

# The most common technical errors in Ice Hockey Shooting

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<p>The objective of this study is to gather theoretical and practical knowledge about ice hockey shooting techniques and examine what is required to learn the skill of shooting. It discusses a two-year-long project, the aim of which was to determine the most common technical errors in youth hockey. This thesis describes the basic shooting techniques from both a technical and a theoretical point of view and examines the steps involved in learning these techniques. This should be useful for those interested in shooting techniques and coaching.</p> <p>A practical shooting analysis project was conducted to analyse shooting and identify common technical errors. The shooting styles researched were wrist shot, snap shot and slap shot. The participants of the project were filmed in the summers of 2017 and 2018. There were almost 300 participants, and each of them received individual feedback. The results consist of a summary of all the feedback.</p> <p>The respondents stated that the most common technical errors relate to the rhythm of the hands and upper body. Rhythm is essential for shots that are quick, accurate and powerful. The results also provide an overview of the key points related to shooting styles from coaching manuals, and it is found that these are useful.</p> <p>The findings indicate that shooting training should be more creative and that coaches should focus more on different environments. This could help with rhythm, which is a significant challenge for many players while performing a shot.</p>	
<b>Keywords</b> Ice Hockey, Shooting, Skill, Learning	

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# 1 Introduction

This is a research oriented thesis that answers the questions, What are the most common technical errors in wrist, snap and slap-shot techniques, and what kind of training should be used? The questions are topical in Finnish hockey because the Finnish Ice Hockey Association (FIHA) has designated scoring as one of its focus areas in youth hockey. Before, FIHA emphasised scoring support actions more, but now the focus is also on the shooting that leads to a goal. The topic was chosen because it relates to the author's work life. One part of my current job is to be a shooting coach and provide shooting feedback for players who participate in the hockey camps. To determine the common errors in shooting, I analysed nearly 300 participants' shooting videos. The participants received individual feedback about their shots, and the result of the project is the summary of all the feedback. The project is designed to support coaches interested in shooting coaching and training by focusing on the shooting analysis and its results. To understand these results, we consider all aspects related to shooting, such as learning, hockey sticks, shooting styles and physical requirements.

The theoretical aim of this project is to determine the learning required and the key points of shooting techniques in coaching manuals. Meanwhile, the practical part of the thesis concerns the results, which are the common errors and the common key points coaches use. The shooting feedback sheet is completed according to the key points. Later, I compare the results to the key points to assess the participants' skill in those factors. Finally, I consider whether the common key points should be added to or changed according to the factors for which the participants' performance is weakest.

As a half-time shooting coach, this project provides me new ideas to plan the shooting training and knowledge about the factors I should focus on. Analysing almost 300 videos also contributes practical experience to future work. Shooting is a quick performance made of small, fast motions, each of which affects another; thus, experience is required to identify the right motions in the performance.

The most important sources are the coaching manuals online and books; another important source is the feedback analysis.

## **2 Requirements of ice hockey**

Ice hockey requires varied skills of its players, and professional players have many technical, tactical and physical skills. The situation in the game can change rapidly, and the player must react with equal speed. Quickly changing situations in the game in particular require a high reaction capability and decision-making skills. The intensity of the game is high, which sets the physical requirements: the player has to be strong, fast and have adequate stamina. During the shift, players must make quick sprints and stop and start often. This requires considerable strength and speed (Koho & Luukkainen 2012, 20).

During the average shift, the player mostly uses the anaerobic energy system, but the amount of lactate varies widely (4-15 mmol/l) depending on the shift. Between shifts, there is a one- to three-minute resting period, and recovery happens through the aerobic metabolism. Physical training, especially with professional players, is done mostly in the off-season. In the on-season, physical training is mostly for maintenance (Koho & Luukkainen 2012, 20-21).

If the player has sufficient hockey-specific skills, he or she can pay attention to and observe the game more. However, if the player has difficulties with the technical skills, the attention and observation focus more on the technical performance than the game (Koho & Luukkainen 2012, 20-21).

### **2.1 Biomechanics of shooting**

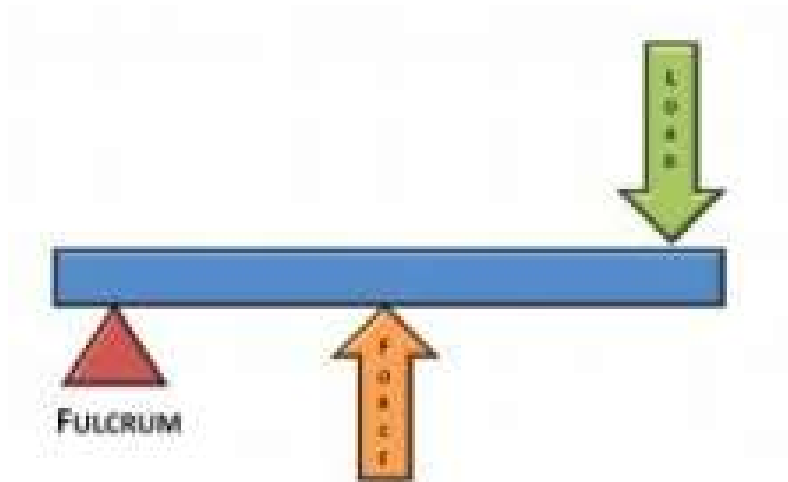
According to Stein, 2005 The stick in the player's hands adds extra length to the body's lever. The body's lever is the arm, which is a third-class lever, but, because the player holds a stick, the stick becomes part of the lever.

The components of this third-class lever are:

- Fulcrum– The top hand
- Load– The blade of the stick and the puck.
- Effort (muscle insertion) – The lower hand on the stick.

And the functions of the lever are:

- To increase speed.
- To enable a full range of motion.



Picture 1. Third-class lever (Stein 2015).



Picture 2. Third-class lever (Stein 2015).

According to Stein, 2005 The third-class lever increases power to the shot, so if a shot is executed precisely the outcome will be positive. The stick increases the range of motion, which, in turn, increases power of the shot when force is applied (Stein 2015).

### **3 Sticks**

In modern times, hockey sticks are usually made of composite, which is flexible and durable, making it suitable for creating a hockey stick. The stick can also be made of aluminium, graphite or wood. A wooden stick is heavier and less durable than a composite stick (Shorey 2004, 32.).

