in offensive play.* The player skates to the middle of the rink and passes the puck to his teammate, whereby he becomes *a player without the puck in offensive play.* In a very short time, the player has been in all of the playing situation roles and made some very quick decisions on the game.

Picture 5. Player's playing situation roles

The playing situation roles give a player an opportunity to quickly realise his/her thoughts. A player carries out his/her thoughts through his/her hockey skills, of which the most important are skating skills and one on one-playing. In practice, better skills means developing skating speed and endurance. During one shift, a player must be able to move around continuously and, depending on the situation, exert short-term maximum efforts. As the game gets faster, 1 on 1 situations are also increased. A player with the puck must be able to control the puck in a smaller space and in shorter time, while at the same time, creating pressure on the opposing player as quickly as possible.

Increasing game speed also means the use of game-like training, where the same drill combines the training of tactic and skills, as well as physical and psychological aspects.

Picture: Jarkko Tapola

Picture 6. Drills to go through different age levels

	F	E	D	C	B	A
1. TECHNICAL DRILLS	60	50	30	20	10	5
2. FLOW DRILLS	–	15	10	10	10	5
3. CROSS-ICE TEACHING GAMES	40	30	25	15	5	5
4. PLAYING SITUATION DRILLS	–	–	15	20	25	30
5. GAMELIKE DRILLS	–	–	5	10	15	20
6. SPECIAL SITUATIONS	–	–	–	5	10	10
7. PLAYING ON FULL-ICE	–	5	10	10	15	15
8. SPECIAL GOALKEEPERS DRILL	–	–	5	10	10	10
TOTAL %	100	100	100	100	100	100

DEFINITIONS OF THE DRILLS

1. TECHNICAL DRILLS

- Include drills that teach skills such as skating, passing, shooting, etc.
- The drills have no opponents (except the goaltender) and include
  a) the entire team;
  b) parts of the team i.e., forwards, defencemen, units, 3 on 0, 2 on 0, 1 on 0; and,
  c) races, etc. (try to get as many players as possible active during the drill).

2. FLOW DRILLS

- Also include drills with no opponent such as
  1 on 0, 2 on 0, 3 on 0 while the players repeat the same task.
  Offensive timing is the key to these drills.

3. CROSS-ICE TEACHING GAMES

- The objective of cross-ice games is to teach playing and thinking skills and team tactics.
  Games include 1 on 1 to 3 on 3 (4 on 4) games with different rules.

4. PLAYING SITUATION DRILLS (1 on 1 to 3 on 3)

- Playing situation drills that simulate a typical game.
  These drills can be one direction drills (offence or defence) or transition drills.

5. GAME LIKE DRILLS (5 on 2 to 5 on 5)

- These other game like drills help to improve the co-operation
  between all five players.

6. SPECIAL SITUATIONS (power play, short handed and face-off drills)

- These drills are special situations in a game which improve team tactics and systems.

7. FULL-ICE GAMES

- The objective of full-ice games is to teach and evaluate the results
  of the drills that have been done.

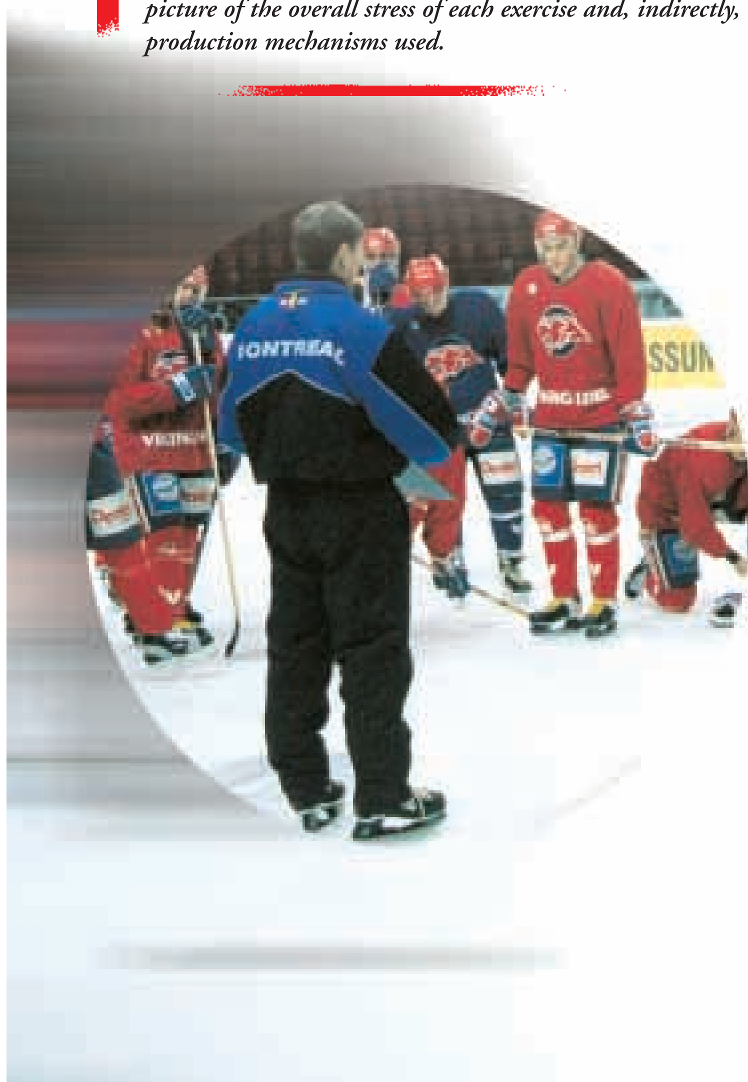
8. SPECIAL GOALKEEPERS DRILL

- The planning of these drills is done to improve goalkeeping.