While taking a shot, the main function of the stick is to convey power to the puck. A player shoots and hits the ice before the puck does. The player's arm conveys the power first to the stick, and the stick bends forward and snaps back into position. Bending and releasing generates even more power for the puck and makes it accelerate (Sharp, 2010, 48.).

#### **3.1 How to select the correct stick**

Before making a purchase, the player should have knowledge of five aspects of the stick: whether it is left- or right-handed, its length, its flexibility, its kick-point and the blade model (Shorey 2004, 32.).

##### **3.1.1 Left- or right-handed**

The curve of the blade is angled to its left or right side, which determines a left- or right-hand shot. The correct side can be determined by trying to shoot from the both sides, which readily shows the most powerful and natural side to shoot from (Shorey 2004, 32.).

##### **3.1.2 The stick length**

The stick length always depends on each individual's height, physical makeup, posture and skating style, so there is no absolute rule about how long it must be. A general guideline is that a player should measure the stick length with skates on. The stick should rise to between the nose and clavicle. Another general rule is that the blade of the stick should lie on the ice while carrying, shooting or passing the puck. Typically, an uncut stick is too long for a junior player. If the stick is too tall, it affects the shot; the puck might be too far away from the body, which means that the player cannot place enough pressure on the shaft. Additionally, the blade is not flat on the ice, which negatively affects the power and accuracy (Shorey 2004, 32-33.).



### **3.1.3 Stiffness and flexibility**

Stiffness affects the contact time between the puck and the blade in the same way that a stiff bow releases an arrow more quickly than a loose bow. The difference is that, in shooting, the power comes from the player, not from the stick (Hache, A. 2002 145).

On a hockey stick, a print shows how flexible it is. The numbers before the word 'flex' indicate how many pounds of weight are needed to bend the stick one inch. For example, to bend a 75 flex stick one inch, a player has to be able to apply 75 pounds of force to it. A common way to choose flex is to pick one equal to player's body weight in kilos (Hockey Review HQ 2010.).

Another important aspect to choose is the shaft. Shafts are divided to three different models: junior, intermediate, and senior. The model determines the length, diameter and flexibility. Senior shafts are stiffest, have the largest diameter and are the longest; juniors are the opposite and intermediates are between the two (Hockey Review HQ 2010.).

### **3.1.4 Kick-point**

Choosing the right kick-point is the athlete's decision; it depends on his or her style of shooting and playing (The Stick Guru 2015.). Young or teenage players usually do not know what kick-point they use, which is one reason young players sometimes say, after the first use of a new stick, that it does not feel the same as the previous stick. Even if the new one is manufactured by the same company as the previous one, has the same flex and blade, the kick-point might be different.

The kick-point refers to where the stick bends the most. Kick-points are divided into three main categories: mid-kick, low-kick and custom or variable models. Low-kick bends the most at the bottom of the shaft and is a suitable kick-point for wrist shots and the snap shots, both, of which require a quick release. Mid-kick bends the most in the middle of the shaft and is suited for slap shots because the pressure in slap-shots hits the middle of the stick. Mid-kick is also suitable for players who apply hard pressure to the stick and have a good technique for doing so. The custom or variable kick-point sticks have two kick-points, usually low and middle, and they have both mid- and low kick-point features. Such sticks are the most expensive (The Stick Guru 2015.). Users should remember that kick-points are helpful, but finding a suitable one does not automatically mean that the shot will be harder or quicker. It does not matter what kick-point new players use; their benefit emerges when the technique improves.

### 3.1.5 Blade

The blade curve is important in terms of physics. In a slap shot, when the blade hits the ice, a straight blade bends to the same direction as the shot because of its elasticity. After, the bending affects the angle of the puck when it releases from the blade. This impairs the accuracy of the shot. If the blade is curved, the blade hardly bends at all, and the accuracy is better (Hache, A. 2002 145-146).

Blades can be divided into three different curve patterns: heel, mid and toe curves. The curves can also be in different positions or angles. The position and the angle of the blade have the highest impact on shooting (Pure Hockey 2018.). For novice players, this information is not important, but more experienced players should know which curve and lie is suitable for him or her. Manufacturers usually do not print curve information on the stick, but they use professional players' surnames to refer to the blades. All the necessary information about the blades can be found on manufacturers' web sites.

The blade patterns determine the location of the puck while shooting or carrying it. A heel curve provides the puck a long release. The location of the puck is measured from the shaft, the beginning of the blade. The heel curve is mostly used by players who shoot many slap shots. The mid curve is suitable for all styles of shots, and the location of the puck is in the middle of the blade. The toe curve is the best curve for the quick shots; the location of the puck is at the top of the blade, which gives it a short release. It is mostly used by players who shoot quickly (Pure Hockey 2018.).

To choose the correct blade lie, the bottom of the blade should be even on the ice. This should be tested with the skates on and standing in puck-carrying position. Some stick manufacturers print the word 'lie' and a number on the stick; the former indicates the angle between the shaft and the blade, and the latter indicates how far the blade and the puck are from the feet. A lower lie number means that the puck and blade are further away. Young and short players usually use four or five lie, and taller players six or seven. The most-used lie is five, which equates to an angle of 135° (Shorey 2004, 33.).

## **4 Learning skills in sports**

Learning skills in sports differs significantly from regular cognitive learning. In sports, the learner's body works as a tool, and many body parts have to be coordinated according to the goal. Learning skills in sports means a chain of actions that are consequences of training, and they lead to permanent changes in the potentiality to produce motions (Jaakkola 2005, 30-31).

To learn skills, athletes must dedicate significant time and hard work, and five elements are necessary: the learner/athlete, the learning process, a task, an environment and a coach. Learning is also an individual and active process (Valmennustaito.info). Improvements in performance and the ability to perform motions in a new environment are signs of learning (Jaakkola 2005, 30-31). The coach's challenge is to create circumstances and environments that enable learning and training. Athletes can learn skills throughout their careers and are never too old to learn new ones (Valmennustaito.info).

### **4.1 Learning**

Through the learning process, changes occur in the brain. These changes are the emergences of new neural cell connections, the strengthening of already existing connections, the emergence of new brain cells and the loss of unused neural cell connections. The changes in the brain that result in learning do not happen in an instant; rather, learning takes time. For example, the maturation of a new brain cell takes approximately one month. The coach should be aware of this and be patient with the results. Learners' feelings are important for the effectiveness of learning: fun and comfort have been shown to improve learning, while stress is harmful because it creates cortisol in the brain, which weakens neural formability. The feeling of shame and the fear of becoming embarrassed are enemies of learning. If all of the athlete's energy is directed to avoiding difficulty, it is unrealistic to expect great results (Valmennustaito.info).

It is essential to know the difference between learning and performance. Performance reflects the athlete's ability to perform at a given moment, while learning is permanent and long-lasting (Jaakkola 2005, 30-31). Certain types of training, such as repeating the same actions, can temporarily improve performance; however, this does not automatically mean that the performance can be reproduced successfully in the long-term. Learning is a permanent change in the athlete's ability to produce movement (Valmennustaito.info).

#### 4.1.1 Stages of learning

Although the spectrum of motor skills is wide, the learning process is similar. Learners pass through the same steps while practicing and trying new skills. Learning can be separate to three different stages: the cognitive phase, the associative phase and the automation phase (Jaakkola 2005, 103).

Learning begins with the cognitive phase of the subject to be learned. At first, the athlete begins to understand what the motion is about. The first attempts to perform the motions are clumsy and uneconomical, and there are many variations across the attempts. The learner's attentiveness is important in terms of performance; attention is focused entirely on the skill to perform, with little observation of the environment. This learning phase is also characterised by loud thinking. The coach can support cognitive learning by directing performance in the right direction; a good example helps the athlete understand what to learn. Of the different stages of learning, this cognitive phase requires significant feedback (Valmennustaito.info).

When the skill level progresses, the athlete finds connections between previously learned concepts and the skill to be learned. This phase is called the associative phase, in which the athlete gradually makes use of already known motions and previous experiences. The skill level begins to stabilise, different repetitions start to resemble each other, and the volatility decreases. Performance gradually becomes more economical, and the learner's attention is focused on targets that are essential for success. The associative phase is characterised by performing the task many times. The coach can support learning by organising an operational environment that provides plenty of training. There must be room for learning, and providing too much feedback during the associative phase can detract from learning (Valmennustaito.info).

The last step in learning the skill is the level of automation. Performance is smooth and economical and can be done in changing circumstances. An athlete can perform motions without conscious effort, and attentiveness can be directed entirely towards the environment. The performance is not deliberately controlled, but the athlete does it automatically. The coach should respect unconscious skills. Increasing the level of automation performance to awareness may complicate and slow performance. Significant variation in training helps the athlete develop the ability to repair performance during the motion (Valmennustaito.info).

### **4.1.2 Conscious and unconscious learning**

Learning skills in sports is traditionally considered a conscious activity, perhaps because, in training, it is important to analyse the performance and make decisions about it. The learning process begins in unconscious parts of our brains. Consciously known parts, such as analysing, problem-solving and decision-making, are activated later. (Jaakkola 2005, 37)

Learning sports skills can happen both consciously and unconsciously. Conscious learning is called explicit learning. A typical situation for this is technique training, in which different exercises and drills are used to improve performance. A large part of learning sports and sports skills is unconscious or implicit. An athlete learns, although he or she may not know it (Kalaja 2012.). An example is a good puck-carrying skill learned on an uneven surface in an outdoor game.

### **4.1.3 Transfer effect**

One of the key concepts of skill training is the concept of transfer effect. In sports, the effect of transmission means that the previously practiced and learned skill affects the learning process of new skills or of implementing the skill in a different environment. There are three types of transfer effect: positive transfer effect, negative transfer effect and neutral transfer effect (Jaakkola 2005, 94).

Positive transfer effect means that the motions learned in the past help the athlete to learn the new skill. For example, a baseball player benefits from a ball-throwing skill if he or she starts to practice javelin throwing. Nerve connections built by previous training and the corresponding imagination of the motion help the athlete learn a similar new skill (Jaakkola 2005, 94-95).

A negative transfer effect is when a performance interferes with learning or performance, as in the case of badminton and tennis. In badminton, wrists are used to produce power when hitting the ball, while in tennis, the wrists are passive and stationary (Jaakkola 2005, 94-95).

The neutral transfer effect works between the limbs. When one hand or foot learns a performance, the other hand or foot also learns the same performance even it does not practice it. In practice, the neutral transfer effect means that it is also worth doing the 'wrong

side'. The added value of this method is the improvement of muscle balance (Valmennustaito.info).

One learning-related variable is learning speed. Traditionally, a fast learner has been considered a good learner. Recent studies, however, have shown that fast learning is not necessarily a talent factor. Often, the quick learner is not ready to invest the effort required to learn the skill properly. Fast learners may be content with a lower level of skill competence. It has been discovered that slower-learning athletes learn more deeply and in a more structured way, and their learning outcomes are often more permanent than those of fast learners (Valmennustaito.info).

## **4.2 Athlete**

Brain research has shown that humans can learn throughout their lives. Despite numerous attempts, no special sensitivity periods have been found for learning sports and sports skills (Jaakkola 2005, 75).

The impact of skill growth and development should be kept in mind. Different parts of the human body develop at a different pace, and sometimes the improvement of exercise skills can be the result of, for example, the maturation of the sensory organs. A young child may have difficulty perceiving a moving object in captivity situations. When the child's eye grows to its final size, however, these difficulties disappear (Valmennustaito.info).

### **4.2.1 Senses and memory**

Athletes constantly receive information about their own bodies and environments through various senses; sight, touch and kinesthetic senses are particularly important (Jaakkola 2005, 60).

Of the senses, sight is the most important for controlling motions. It has been estimated that 70% of all sensory receptors of human body are in the eyes. In addition, 40% of the cortex is under the control of the sense of sight in some way. The sense of sight is dominant in performing motions because its route through central nervous system reaches almost every other brain area, especially the areas of motor control. This means that motions are mostly controlled by sight (Jaakkola 2005, 61). In sports, different senses integrate into one appropriate entity, also called sensory integration. Sensory sensitisation has proven its benefits in learning process. A useful method of sensory sensitisation is by

closing off the other senses; eye closure, for example, is a fruitful method in almost any sport (Valmenustaito.info).

Memory and its structures are a central part of learning skills and skill coaching. The aim of skill training is to make permanent changes in the athlete's ability to produce movements. The skill is stored more or less permanently in the long-term memory. Cycling is an example of performance that most people have in mind permanently (Valmenustaito.info).