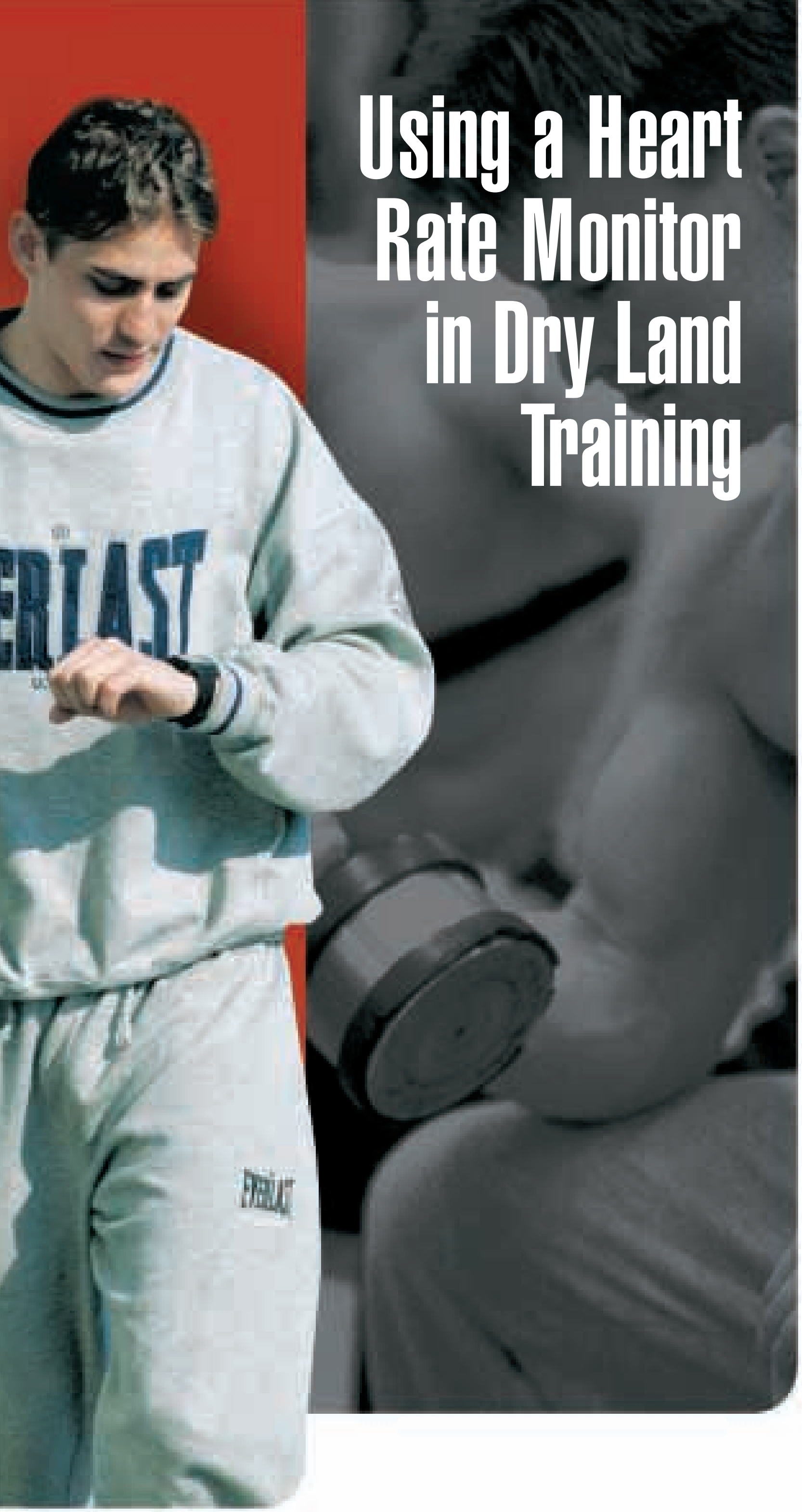
At younger ages, the development of ice hockey sense and technical skills is started in cross-ice games. As the training progresses to older junior levels, the development of technical skills and ice hockey sense moves from playing situation drills into the development of playing skills in different playing situation roles. In this way, the training progresses from the whole to parts and back to the whole (Picture 6).

When the different training areas are combined in one practice or drill, a coach must have good knowledge and skills. In particular, the anaerobic nature of ice hockey presents a challenge for a coach to know the different ways of producing energy in the drills he/she uses.

The heart rate and heart rate monitors allow a coach to have a picture of the overall stress of each exercise and, indirectly, of the energy production mechanisms used.



Using a Heart Rate Monitor in Dry Land Training



CONSTRUCTIVE TRAINING

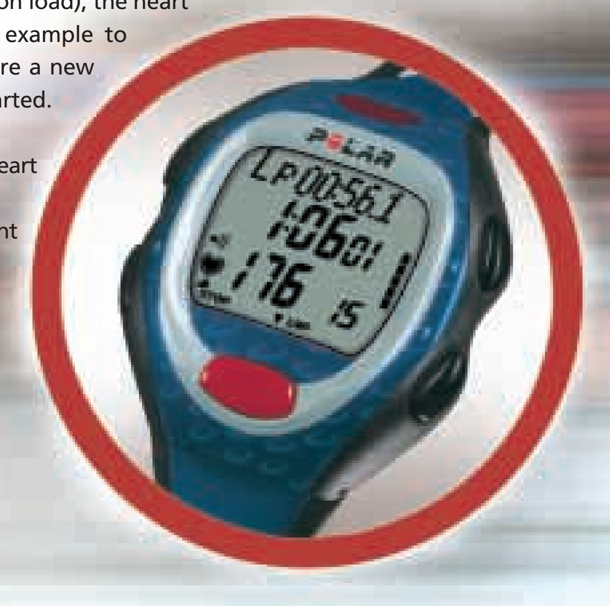
In dry land training, the primary objective is often to develop a player's physical qualities. Since the league season in ice hockey has an anaerobic (="consuming") nature, off-ice training focuses on constructive exercising – building strength and speed, and improving aerobic endurance.

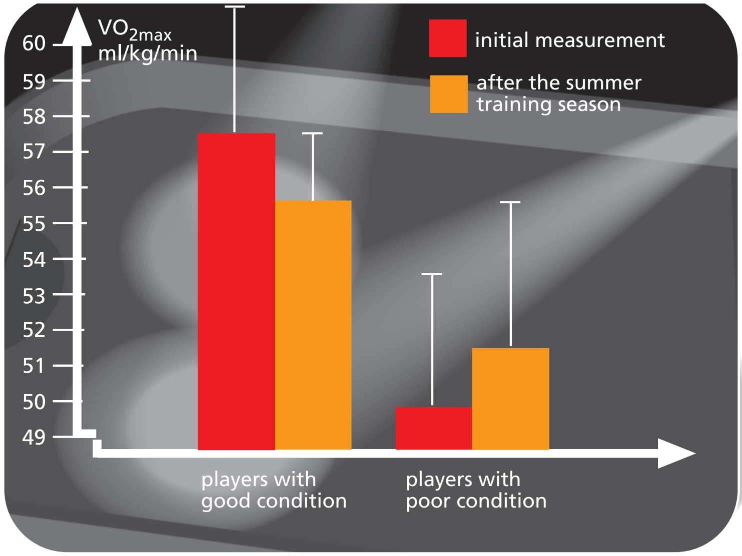
As outlined earlier, the sources of energy for constructive training are the short-term phosphate reserves in muscles (ATP + CP) and aerobic energy production.

To keep practices constructive, a coach must know the principles of energy production. As such, he/she can adjust exercise intensity and the duration of work and rest periods. A heart rate monitor allows a coach to monitor the heart rate as the intensity of a particular exercise is increased.

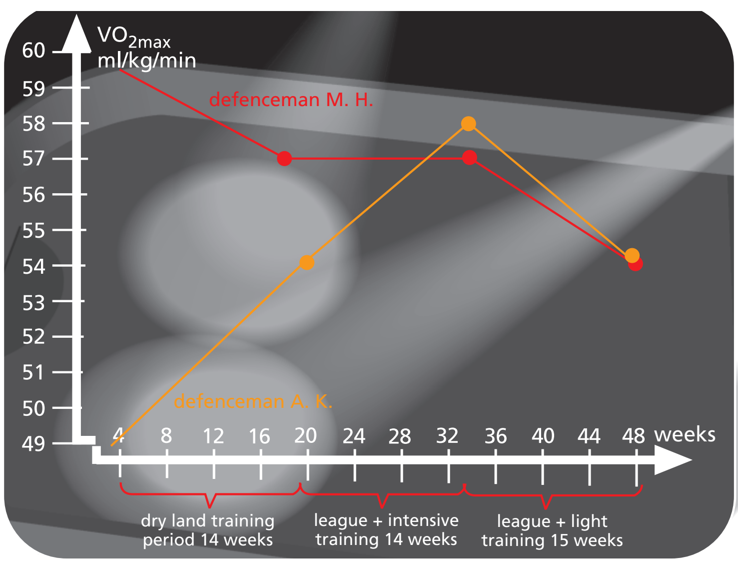
Aerobic exercise at its different levels - aerobic threshold, anaerobic threshold, and maximal oxygen uptake - can easily be controlled with a heart rate monitor. At the same time, a heart rate monitor can be used to control the stress level of short interval performances in strength and speed exercises. For example, in maximum strength or sprinting exercises, the recovery time can be considered to depend on a player's heart rate. For a short work period (3 – 10 seconds, depending on load), the heart rate is lowered for example to 110 – 120 bpm before a new working period is started.

The Polar Heart Rate monitor interval program is an excellent tool for constructive exercises.





Picture 7. The effect of dry land training (x and SD) on VO_{2max}, for players with good and poor general condition, respectively. The VO_{2max} decreased for those with good condition and increased for those with poor condition.



Picture 8. Impact of training periods on the VO_{2max} of two defencemen players with different conditions.

LEVELING IMPACT OF PRACTICING AS A TEAM

To obtain good exercise impact, it is not enough that an average exercise stimulus be focused on a team. Individual differences of the 20 – 30 players in a team may be great, and the training impact may vary greatly.

Picture 7 illustrates the effect of the dry land training period on the VO_{2max} for players with "good" and "poor" physical condition. Players of the team which qualified from Division I to the Finnish national league were divided into two groups before the summer training period based on a test. Players whose VO_{2max} was 57 ml/kg/min or better were assigned to the "good-condition" group, and players whose VO_{2max} was 50 ml/kg/min or worse were assigned to the "poor-condition" group.

The assessment after the dry land training period (14 weeks) showed that the oxygen intake capacity had decreased for the "good-condition" players while increased significantly for the "poor-condition" players. The training stimulus had been suitable for the "poor-condition" players but insufficient for the "good-condition" players. Practicing as a team has a lurking danger of a levelling effect.

Picture 8 illustrates the development of the VO_{2max} for two players with different physical conditions. For the "good-condition" MH, the VO_{2max} was 61 ml/kg/min at the beginning of the season, and for the "poor-condition" AK, the figure was 47 ml/kg/min. At the end of the season, 48 weeks later, the result for both players was 55 mm/kg/min.

It is of primary importance to individualise the training program for young players, on the one hand, and, on the other, for top-condition elite players.

INDIVIDUALISED TEAM PRACTICE WITH HEART RATE MONITORS

Individual differences may vary greatly within a team. Maximum heart rates can vary by 40 – 50 bpm between players. A coach's instruction to players to work at 160 bpm may lead to quite different results. For example, for one player it can mean that his/her aerobic threshold level is reached, while for another player it may mean that his/her maximal working level is reached.

Heart rate monitors even allow for team practices to be individualised.

To attain an individualised training effect, a player's maximum heart rate and working heart rates must first be determined at the different levels of aerobic energy production. Maximum heart rate can be determined with a maximal practical field test, such as running 400 meters, after which the heart rates for different working levels can be determined.

One simple and sure way to measure general condition is a test at the beginning of the season to determine the maximal oxygen intake. For example, a bike ergometer test with gradually increasing resistance up to total exhaustion could be used to determine individual heart rate zones for each player at different working levels.

For example, for a player whose maximum heart rate is 182 bpm three working zones an be determined:

1. *Heart rate 170 – 182 bpm is the maximal oxygen intake work zone.*
2. *Heart rate 160 – 165 bpm develops anaerobic threshold.*
3. *Heart rate 140 – 145 bpm develops aerobic threshold.*

In this manner, individual work zones can be defined for every player in a team. The work zones can be controlled by the players or the coach during an exercise to focus the impact of the exercise on the correct target. A heart rate monitor can be used for immediate stress control or, by recording the heart rate data, for later analysis.

The task below will demonstrate how a heart rate monitor is a useful tool for optimising the impact of individualised exercise programs.

TASK 1.

Carry out an exercise with your team in which the players work at three different work zones of aerobic endurance. Select a continuous performance (running, cycling, skating, etc.) where the athlete can stabilise the working level.

1. **20 minute level performance at the aerobic threshold work zone.**
2. **2 x 7 minute work period with 2 minute recovery at the anaerobic threshold work zone.**
3. **2 x 3 minute work period with 3 minute recovery at the maximal oxygen intake work zone.**

Before carrying out the practice, determine the athletes' personal heart rates at the different work zones and set these limits in the heart rate monitors.

During the exercises, an athlete must follow his/her own heart rate with the heart rate monitor and attempt to attain the work zone in question. You can also record the heart rates and analyse the results later with the athlete. With the help of an exercise the athlete learns to recognise the different levels of endurance training.

FROM JOGGING TO SMALL GAMES

The main focus in endurance training has shifted in recent years from level-paced performances, such as jogging, to interval-type small games (2 on 2, 3 on 3, 4 on 4, 5 on 5). In addition to a more game-like physical stress level, small games develop a player's skills and ice hockey sense.

Several factors have an impact on the physical stress of small games. Sports that often are used as auxiliary sports for ice hockey, such as soccer, handball, basketball, floor hockey, stress the players in different ways.

The selection of the playing area also has a great impact. Much of the playing intensity depends on the field size and how well the playing object remains in the playing area. For example, 3 on 3 soccer on a grass field compared to indoor soccer in a small gym, where the ball does not "escape" from the game, are very different types of game.

The number of participants in a game is also an important variable. Games with smaller numbers of players force everyone to participate in the game, thus increasing the stress level. A coach can control the stress level to a desired level by playing the same players continuously, replacing individual players at intervals, or by changing all players simultaneously.

The duration of the work and rest periods is naturally one of the most important variables. For example, in a continuous long-term performance, the intensity is lower and the effect of the exercise primarily develops the aerobic threshold.

When a coach wants to increase the intensity, one option is to limit the duration of the continuous performance, to 3 – 8 minutes for example, and then focus the exercise load on the anaerobic threshold development zone.

In a load that reaches the maximal oxygen intake work zones, continuous work time can be even shorter, and recovery times very short, which allows the respiratory and circulatory organs to be developed longer near the maximal level.

In addition, a coach can affect the stress of a game with different rules. For example, when defence is activated, the tempo of the entire game increases. Also, when scoring is made easier or more difficult, the nature of the game can vary greatly.

A coach can experiment to find the most suitable exercises for himself/herself and the players. Heart rate monitors allow a coach and players to receive immediate feedback on the impact of an exercise and, if required, to develop the exercise towards a desired direction.

Small games are an excellent way of combining skill, ice hockey sense, and physical stress in the same exercise. However, playing only small games does not produce the desired physical development.

A coach must know which area of endurance he/she wants to improve, and control the stress of the exercise with heart rate monitors.

In recent years, ice practices have been added to the summer dry land training programs. For example, the strength exercise in the morning will try to be "melted" into individual skill or game-like endurance in ice practices. This way the load not only affects the respiratory and circulatory systems but also the muscle level required in ice hockey.

The small game concept is also suitable for summer-time ice practices.

The above can be demonstrated by doing the advanced task outlined below.

ADDIOTIONAL TASK

Design three different small games where players work at:

1. **The aerobic threshold work zone.**
2. **The anaerobic threshold work zone.**
3. **The maximal oxygen uptake zone.**

Write down the game type, number of players, size of the field, special rules, and detailed number and duration of the work and rest periods. Before carrying out the exercise, determine the players' personal heart rates at different work zones and set these limits in the heart rate monitors.