If attention is paid to the information the senses receive, the work memory begins to function. The work memory is a temporary storage location for information, and its capacity is limited; a human remembers an average of seven +/- two units. The expert differs from the novice by being able to bundle more information into one unit. The senses stay in the sensory memory for a short time and then disappear. In terms of sight, we speak of icon memory, and in the case of hearing, we speak of reverberations. For example, with remembrance memory, an athlete can mechanically reproduce the last words of the coach's instructions, even if he or she has not actively listened to the instructions. In sports, athletes' kinesthetic sensations are important. While taking a shot, it is also important that it feels right; this is the only way to achieve the best results (Valmenustaito.info).

As a result of processing in the work memory, the information is stored in a long-term storage memory with almost unlimited capacity. A special feature of remembering sports skills is that the operating memory is located in the unconscious area of the brain. Automation-level performance comes from the 'spinal cord', and knowledge is not necessarily recognised. It is helpful for the coach to be aware of the features of this operating memory, as raising an automated movement to consciousness usually interferes with movement and makes it clumsy and uneconomical (Valmenustaito.info).

#### **4.2.2 Cognitive effects**

The focus of attention affects the flow of physical performance. The beginner's attentiveness is at the moment of execution and in the moving body, while the attentiveness of skilled athletes is beyond the body and in the future. The novice athlete focuses on his or her position and what he or she does in that moment. A skilled athlete, on the other hand, focuses on the environment and the future. Watching one's own exercise often makes the movement cumbersome. The term 'paralysis by analysis' aptly describes this phenomenon, which concerns the pathways of nerve impulses in the nervous system and in the brain. The automatic motion takes place under the control of the lower brain layers. When

the motion is monitored consciously, the signals circulate through the motor cortex, and thus the control is slower and less accurate (Valmenustaito.info).

Motivation means a stimulus in action; it is the power that makes athlete work. Motivation can be categorised as either internal or external. An internally motivated athlete is involved in the activity for its own sake, while an externally motivated athlete works because of external factors or rewards. According to the theory of self-determination, three factors form the basis of a person's mental well-being: perceived proficiency, autonomy and social cohesion (Jaakkola 2005, 117-120). If an athlete feels good in what he does, perceived proficiency is high. If, on the other hand, athletes feel they are being influenced by their own affairs, athlete perceives feels of autonomy. The third element of mental well-being is social cohesion. If athletes have fun with others and feel like they belong to a group, they achieve a feeling of social cohesion (Valmenustaito.info).

Perceived proficiency can be demonstrated by a goal orientation theory in a task-oriented or competitive way. A competitive athlete is satisfied when winning or achieving improved results. A task-oriented athlete, meanwhile, is happy while trying his best, progressing, learning and doing things with others (Valmenustaito.info). All athletes have features of both competition and task orientation, but usually one of these features is prevalent. In terms of learning, task orientation is preferred over competitive orientation (Jaakkola 2005, 120-121). Competition is an essential part of competitive sports, but it is best to use the elements of competition fairly when learning about performance techniques (Valmenustaito.info).

### **4.3 Modifying tasks and the environment**

The basic infrastructures of skill training are the creation, modification and randomisation of both the tasks and the training environments. One of the main responsibilities of the coach is to create circumstances, environments and challenges that enable learning and training (Jaakkola 2005, 136). The coach can customise the difficulty of the task individually for each athlete by demanding an athlete perform it, for example, faster or under changing circumstances. The traditional order of easy to hard difficulty is not necessarily the best (Valmenustaito.info).

Skill training can be centralised or decentralised. Centralised training, also called block training, means that the drill or motion is always the same during the practice. Decentralised training, also known as random training, means that the drills or motions change during the practice. The idea behind random training is that the athlete has to solve more



problems during practice than in block training. In random training, the equipment and the environment changes, and in the block training, they are always same. Research has shown that decentralised, random training is a more effective method in skill training than centralised block training. However, block training is more effective when the purpose is to develop one specific skill or performance quickly. What is often misunderstood in skills coaching is that the repetitions play a determining role in learning skills. The key word of skills training is 'multiplicity' (Jaakkola 2005, 136-137).

#### **4.4 Feedback**

Athletes need feedback, which is a substantive part of learning. After athletes have done the motion or performance to be learned, they receive feedback through the senses, but the athlete also needs external feedback from the coach or the video. There are two kinds of external feedback: information about the performance of the motion and information about the success of the motion (Kalaja, S 2016. 238-241).

The amount of the external feedback also matters, especially the frequency, timing and precision. If there is too much external feedback, the athlete becomes addicted to it. Feedback should be given to help the athlete process the information he or she has received from the motion. If the coach gives all the answers, the learning process is not effective. The feedback can be given more often at the beginning of the learning process; as the athlete develops the performance, the amount of the feedback should decrease. Thus the feedback should be provided when the learner does not yet know how to amend the motion him or herself (Kalaja, S 2016. 238-241).

#### **4.5 Nonlinear pedagogy**

Traditionally, skill training directs the athlete towards the perfect performance. It was believed that skills are learned only by repeating correct and "clean" performances. Nonlinear pedagogy and differential learning challenge this belief. Research has shown that no two motions or performances are exactly the same and that there are no optimal performance techniques, not even at the individual level. Instead of pursuing perfect techniques, skill training should strive to develop an athlete's ability to fix errors. In nonlinear pedagogy, practice is planned to simulate a game-like environment. For example, in team sports, teams often practice with different games. By changing the rules or equipment, the coach can affect the player's performance. With this approach, results can be achieved in many different ways and the athlete can perform in his or her individual way. In nonlinear pedagogy, feedback from the coach is minimal. If feedback is given, it is generally focused on the outcome of the performance. In sports, situations change rapidly, and an athlete

must be able to perform in multiple environments and circumstances. The main purpose of differential learning is to achieve performances that are alike, but still with different variations. The athlete learns how to observe differences between the performances and to adapt his or her performance to different environments. The job of the coach is to develop different variations of the performance, which can mean changes in rhythm, speed, equipment or the environment ( Kalaja 2016, 241).

## **5 Shooting styles**

If the athlete wants to be a great hockey player, he or she must handle many different styles of shooting. An accurate shot is a valuable skill because three out of four goals are scored by shooting. Another important skill is that the shot is released quickly, which mostly depends on the technique (Hache, A. 2002 102-103). The five main shooting styles are wrist shot, snap shot, slap shot, backhand shot and one-timer shot (Koho & Luukkainen 2012, 67).

### **5.1 Wrist Shot**

The wrist shot is highly accurate; it is the most popular shot in ice hockey. It is the easiest shooting style in terms of controlling the position of the puck (Shot Tec 2017). This shot is so accurate because the blade is in contact with the puck more than in any other shooting style (Sharp, 2010, 55.). Wrist shots are mostly used close to the net, up to the blue line, or in breakaways. Wrist shots are thus used in hurried situations in which the puck should be released quickly, so it should not take as much time to release as a slap shot (Shorey 2004, 56.).