Record the heart rates of the players, print heart rate curves for each game, and analyse the results of the exercise with respect to the set objectives.

BALANCING STRENGTH AND ENDURANCE TRAINING

In Finnish hockey, the 1970s and 80s were the "golden ages" of endurance training. In the 1990s, the focus of training has shifted to strength while endurance, compared to the increased muscle mass, has alarmingly decreased.

For example, the average maximal oxygen uptake in the Finnish 20 year old national team at the beginning of 1990 was between 57 – 58 ml/kg/min. Today, the figure has dropped to 53 – 54 ml/kg/min. When one considers that the values are averages, and are obtained from the most talented players, the situation is not optimal. Similar results have been found with the Swedish national team; from 1993 to 96, the average maximal oxygen uptake dropped from 58 to 55 ml/kg/min.

In ice hockey, players need strong and fast muscles because they must be able to repeat strong and fast performances throughout an entire game. This requires good endurance qualities. Therefore, strength and endurance training must be balanced. Ice hockey players must have strong muscles while at the same time, ensuring that the "maintenance system," or the respiratory and circulatory organs and local circulatory system, are in good shape. Currently, we are moving to a critical level with the top young players, and attention should be paid to training endurance qualities.

One way of balancing strength and endurance qualities is to combine these exercises within one drill. By repeating speed and strength exercises typical to ice hockey in circuit training with short recovery times, the respiratory and circulatory organs can be simultaneously stimulated at the aerobic or anaerobic working zone level. In addition to the central circulatory system, training stimulus is also focused locally on a muscle.

Below is an exercise to develop a combined drill.

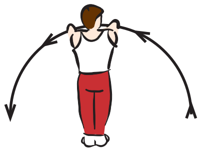
TASK 2.
Design a training circuit where players work at the anaerobic threshold stress level. Select 10 speed or strength exercises characteristic to hockey. Make sure that the loaded muscle groups are large enough to raise the blood circulation to a sufficient level. Pace the exercises so that they load the legs, body, and arms alternatively.

The duration of the work period is 60 seconds, and the rest period 20 seconds, during which the player moves to the next exercise. Carry out two rounds with a 3 minute break in between.

Before carrying out the exercise, determine the players' personal heart rates at the different work zones and set these limits in the heart rate monitors. After the exercise, print out the players' heart rate curves and which exercises were efficient and which were not and why. The following two pages contain examples of the typical exercises used.

STRENGTH EXERCISES TYPICAL TO HOCKEY AT THE TRESHOLD LEVEL:

1. Push-up position + a circle

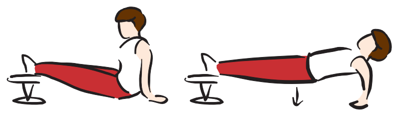


2. Skating jumps

3. Abdomen exercise with a medicine ball

4. Touching side lines while legs in skating angle

5. Mid-body exercise

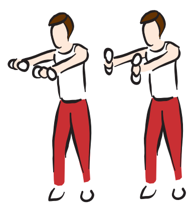


6. Jumping with weights

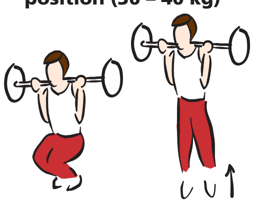
7. Stick-handling exercise

8. Fakes: move forward and back, drop to one knee, do somersault

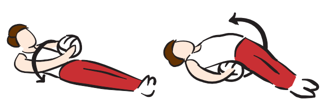
9. Wrist exercise (2 x 5 kg)



10. Jump up from deep squat position (30 – 40 kg)

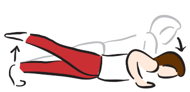


11. Mid-body exercise with a medicine ball

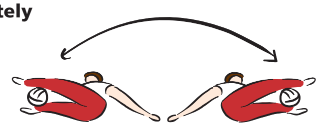


12. A figure 8 with a 20 kg weight. Note: Assume the skating position and keep the back straight

13. Push-ups by raising straight legs alternately

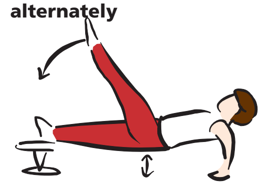


14. Abdomen exercise with a medicine ball

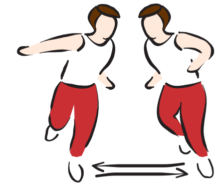


15. Shifting the body weight

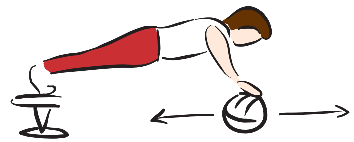
16. Raise the legs alternately



17. Skating jumps in one place

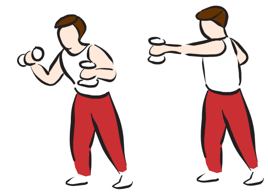


18. Lean forward, move with medicine ball

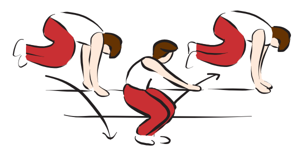


19. Jumps over a hurdle

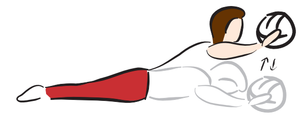
20. Boxing



21. Jumps over a bench with support by hands



22. Back exercise with a medicine ball



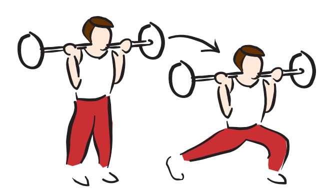
23. Skipping rope

24. Abdomen exercise

25. Lean forward, and jump; pushing off with both or alternate legs

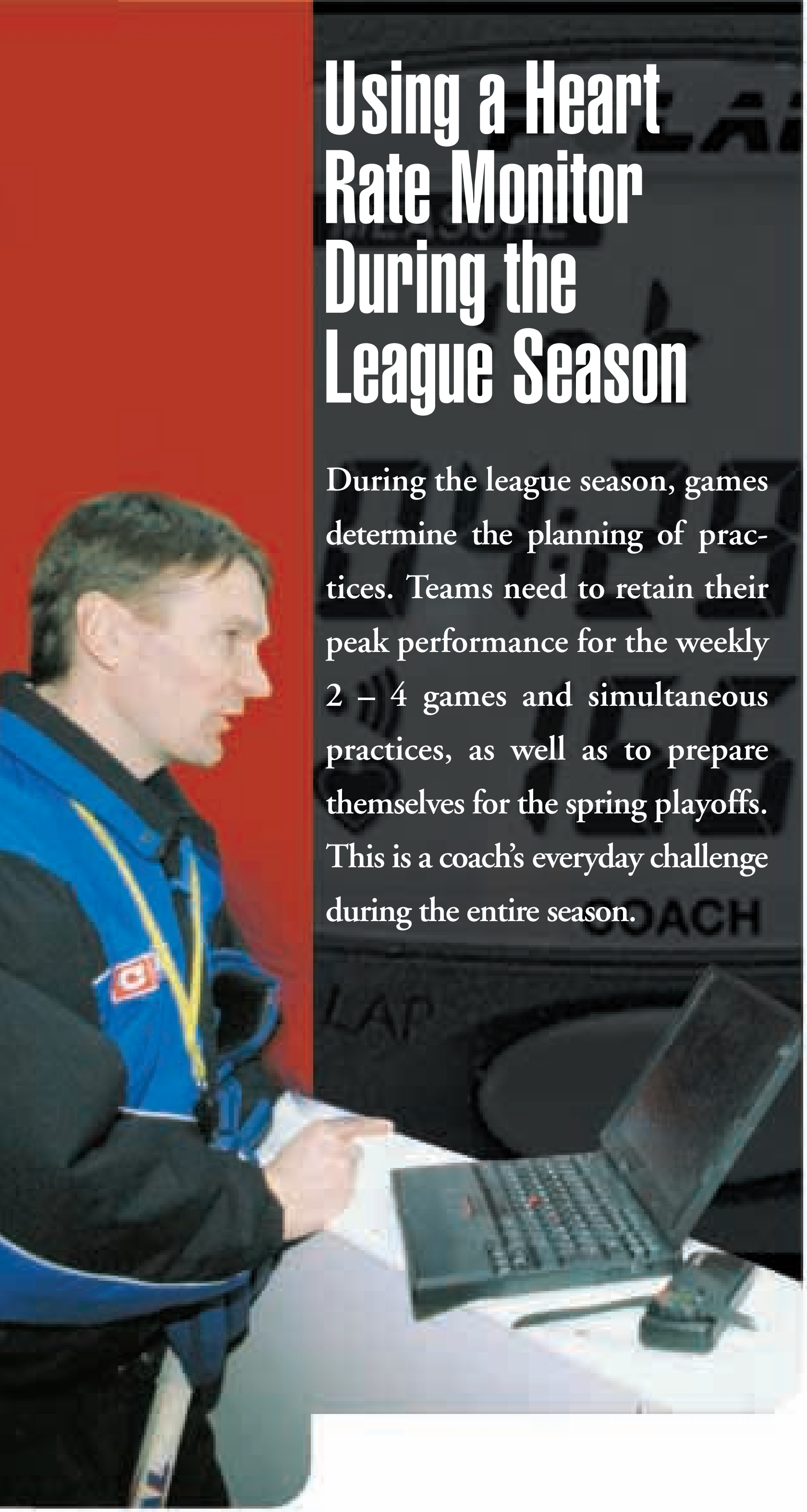
26. Arm extension behind the back (20 kg weight)

27. Forward steps or side steps (approx. 40 kg)



Using a Heart Rate Monitor During the League Season

During the league season, games determine the planning of practices. Teams need to retain their peak performance for the weekly 2 – 4 games and simultaneous practices, as well as to prepare themselves for the spring playoffs. This is a coach's everyday challenge during the entire season.



Due to the anaerobic energy production, the overall stress of ice hockey is very "consuming" for the body. Although the primary objective of ice practices is the exercising of skills and tactics, a coach should be aware of the physical stress of the drills.

Since the games make ice hockey so "consuming", practice sessions should avoid excess loading of anaerobic glycolysis. On the other hand, the intensity of the drills must correspond to a game situation so that the transition from a practice to a game is as easy as possible. In this case, the stress of an ice practice approaches the anaerobic threshold level—tempo is high, but excess lactic acid is not formed in players' bodies.

Heart rate monitors are excellent tools for a coach to learn the stress of his/her drills and the physiological differences of individual players.

EXAMPLES OF ICE PRACTICES

The heart rate monitor is excellent in dry land training for providing immediate information on the stress of an exercise. In ice training, a recording monitor is very useful.

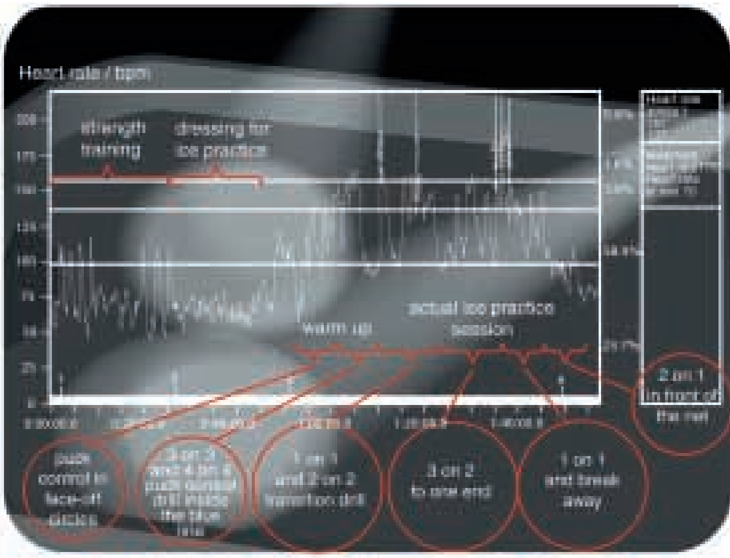
In ice practices, it is difficult to adjust the drill according to individual load. An analysis of a recorded heart rate curve can produce rather good results. After a practice session, a player and/or coach can take his/her time to decode the practice, drill by drill, and check the player's physical load. Individual heart rate zones can be programmed into the heart rate monitor and hence recorded and drawn on top of the heart rate curve, which makes it easier and more accurate to analyse the data.

Example 1 presents the player's heart rate curve for a 20 minute light-intensity strength exercise and the subsequent 60 minute ice practice.

In the strength exercises, the load is focused on local muscles, and the impact on the central circulation and heart rate is minimal. A player however, can use his/her heart rate to monitor his/her recovery before the next working period.

Since the strength exercise aims at developing the "explosive" leg strength, it is important that a player starts each work period "fresh," i.e., sufficiently recovered. In this type of exercise, the source of energy is creatine phosphate (CP), and the recovery time with respect to energy production is 1 – 3 minutes.

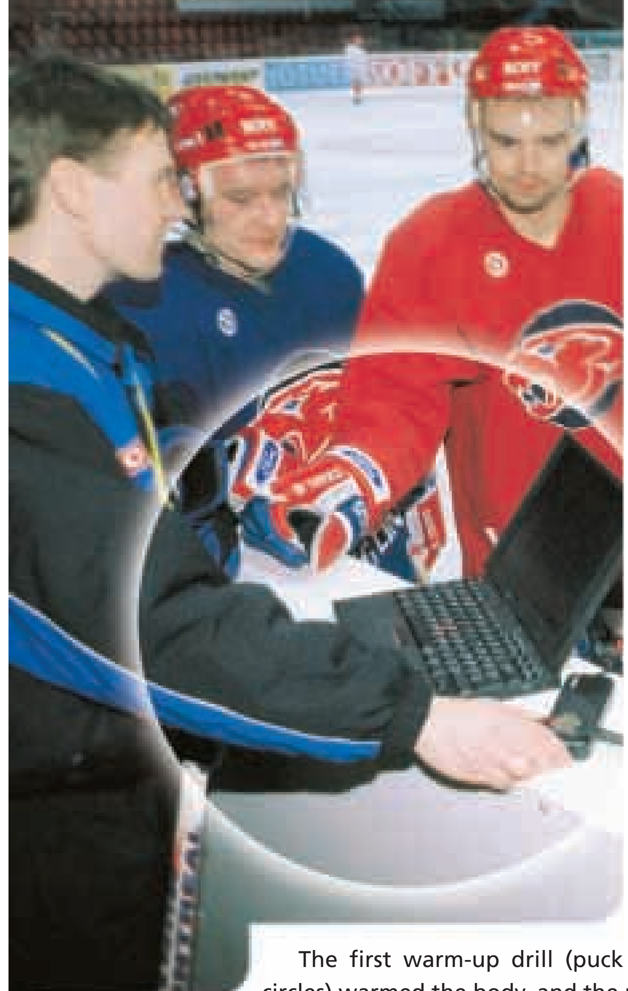
The purpose of the ice practice after a strength exercise is to refine strength into a game-like type of strength and speed.