There are two ways to shoot a wrist shot. First, the puck can be behind or in front of the player. It can be on the blade the whole time, or the player can take the blade off the puck for a short moment (International Ice Hockey Centre of Excellence 2012b.).

The six basic elements of wrist shot are keeping the eyes towards the net, keeping the armpits open, having a rotating motion starting from the hips to the shoulders, a top hand pull and lower hand push, rotating the wrists at the end and the weight transfer from leg to leg (depending on the situation) (International Ice Hockey Centre of Excellence 2012c.).

#### **5.1.1 How to perform the wrist shot**

Most wrist shots begin with the puck positioned behind the back foot. The puck should be located near the middle of the blade, with the top of the blade angled over it. The arms should be fully extended backward in order to drag the puck forward in a sweeping motion and then snap the wrists at the last moment in opposite directions to create power. The bottom wrist pushes toward the net and the top wrist pulling toward body. The weight transfer moves from the back leg to the front leg at the conclusion of the shot, as the puck is swept along the ice. The player should be leaning well over the puck, which should not be released from the blade before reaching the front skate (Shorey 2004, 56.).

## **5.2 Snap shot**

The difference between the wrist shot and the snap shot is that the snap shot has no back swing. The snap shot can be done from either leg, and it is mostly used near the net, during the hassle in front of the net or on rebounds. It can also be used straight from skating (Shorey 2004, 57.).

The snap shot is almost same shot as the wrist shot, so the key points are the same as those mentioned above.

### **5.2.1 How to perform the snap shot**

In a snap shot, there is no back swing. The toe of the blade should be turned or cupped downward, resting on the ice about 15 cm behind the puck. The heel of the blade should then be in the air about 25 cm off and above the ice. The bottom wrist is locked and then snapped upward as the arms move forward to hit the ice just before the puck. It is similar to completing a letter 'c' with the blade heel at the top of the letter and then brought around. The puck is positioned slightly ahead of the body and stick side. The puck is glided and struck, or it is pulled toward the body and snapped (Shorey 2004, 57.).

## **5.3 Slap shot**

The slap shot is based on the crash between the blade and the puck, and it is the most powerful shot in hockey in terms of puck speed. It takes time to shoot and is less accurate than the wrist shot; because of this, slap shots are used less often in games (Hache, A. 2002 125).

The six basic elements of backhand shot are keeping the eyes towards the net, keeping the armpits open, the top hand pulls and lower hand pushes, rotating the wrists and the blade at the end, hitting the ice before the puck and a weight transfer from the back to front leg (International Ice Hockey Centre of Excellence 2012d.).

### **5.3.1 How to perform the slap shot**

There are three phases in slap shot mechanics. First, the upper body loads and begins the accelerating rotational motion of the body and stick. Next, the blade of the stick crashes on the ice and the puck. As a result, the shaft of the stick bends and gathers significant potential energy. In the last phase, the speed of the puck accelerates, and the puck releases from the blade, while the shaft returns to its normal shape (Hache, A. 2002 126).

## **5.4 One-timer**

The four basic elements of the one-timer shot are keeping the eyes towards the net, immediately shooting after receiving the puck, a fluent motion chain starting from the hips and proceeding to the hands and a weight transfer throughout the shot (International Ice Hockey Centre of Excellence 2012d.).

### **5.4.1 How to perform the one-timer shot**

To execute this shot, the player must be positioned on the off-wing side and facing the incoming puck. The pass might come behind the net; in that case, the player should slide his or her hands down the shaft of the stick to gain more control and accuracy. The one-timer is all about timing; the player should hit the puck as in a slap shot, but when the puck is moving, correct timing is required (USA Hockey Magazine, 2019).

The player can drop the lower hand-side knee down if the aim is to move the puck high and close to the net. This allows the player go under the puck and lift it quickly (How to Hockey 2012a).

## **5.5 Backhand shot**

The backhand shot is effective when perfected and is used close to the net when the puck is on backhand side and when sweeping the rebounds. The backhand shot is almost the same as the wrist shot in terms of technique, but on the backhand side (Shorey 2004, 59).

The six key points of wrist shot are keeping the eyes towards the net, keeping the armpits open, having a rotating motion starting from the hips through the shoulders, the top hand pulls and lower hand pushes, rotating the wrists and the blade at the end, and the weight transfers from the upper hand-side leg to the lower hand-side leg (International Ice Hockey Centre of Excellence 2012e.).

### **5.5.1 How to perform the backhand shot**

The puck is positioned in the middle of the blade on the backhand side. The arms should be fully extended backward, with the weight on the back leg before transferring it to the front leg while rotating the arm swing. The puck should be released at the front foot, lifted upward and followed through to the height. The follow-through should be high to shoot the puck up or low to shoot it down (Shorey 2004, 59).

## 6 Physical requirements of shooting

Shooting is a chain of minor motions that happen quickly. To be able to perform many motions in one movement, the player needs the skill of rhythm is essential. 'Rhythm' is defined as describing timing (Athletes Acceleration 2019).

To improve shooting power, the athlete must train muscles that are used in the shot in a similar manner to how they are used on the ice. While shooting, the player must bring as much power into the shot as quickly as he or she can. Shooting thus requires explosive strength (How to Hockey 2013b). A shot's power is generated primarily by latissimus dorsi, external obliques and pectoralis major (ISBS, 2004).

Explosive strength means the ability to produce as much power in as short a time as possible. The use of elasticity is especially highlighted in explosive strength performances. In explosive strength training, the aim is to develop high-speed cellular nervous system excitation, muscle elastic properties and sport-specific speed prerequisites (Forsman,H & Lampinen,K. 2008).

The latissimus dorsi muscles are the two largest muscles in the back, and are located in the middle of it. Latissimus dorsi muscles are extensor muscles, and their main job is to help lift the arms as they lengthen and reach. These muscles are involved in other important functions beyond shoulder extension, including internal rotation of the torso and supporting mid-body stability. Chin-ups, lat pulldowns and dumbbell one-arm rows are examples of useful exercises for these muscles. (Dr.Axe 2017)

The external obliques are located on the outer surface of the sides of the abdomen; they are the largest and the most superficial muscles in this area of the body. The external oblique muscle's main responsibility is the twisting of the trunk, whose rotation is opposite to the external oblique that contracts. Thus, when the right side is at work, the body twists to the left (Study.com, 2019). Helpful exercises for external obliques are, for example, medicine ball rotational throws, side plank and seated barbell twists (Bodybuilding.com, 2018).