EXAMPLE 1

In example 1, the objective of the ice practice is to develop individual ice hockey skills at maximal tempo that correspond to a game situation. With respect to energy production, this primarily means the use of short-term phosphates and the lactic acid system: 1) to produce energy for strong, explosive performances; 2) to tolerate the generated lactic acid (5 – 10 mmol/l) and retain the skill level despite exhaustion; and, 3) to prevent the loads from increasing too high and "consuming".

An evaluation of the heart rate curve in example 1 indicates that the physiological objective of the practice was succeeded.



The first warm-up drill (puck control inside face-off circles) warmed the body, and the next warm-up drill (3 on 3 and 4 on 4 puck control drill inside the blueline) is closer to game-like intensity. The following two drills are tempo drills in open ice areas. In the transition drill (1 on 1 and 2 on 2), the duration of the work period was 20 seconds on average and the work/rest ratio was 1/3 and 1/2. The heart rate clearly exceeds the anaerobic threshold. When the duration of the work remains short, the exercise load closely corresponds an actual game situation.

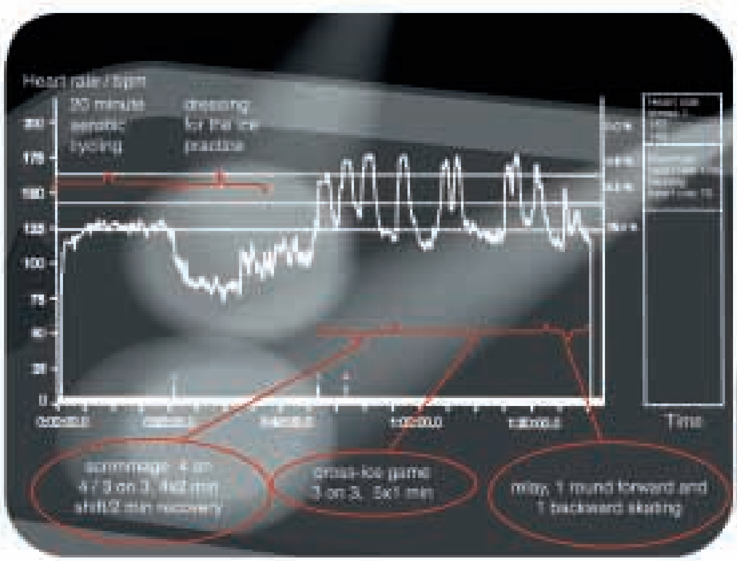
In the 3 on 2 offensive drill to one end, the heart rate remains below the anaerobic threshold. The players' skating intensity is probably not high enough in the drill, and sufficient physiological effect is not produced. This drill could be developed by picking up a second puck from the middle zone after the first attack, thus increasing players' skating and the duration of a single repetition.

The last two drills are 1 on 1 and 2 on 1 in a small ice surface. A player's muscles are working quite static, and the heart rates remain at a lower level than in open ice drills. However, the stress of these drill corresponds to the load of a small ice situation in a game.

When a coach wants to practice his/her team at a game-like stress level, he/she must make sure that there is enough open ice movement within the practice, that the exercise intensity is high, that work periods are not prolonged, and that the recovery between working sessions is sufficient.

In example 2, a 60 minute ice practice follows a 20 minute aerobic cycling exercise.

The physiological objective of the ice practice is to improve the endurance of a player's anaerobic threshold level. In practical terms, this means a player's ability to play at a maximal intensity without accumulating lactic acid in his/her body. The heart rate curve in example 2 shows that the intensity has increased too high, when the objective was to develop the anaerobic threshold. Excess lactic acid has formed in the body, and the practice is more physiologically depleting than developinIn a 4 on 4 and 3 on 3 scrimmage, a 2 minute work period is too short and the intensity rises too high. The load would probably



EXAMPLE 2

approach the anaerobic threshold with a 3 minute work period and 1 minute recovery. In small area games (cross-ice 3 on 3), a 1 minute work period also appears too short. The duration of the work period, 2 – 3 minutes, with a short 30 – 60 second recovery would produce the desired exercise effect.

Task 3 below enables you to utilise the concepts above in designing a 50 minute ice practise session.

TASK 3.

Design a 50 minute ice practice session for the day preceding a game, where the tempo is maximal and the exercise must not be too depleting (=no excess lactic acid is produced in the body).

Put the practice together from 4 – 5 drills. Record the following for each drill:

1. **Name and objective of the drill.**
2. **Physiological objective of the drill (e.g., how high the heart rate should increase, and what energy production mechanism the exercise stresses).**
3. **Estimated number of working periods per player.**
4. **Duration of working and resting periods.**

Before the practice, distribute heart rate monitors to both forwards and defencemen and set the players' individual heart rate zones in the monitors.

After the practice, print the players' heart rate curves and evaluate results drill by drill with respect to the set objectives. Compare the figures between different individuals, defencemen and forwards, and think of ways to further develop the drills.

As in task 3, you can set different objectives for the practice sessions and test the physical stresses of the drills with heart rate monitors.

By analysing heart rate curves, experimenting and gathering data, a coach can develop his/her knowledge of physiology and, above all, optimise the drills for his/her team.

Also, by varying the number of players in drills, the intensity, as well as the duration of work and rest periods, drills can be developed as desired, while at the same time, accounting for individual differences in players so that the same exercise stimulus is reached. For example, in most drills the load of defencemen remains lower than that of forwards.

AEROBIC ENDURANCE DECREASES DURING THE LEAGUE SEASON

Previous studies have indicated that players' aerobic endurance weakens during a season. As described earlier, good aerobic endurance plays an important role in maintaining a player's performance capacity. The decreasing of aerobic capacity during a league season is partially due to hockey's highly anaerobic nature. The work period in hockey is too short to sufficiently stress the aerobic energy system. Good drills targeted at the anaerobic threshold level can prevent and influence the decrease of the aerobic capacity. Various jogging and cycling sessions are a simple, easy, and individualised way of maintaining and developing aerobic endurance.

Depending on the game schedule, anywhere between 2 to 5 games, weekly 20 – 30 minute jogging sessions at the aerobic level before or after an ice practice sustain endurance and train the body well. Heart rate monitors ensure that the exercise stimulus is individually suitable.

Often jogging is stopped after the summer training season, and when the same jogging exercise is attempted during the league season, the players' legs become sore when different muscle groups are stressed than those in skating. A players' jogging condition should be maintained after the summer, by using light jogging as a recovery exercise during the league season.

HEART RATE MONITORS AND INJURED PLAYERS

During a league season, the highly anaerobic nature of games and practices repeated too often may cause a local overload. Players often experience this as "heavy legs" and loss of sensitivity. Green (1983) assumed that this type of exhaustion relates to an internal contraction of a muscle cell. This risk can be reduced with heart rate monitors.