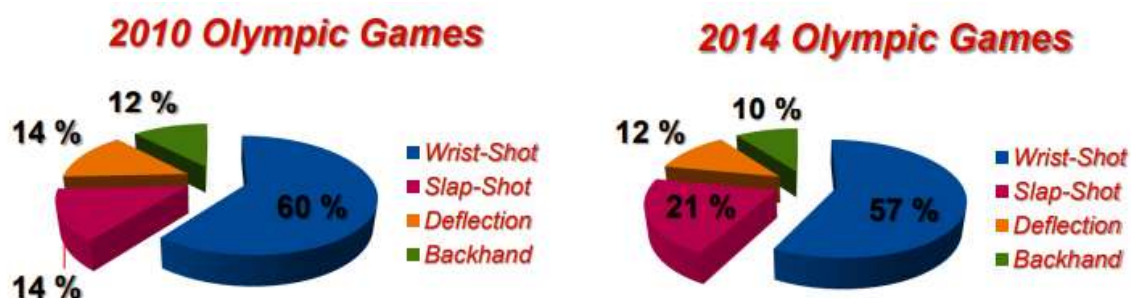
The pectoralis major is located on the chest and is the most superficial muscle in the pectoral region. Its main function is to adduct and medially rotate the upper limb and draw the scapula anteroinferiorly. The clavicular head acts individually to flex the upper limb (TeachMeAnatomy, 2017). Exercises for the pectoralis major include the bench press, incline bench press, push-ups and flyers (Freetrainers, 2019).

## 7 How goals are scored

The IIHF has investigated the ways goals were scored in 26 games at the 2010 and 2014 winter Olympics in ice hockey. The investigation included multiple statistics about scoring, such as goal scoring zones, how, where, what type of shot, attempted shots and other factors (IIHF 2014).

The analysis shows that quick shots dominate the statistics. For this study, the IIHF counted the snap shots as part of wrist shots; remarkably, slap shot goals increased by 7% in 2014 (IIHF 2014). This could be the result of the decision to move the blue line, thus making end zones larger than in 2010.

The contribution of the quick shots (wrist shot and backhand shot) confirms the perception of the speed of the game.



Picture 2. How goals were scored in the Olympics (IIHF, 2014)

## **8 The project process**

The following chapter includes the subject, aims, target group and methods of this project.

### **8.1 The aims**

The aim of this research was to determine the most common technical errors in different shooting styles. Another goal was to learn the players' skills in the key points of shooting styles, which can be found in many coaching manuals. If their skills are high, another factor should perhaps be the focus of training.

### **8.2 The target group**

The target group for this research is the coaches, primarily those who coach 10-18 year old players. Players that were involved in the research ranged in age from 10 to 15.

### **8.3 Methods of the project**

The researched players were in Fini-Pro Camps in Piispala that occurred during the summers of 2017 and 2018. There were 296 total participants in the two years. The Pro-Camp is meant for motivated players who are selected based on applications. Pro-Camp is a training camp, and shooting is one of its key themes. Shooting practices were held mostly in Breakaway Hockey centre and also on the ice. Breakaway Hockey centre is a small, synthetic ice rink. Shooting practices took place twice a day during the camp, and the camps were five days long.

The research is based on the shooting feedback, which in turn was based on shooting videos that were filmed at the camp. On the first camp day, at the first Breakaway practice, the players were filmed. At the beginning of the first practice, for about 40 minutes, players had time to become familiar with the new surface because synthetic ice differs from regular ice. Players were granted this time so that their filmed shots would be as realistic as possible; 40 minutes was enough time to ensure that they shot as they would on real ice.

The shooting styles selected for this project are the wrist shot, snap shot and slap shot. In the video, the players shoot 10 wrist, snap and slap shots. A few weeks after the camp, the players receive the feedback sheet about their shooting. Each video took about 20 minutes to edit and analyse.



## 8.4 The feedback sheet

The following feedback sheet was completed by observing the key elements of shooting. The feedback sheet was the same for every shooting style.



Pvm 05/10/2017 Nimi:



<b>Rannelaukaus</b>	<b>1</b>	<b>2</b>	<b>3</b>
1. <u>Asento, jalat (OK/Pysty)</u>			
2. <u>Mailaote (OK/Kapea/Leveä)</u>			
3. <u>Painonsiirto, jalat (OK/Lähtee keskeltä/Jää keskelle)</u>			
4. <u>Ylävartalon liike (OK/Jäykkä, ei kiertoa)</u>			
5. <u>Yläkäden liike (OK/Yläkäsi jäykkä/löysä)</u>			
6. <u>Alakäden liike (Painaa mailaa vasten/Ei tue laukausta)</u>			
7. <u>Katse (Maalissa/Kiekossa)</u>			
8. <u>Ylävartalon liikesuunta (OK/Jää pystyyn/Sivuuin)</u>			
9. <u>Mailasaatto (Laukauksen perään/Muualle)</u>			
10. <u>Ranteiden käyttö (OK/Ranteet jävkinä/Liikaa taivutusta)</u>			
11. <u>Niikan suunta (Maalille/Puolittain/Vinossa)</u>			

### Sanallinen arvio

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Picture.3 The feedback sheet

- Number one refers to the posture; is the player standing, or is he or she ready to play in hockey position?
- Second, the grip: is it correct, too narrow or too wide?
- Third, weight transfer: is it acceptable, does the shot begin with weight on both legs or does it stop in the middle?
- Fourth, upper body rotation: is it acceptable, stiff or does it happen at all?
- Fifth, top hand motion: is it fine, stiff or slack?
- Sixth, lower hand motion: does it push the shaft or not?
- Seventh, does the player look to the net or to the puck?
- Eighth, upper body motion after the shot: is it fine, is the spine straight or does the player fall to the side?
- Ninth, stick following: does the stick follow the shot or not?
- Tenth, wrists: do the wrists give power to the shot, are they stiff or do they bend too much?
- Eleventh, ankle: are the toes pointing to the net, to the corner, or is the player facing totally to the side?
- There is also a comment section at the bottom with written feedback, consisting of tips concerning which parts the player should practice the most. Other notices can be included, as well, for example whether the puck is in the right place on the blade or whether hands are in front. In addition, positive feedback is provided in this section.