Heart rate monitors allow coaches to adjust the overall stress of games and practices, as well as to prevent hyper-condition and the resulting physical injuries. This way, unnecessary "sick days" can be prevented, which keeps the team in top condition.

Nevertheless, injuries are inevitable in physical contact sports. A heart rate monitor is a highly efficient tool in the individual rehabilitation of players back to the ice.

Often rehabilitation exercises are separate from team practices, which allows the stress to be completely determined based on the individual's terms. A heart rate monitor allows dry land training and ice practice to be adjusted according to personal requirements.

Picture: Jarkko Tapola

Determination of Maximum Heart Rate With a Practical Field Test

It is important to know the maximum heart rate of the individual players in order to interpret any heart rate measurements. A player's maximum heart rate can be determined in a simple way, as described next page.

The player runs four laps around a field or track at a moderate speed corresponding to a pace of about two minutes per lap (or another type of warm-up). This is followed by running one lap at a higher speed (in about 90 seconds), then half a lap in about 40 seconds, and finally half a lap at maximal speed, which may take about 30 seconds.

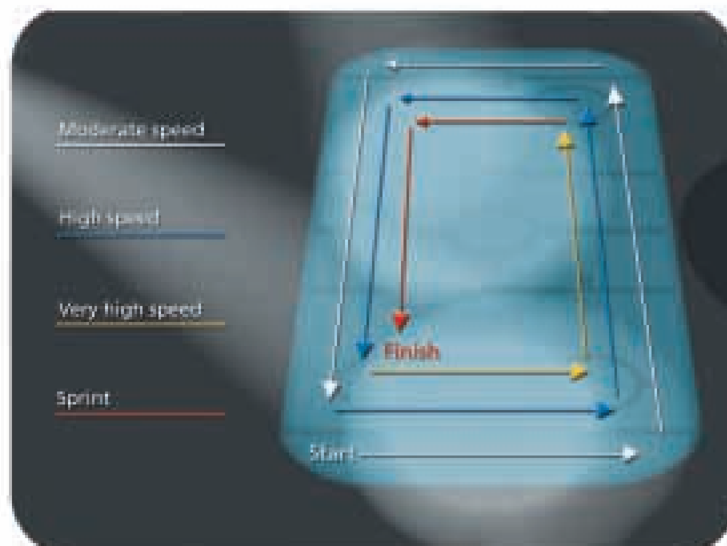
Immediately after finishing the test the player's heart rate should be observed at the LCD display of a Polar heart rate monitor or downloaded later on to the computer from the memory of the heart rate monitor.

The test lasts about 11 minutes for each player. The duration of the test can be as short as three minutes if another type of warm-up is used.

If a whole team is to be tested, the players can start at intervals of 30 seconds, thus 16 players can be tested (including warm-up) in 20 minutes.

Another way to determine a player's maximum heart rate is to measure it immediately after a bout of presumed maximal intensity exercise during training. However, such measurements should be repeated several times to ensure that the true maximum heart rate has been obtained.

A player's maximum heart rate will not vary with changes in training status throughout the season, but it will decrease as a player gets older. It is therefore necessary to determine a player's maximum heart rate once a year.[1]



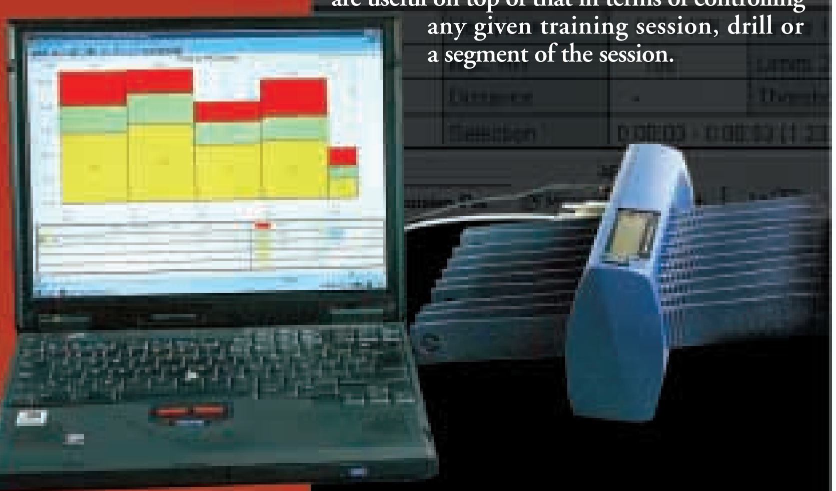
[1] Test adapted from Fitness Training in Football by Jens Bangsbo

Maximal Utilization of Heart Rate Monitors

The following functions are available either in the Polar Team System or in the range of Polar heart rate monitors. Please, note that all of them can NOT be found in all the different product models, but only in the most sophisticated ones.

In order to buy the best possible product to satisfy your needs, please, study the below list carefully – and then contact your local Polar distributor or retailer for more information to help select the right product for you.

The product functions are divided here into two categories. Into those that will help you to monitor the whole training program as well as calibrating any specific drills in general or individually. And into those that are useful on top of that in terms of controlling any given training session, drill or a segment of the session.



Functions to monitor training sessions or drills

The monitoring features are useful to get a reliable overall picture of what is being done easily and effectively. They the basis for any quality program. This is based on after-the-fact analysis and correcting/changing things for the next session.

RECORDING the entire training session into the transmitter belt

This feature is unique to the Polar Team System product. You can easily and automatically record the entire training session – per player – up to 10 players with a single system – into the memory of the transmitter belt.

As you will not require any additional wrist receivers, if you do not want them, you can record information also from matches, which opens up a totally new inside view to the whole physiology of your team sport.

Now for the first time you will know what you are exactly training for, because you will know what is going on during a competitive match.

There are no buttons to push for the players, which makes the use extremely easy – all one has to do is to put the belt on (it will start automatically itself) and to take it off (and it will shut itself off automatically).

You can also either expand the system with additional transmitter belts or simply purchase several systems.

ANALYZING the recorded heart rate information

The Polar Team System comes with a versatile software package that will enable you to plan, record, analyze and to report any and all progress you are making in training, individually, player per player.

Over time the systematic use of this product will give you a valuable overall understanding on how your drills and exercises work for your players and team as well as show any progress individually, concretely and objectively.

CODED HEART RATE TRANSMISSION to a wrist receiver

All the Polar Team System transmitter belts come with a coded transmission technology. This means the heart rate data of the individual players will not get mixed with that of another player.

In the Polar Team System product you have the option either to use this feature or not. Examples on where the additional use of the wrist receiver may be useful in team sports have been given below in the presentation of the wrist receiver features.

The Polar Team System transmitter belt will work with any recommended Polar wrist receiver.

Functions to control training sessions or drills

The controlling features will give you an even closer look on details during the session in a drill or a segment of the session as well as between drills or segments of the session.

The controlling features are best used once the overall monitoring is already being done – and specific changes or qualitative goals are being sought.

HEART RATE DISPLAY

The heart rate is shown, as beats per minute, continuously and clearly on the LCD display of all the Polar wrist receiver models. Thus players and the coach can see the heart rate at any given time during a training session by simply glancing at the LCD display on the player's wrist.