## 9 Results of the project

While reading the results, we should remember that the shots were filmed on synthetic ice, which does not slide as much as normal ice. Sometimes, the shot motion might stop earlier than on the real ice because the players are more aware of not falling down.

It is also important to remember that the percentages do not always provide accurate information; for example, one factor may appear positive in terms of percentages. However, it may look good because another factor is weak. Shooting is a chain of small motions, and if one is missing, another may be easier to perform or it could be impossible. In this research, we focus more on the minor motions that are missing and make others impossible to perform. I also mention other explanations.

### 9.1 Wrist shot results

The wrist shots were taken with the weight on the top hand-side at the end of the shot. Based on the results, we can see that the players received advice on the key points mentioned in section 5.1. The weight transfer in the results provides a slightly inaccurate picture; sometimes, the player was trying to avoid falling down and did not glide as he or she would have on real ice.

Remarkably, 66% of the players had troubles applying pressure to the stick. The reason for this was not the lower hand; instead, the primary reason for was the player's posture or the fact that the puck was too far or too close to the player. The reason could be also that the player applied too much pressure to the stick too early, when the puck was still behind the body line. When the player pushes the stick behind the body, many times, they exempt the pressure when the puck starts to move forward. In that case, they bend the stick at the wrong time.

The top hand motion was one of the key points discussed in section 5.1. Often, the top hand was away from the body, but it did not pull; typically, the hand was too loose to do so. In addition, this motion requires the ability to do many things in a rhythm, and it seems difficult for many players.

Overall, the wrist shot was usually, technically speaking, the player's cleanest shot. The wrist shot is not the quickest shot in hockey; it makes it easier to manage and the coaches have more knowledge to help athletes improve the wrist shot than with quicker shots.

<b>Wrist shot</b>			
Posture 1=OK 3=Not	42%		58%
Grip 1=OK 2=Narrow 3=Wide	69%	15%	16%
Weight transfer 1=OK 2=Starts from middle 3= Stops middle	35%	23%	42%
Upper body rotation 1=OK 2=Stiff 3=Does not rotate	39%	47%	14%
Top hand motion 1=OK 2=Stiff 3=Loose	42%	12%	46%
Lower hand motion 1=Push stick 2=Does not support	34%		66%
Look 1=To the net 2=To the puck	68%		32%
Upper body motion after shot 1=OK 2=Stays up 3= To somewhere	44%	19%	37%
Stick following 1=OK 2=To somewhere	70%		30%
Wrists 1=Ok 2=Stiff 3=Too much bending	46%	21%	33%
Ankle 1=Straight 2=Almost straight 3= To somewhere	44%	19%	37%

## 9.2 Snap shot results

The snap shots were taken with the weight on the lower hand-side at the end of the shot. They seemed to be the most difficult style to shoot in this study. As with the wrist shot, the results show that the players received advice regarding the key points mentioned in section 5.2. Again, weight transfer seems to be the most difficult aspect to handle from the key points.

The snap shot is a more difficult shooting technique to manage than a wrist shot because it is quicker. The puck does not go behind the bodyline, as in the wrist shot, making it faster. Additionally, players seem more accustomed to shoot the weight on the top hand-side. The rhythm of the legs is often a problem for players; only 29% got it right. Others either started shooting with their legs side by side, or they started shooting from the correct leg, but when the shot released, they were standing on both legs. This also results in a standing posture for almost every player who shoots without a weight transfer.

As with the wrist shot, players did not apply enough pressure to the stick. As before, this was not the fault of the lower hand but depended on other factors. If the posture was standing or the weight did not move to the other leg, the player could not apply pressure to the stick.

A comparison of the section 'ankle' between the wrist and the snap shot is useful. 44% kept their ankle straight in the wrist shot, and 63% kept it straight in the snap shot. In the wrist shot, the players transferred the weight better to the other leg, which means that it was harder to keep the ankle straight. In the snap shot, the players were less skilled in transferring the weight, so it was easier to keep the ankle straight. Thus, although the results suggest that the players are better in this regard in snap shots, this is actually not the case.

Overall, the players should practice more snap shots. The game will be faster every year, which means that, in the game, they need quicker shots. In addition, in the results, the snap shot seemed to be the participants' weakest shot.

<b>Snap shot</b>			
Posture 1=OK 3=Not	39%		61%
Grip 1=OK 2=Narrow 3=Wide	69%	15%	16%
Weight transfer 1=OK 2=Starts from middle 3= Stops middle	29%	33%	38%
Upper body rotation 1=OK 2=Stiff 3=Does not rotate	33%	27%	40%
Top hand motion 1=OK 2=Stiff 3=Loose	40%	16%	44%
Lower hand motion 1=Push stick 2=Does not support	30%		70%
Look 1=To the net 2=To the puck	58%		42%
Upper body motion after shot 1=OK 2=Stays up 3= To somewhere	63%	18%	19%
Stick following 1=OK 2=To somewhere	66%		34%
Wrists 1=Ok 2=Stiff 3=Too much bending	42%	23%	35%
Ankle 1=Straight 2=Almost straight 3=To somewhere	63%	18%	19%

### 9.3 Slap shot results

As in the other styles, the players had clearly received advice on the points mentioned in section 5.3. The slap shot seems to be the players' favourite shooting style. In the video, they did not need time to think about how to perform it. Many players seemed more confident while shooting a slap shot than they were in the other two styles. This can be explained by training: the players like to shoot slap shots, so they have practiced it more than other styles on their own.

The main problems seem to be that players looked at the puck and the top hand did not support the shot. Looking at the puck can be explained by the fact that players tried to shoot as hard as they could. The slap shot is a slow shot, but the stick swings quickly to the puck. When players try to shoot hard, they need to put more focus on that than actually hitting the puck. The top hand motion would be better in many cases if they kept their hand more in front. The hardest part of the top hand motion is to pull while the lower hand pushes the stick.

<b>Slap Shot</b>			
Posture 1=OK 3=Not	64%		36%
Grip 1=OK 2=Narrow 3=Wide	55%	17%	28%
Weight transfer 1=OK 2=Starts from middle 3= Stops middle	51%	11%	38%
Upper body rotation 1=OK 2=Stiff 3=Does not rotate	39%	47%	14%
Top hand motion 1=OK 2=Stiff 3=Loose	22%	32%	46%
Lower hand motion 1=Push stick 2=Does not support	41%		59%
Look 1=To the net 2=To the puck	29%		71%
Upper body motion after shot 1=OK 2=Stays up 3= To somewhere	38%	36%	26%
Stick following 1=OK 2=To somewhere	74%		26%
Wrists 1=Ok 2=Stiff 3=Too much bending	48%	18%	34%
Ankle 1=Straight 2=Almost straight 3= To somewhere	38%	36%	26%

## 10 Outcome of the project

The shots analysed in this project were filmed in circumstances in which the players were unhurried. They had time to shoot shots that were as 'clean' as they wanted. In real games, they do not have time to think about the technique. It is also important to practice the shots in an environment without pressure, but the shooting training should be versatile; in Finnish hockey today, however, this is not the case. The old model, shooting enough repetitions to become a master, persists. As mentioned in the theoretical discussion, repetitions are necessary for moving the shot towards the automation phase of learning. Hockey is a fast-paced game, and the situations are always different; thus, repeating the same motions does not produce the best results. In addition, the shots are complicated chains of fast, minor motions that happen quickly. They are mostly made under the pressure from the opponent and in a small area, so the athlete should also practice in a changing environment.

The most significant challenges in shooting techniques were the top hand motion and the power delivered to the stick. Both can result from many factors, but one factor unites them: rhythm.

The top hand pull is important to add more power to the shot, and it also helps the player aim the shot better. When the top hand does not pull the stick, the reason is that the player cannot do so at the right time or in the rhythm. It may also be the case that the hands are too close to the body and do not follow the shot in the same rhythm in which the puck moves.

The power delivered to the stick means that the stick is not under pressure and the player does not achieve as much power in the shot as when the stick is under pressure and bends. The reason for an unbent stick is mostly the rhythm, a weight transfer between the legs at the wrong time or a failure to transfer the weight at all. Another reason may be the hands, which may move at the wrong time or push and pull the stick at wrong time. Yet another significant issue is a stick that is too stiff. Even if the player does everything correctly and in a rhythm, if the stick is too stiff for the athlete, it does not bend. Many reasons are thus possible, but these are the most common.

To improve the shot rhythm, we must be creative in training. Using sports equipment other than a puck can be one solution. Shooting with a dike or shooting by closing the senses is also helpful.

One of the aims of this study was to determine if we should change or add key points to the coaching manuals. I think that the key points mentioned in this thesis are adequate as long as the coach understands them and what makes the shot. If the coach does not fully understand the key points and why they are necessary, he or she may not be able to help the athlete shoot correctly. For example, the coach may see that the player does not follow through the shot, but the coach must know how to address why the player does so. Often, the reason for problems stems from something other than the problem factor itself. In this case, the reason could be the ankle; if it is not straight, the player cannot follow through because he or she reels back after the shot.

If I could add something to the key points, it would be one sentence: every key point is connected to the others.



## 11 Discussion

The main aim of the theoretical section was to determine what kind of skill shooting is and how it can be learned. Other object was to ascertain what is physically required to shoot in hockey, and a third was to identify key points with regard to the main shooting styles. The aim of the study section was to learn whether the players had incorporated the key points found in coaching manuals. Shooting is a chain of minor motions that happen quickly. Biomechanically, it involves the seven main principles mentioned in Chapter 2. Understand the 3<sup>rd</sup> class lever; we can understand the results better.

The main factors that affect the results of skill training and learning are the amount of practice, the versatility of the training and the feedback the athlete receives. Skill training should be more versatile than it is in Finnish hockey today. Sometimes, facilities are the problem, but I believe that versatile training without elaborate equipment or environments is possible. Closing off the senses or using different balls or sticks do not require much of the environment and is inexpensive. Coaches should be creative. They should remember that learning takes time and provide feedback for the athlete.

Physically, shooting does not require much. Although it requires explosive strength, the shot does not depend entirely on strength. (How to hockey 2012c) It depends more on technique, good motor skills and the ability to perform rhythmic motions. Therefore, coaches should focus more on training that is done in a rhythm. This doesn't mean that there is no need for strength training. There is, but the technique is more important.

The key points with regard to shooting styles were determined in the analysis. In accordance with these points, I created a shooting feedback sheet containing 11 factors and a written analysis. The feedback sheet was useful for its purpose and provided answers to the research questions. Later, I will discuss what I would change in the feedback sheet in the future.

The three major questions were as follows. What are the most common technical errors in shooting? Have the players assimilated the key points of shooting styles? Should we add to or change the key points in the coaching manuals? The results show that the most common errors related to top hand motion and the power delivered to the stick. The third-class lever theory provides an understanding of why the top hand motion is important. Without top hand motion, the third-class lever does not lend power to the shot. The reason for a weak top hand motion is that a player's training does not change. Training mostly

consists of repeating the same performance, which means that players are not able to improve the rhythm of their shots.

As mentioned in Chapter 10, weaknesses are often caused by other factors because every motion is connected to other motions. Overall, the players managed to incorporate the key points from the coaching manuals well. For future investigations, we could create a manual that shows how motions are connected to each other. In response to the third question, I would not change the key points, but I might add information to remind players that each motion matters.

The shots researched for this study were filmed on synthetic ice, which was not the perfect surface for research, but it did provide a general picture. The most significant challenge with synthetic ice is that it does allow for as much slide as real ice. For future investigations, the same process could be performed on real ice and under pressure from opponents. It would also be useful to add a section on the hands to the feedback sheet, to investigate whether the armpits are open or not and whether the hands are in front. I would also add a section to examine whether the puck is correctly positioned on the blade. The same project could also be carried out on professionals to investigate why they are so good.

The players researched had the most difficulty with the snap shot. The 2014 IIHF research discussed in Chapter 7 shows that most goals are scored using the wrist shot. In that study, the snap shot was counted as a wrist shot, which indicates that it is an important shot. In conclusion, it can be said that the athletes should work mostly on the snap shot. Training should be versatile and should often occur under pressure from opponents.

The project was useful for me because I have to provide feedback for my work. The analysis was interesting and helpful for planning shooting technique practice. Before this study, I always began training a new player by practising the wrist shot. I believed that this was the best way to begin because players shoot slap shots so much on their own and because the snap shot is too complicated to begin with it. Now, I think that I should begin training new players by practising the snap shot. The rhythm of the wrist shot and that of the slap shot are almost the same. However, the players seem to manage the rhythm of the wrist shot better than the rhythm of the snap shot. Therefore, I think that it is wise to begin with a different shooting style and a rhythm that the players are used to.

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