TARGET ZONES with warning "beeps"

This function allows for a target heart rate zone (i.e. an upper and a lower limit) to be set. When the heart rate of a player is outside of this zone a "beeping" sound is emitted from the wrist receiver. For example, during a small-sided game with a 4-minute work period the goal may be to establish a physiological loading that is categorized as aerobic high intensity training. Accordingly the upper limit of the target zone will be set as 95% of the players tested maximal heart rate and the lower limit as 85% of the same. For a player with a maximum heart rate of 200 beats per minute, this would correspond to an upper limit of 190 beat per minute and a lower limit of 170 beats per minute. Hence, should the player's heart rate drop below 170 beat per minute the wrist receiver would "inform" the player about this. When this happens the player knows to work harder in order to achieve the desired physiological effect.

TIME SPENT IN TARGET ZONE

To compliment the target zone function, the total time spent in a given heart rate target zone can be recorded in the wrist receiver as well as be displayed on the LCD display at the end of the training session. Hence, for the above player, with the target heart rate zone of 170-190 beats per minute, a coach could set a goal to work at this aerobic high intensity zone for a total of 20 minutes. The goal can be split into practical details such as playing a small-sided game for 5 x 4 minutes with 2 minutes recovery periods between repeats. At the end of the session the coach can check from the wrist receiver the total time the player really did spend in the given target zone.

Record INTERVAL/SPLIT TIMES AND MOMENTARY HEART RATES in the wrist receiver memory

With this feature the momentary heart rate of the player can be recorded at any given time in the memory of the wrist receiver by simply pushing a button.These so-called "split time values" can then be displayed and analyzed at the end of the training session. This feature is useful for example in connection of making use of the Yo-Yo tests i.e. the heart rate of a player at the end of each running level can be recorded in the memory if the players are instructed to press the button at the appropriate time.

AVERAGE HEART RATE of a training session or segment(s) there of.

The heart rate of a player will fluctuate during any given drill or exercise in any intermittent team sport. Thus, it may be useful to know the average heart rate of any given exercise period to verify the overall intensity for

the same (this is most useful when repeated for all the different segments of the training session separately). This would be done to better know the general physiological effect of the exercise.

INTERVAL TRAINER

Features that can be programmed to automatically guide both the work (number and duration of repeats) and rest (duration between repeats) periods of a training session. This function enables a player to work according to individualized program even in a team situation. This function is useful for example in small-sided games as the coach can program for example 4-minute work periods to be repeated 5 times interspersed with a 2 minute recovery period into a wrist receiver. In such a case the wrist receiver will time the sessions – and the coach can concentrate on sport specific quality issues such as technical and/or tactical details of a player in the drill. Based on the programmed workout details the wrist receiver will record corresponding heart rate information for analysis.

MULTIPLE TARGET ZONES

The concept of target heart rate zones has been mentioned above. With multiple target heart rate zones multiple higher and lower limits can be set according to the different aims within a drill or the different drills within a training session. For example, players may alternate between playing in a 3-a-side game, where the target heart rate is between 90 and 100% of their tested maximum heart rate, and a 6-a-side game where the target heart rate is reduced to between 80 and 90% of their tested maximum heart rate.

Record a whole training session in the memory and DOWNLOAD TO COMPUTER

With this function a series of momentary heart rate data (sampled every 5, 15 or 60 seconds) from one or more training sessions is saved in the wrist receiver. This data can be downloaded into a computer using either a Polar Interface device or with some of the new S –series models also via infrared port. The data can then be analyzed in many different ways, for example, a heart rate curve can be drawn and printed out or a summary report on time spent in the different heart rate zones (High intensity, Moderate intensity or Low intensity zones) can be calculated.

PROGRAMME THE WRIST RECEIVER from the computer

This function allows for the pre-programming of a wrist receiver from a computer (without the need to memorize the-push-button-routine of the wrist receiver). It is a useful function to easily personalize the settings on every wrist receiver per player with a few keypad strokes of your computer. Physically this can be done either by using a Polar Interface device or via a special Polar Sonic Link up-link feature through the microphone of your computer.

Polar Team System™

Polar S610i™

Polar S410™

Polar S210™

Polar Team System™
The System consists of
* 10 Team Transmitter heart rate belts with straps
* 1 Manual for the hardware and the software
* 1 Interface/Recharging unit for the heart rate belts
* 1 connection cable to the computer
* 1 power adapter (220V or 110V)
* 1 TeamPak vinyl carrying case (with shoulder strap)
* 1 Polar Precision Performance SW 3.0 Team Edition
* Service Card
  2 years warranty for the transmitter belts
  2 years warranty for the interface/recharging unit

Main benefits:
* Automatic heart rate recording into the transmitter belt in order to monitor matches, training or testing
* A system to manage fast and easy the training data of 10 players at once
* Computer programmable transmitter belts
* Records unlimited number of files
* Rechargeable transmitter belts
* Optional coded heart rate transmission into a wrist receiver for training control
* Downloads to a computer
* Includes software for planning, storing, analyzing and reporting exercise data

Polar S610i™
* Coded heart rate transmission
* OwnCal™ calorie calculation for estimating nutritional needs
* Percentage of maximum heart rate display
* 3 programmable target zones with audiovisual feedback
* Programmable Interval trainer with timers
* Stores 5 pre-programmed exercise sets
* Automatic recording of maximum heart rate of either the entire session or an interval
* Average heart rate of either the entire session, each interval or each lap time
* Programmable from a computer (Polar UpLink)
* Records 99 number of files into memory
* Downloads to a computer (IR-Interface)
* Includes software for planning, storing, analyzing and reporting exercise data

Polar S410™
* Coded heart rate transmission
* OwnCal™ calorie calculation for estimating nutritional needs
* Percentage of maximum heart rate display
* 3 programmable target zones with audiovisual feedback
* Programmable Interval trainer with timers
* Stores 5 pre-programmed exercise sets
* Automatic recording of maximum heart rate of either the entire session or an interval
* Average heart rate of either the entire session, each interval or each lap time
* Programmable from a computer (Polar UpLink)
* Records one complete file into memory
* Downloads the recorded file to a computer (SonicLink™)
* Includes software for planning, storing, analyzing and reporting exercise data

Polar S210™
* Coded heart rate transmission
* OwnCal™ calorie calculation for estimating nutritional needs
* Percentage of maximum heart rate display
* 3 programmable target zones with audiovisual feedback
* Programmable Interval trainer with timer
* Stores 5 pre-programmed exercise sets
* Automatic recording of maximum heart rate of either the entire session or an interval
* Average heart rate of either the entire session, each interval or each lap time
* Programmable from a computer
* Records one complete file into memory
* Does not download to a computer

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“Faster, faster, faster!” This trend has long affected the development of hockey. As the game continuously becomes faster, the players increasingly have to make their decisions faster according to a playing situation, and not based on a preplanned game system. This requires players to quickly “read” the game, react rapidly, and make quick decisions. Today’s hockey is not played according to a system, instead playing situations determine player roles.

This booklet sheds some light on the work that was done behind the scenes as HIFK climbed back to the top of Finnish hockey. The results speak for themselves. Eleven men have been coached by the most renowned coaching pair of recent years, and have taken off to the NHL. In addition, several HIFK players played on the Finnish national team in its two silver medal wins in the World Ice Hockey Championships.

No longer are strong muscles the only physical requirement in hockey – the new playing style requires extreme endurance. Each player must be able to react and act according to the playing situations of an entire game. The authors of this booklet, Erkka Westerlund and Raimo Summanen, have found a very illustrative and useful way to present a method for improving the physical endurance demanded by today’s hockey – in each situation throughout the entire game.

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