

## **A TESTING BATTERY ON BALANCE AND PERFORMANCE SYMMETRY FOR TEAM SPORTS – AN EXAMPLE FROM ICE HOCKEY**

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The purpose of this study was to develop and apply an injury and performance screening programme for team sports and exemplify this for ice hockey. A set of four tests including landing, jumping and turning was employed and performance and balance related symmetry was extracted from force plate data and velocity measures in a test group of 28 elite ice hockey players. In this team, certain exercises showed a reflection of individual injury history while players showed a high symmetry for single leg landing task. This may be an effect of the specific training this group of athletes had undergone prior to the tests. Currently, we are assessing other teams who followed different training programs and apply these tests as a longitudinal screening tool. While final results are still outstanding, the potential of this approach was discussed.

**KEY WORDS:** balance; symmetry; landing; ice hockey; injury; force platform.

**INTRODUCTION:** It may be argued that ankle and knee sprains are the most common joint injuries in many team and field sports (Fong et al., 2007; Chéron et al., 2017) and that both have devastating impacts on elite players' careers as well as costly implications for health care systems when including all practitioner levels. Other sports, such as soccer or athletics show high rates of soft tissue injuries such as muscle strains which similarly may lead to long periods of absence from practice. While it is difficult to identify specific risk factors for each of these injuries several studies indicate that symmetry may be a factor related injury risk (Ergün et al., 2004; Livingston & Mandigo, 1999).

Ice hockey is a team sport that consists of explosive accelerations and quick changes of direction (Haukali & Tjelta, 2015) while the injury incidences include muscle strains and concussions. Many of the movement patterns in the sport are asymmetric as the stick is carried on one preferred side by each player, mainly used when passing and shooting. In ice hockey, it is important to be able to regain balance as fast as possible, which is challenged by the narrow base of support and the low friction surface. Therefore, it may be indicated to develop a screening program which allows for testing muscular performance and symmetry in an ice hockey specific way. The use of such a screening programme may be of particular interest during the rehabilitation phase following injury.

The aim of this study was to investigate if differences between the preferred and the non-preferred side occur for professional ice hockey players using a test battery including single leg drop jump and single leg lateral jump, a counter-movement jump and a change in direction task.

**METHODS:** Twenty-eight professional ice hockey players (22.4±4.2 years, 82.6±6.4 kg, 183.5±3.8 cm) participated in the study. The subjects underwent approximately 15 min of warm up before the two tests. The first test was a single leg drop jump task where the subjects stood on a box 39 cm above the ground and with a distance of 35 cm to an AMTI force platform (model OR6-7-1000, sample rate at 1000 Hz, Advanced Mechanical Technology Inc., Watertown, USA). The subjects were instructed to stand on one leg and fall down (not jump) on the other leg onto the platform with arms akimbo. Subjects were

instructed to find and keep balance for approximately 10 s after jump. The test was performed three times on both legs, alternately.

The second test was a single leg lateral jump of 140 cm length over a 43 cm high box, approximately halfway. The subjects were instructed to land on the force platform, to have arms akimbo when jump and to find and keep their balance for approximately 10 s. The test was performed three times on both legs, alternately. Time to stability was defined as the first sample where the vertical component of the ground reaction force within one bodyweight  $\pm$  5% for 1 s consecutively.

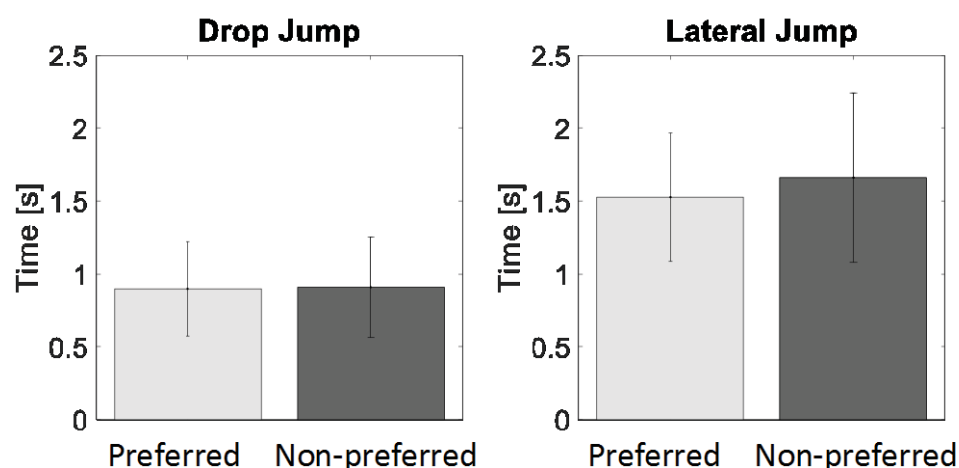
In a third test, subjects were asked to perform five counter-movement jumps (CMJ) with hands akimbo and five with using their arms as they liked. This test was performed on two force platforms under each foot to assess the individual contribution of both legs to jump performance.

In a fourth test, the subjects were asked to perform a maximum effort, 180-degree change of direction task on two force platforms to both sides with five repetitions each. Incoming and outgoing velocity was tested by using one retroreflective marker on the sacrum, which was recorded by an eight-camera motion capture system (Oqus 300, Qualisys A/S, Gothenburg, Sweden) sampling at 500 Hz.

The difference between the preferred side and the non-preferred side was tested using a paired t-test with a significance level of  $P = 0.05$ .

**RESULTS:** The single leg drop jump showed a mean time of 0.90 s for the preferred side and 0.91 s for the not preferred side. This is a 1.1% difference, was not statistically significant ( $P = 0.89$ ; Figure 1). The single leg lateral jump resulted in a mean time of 1.53 s for the preferred side and 1.66 s for the not preferred side. This is an 8.5% difference which was also not statistically significant ( $P = 0.19$ , Figure 1).

The CMJ and the change in direction task showed significant differences between the preferred and non-preferred sides. The maximum force was approximately 5% higher for the preferred leg over the whole group. Individual differences were up to 35% which was generally the case in athletes with a previous injury ( $N = 4$ ). Similarly, the peak forces and impulses in the change of direction task were showing differences in particular in subjects with an injury history.



**Figure 1: Results for the drop jump and lateral jump tests.**

**DISCUSSION:** Screening programmes for elite athletes and practitioners of field and team sports may help in monitoring performance and injury risk, or rehabilitation programs following injury. An open question in this context remains as to when an athlete can be cleared for return to practice and, most importantly, for return to competition. The proposed test battery is thought of as a general approach to include certain motoric capacities which can be supplemented by more specific tests depending on the sport it is applied to. One of

the important factors in this context was to assess the symmetry between preferred and non-preferred body sides as a criterion.

The results of this study show no significant differences between the preferred side and the non-preferred side in balance landing tasks, i.e., landing after a single leg drop jump and single leg lateral jump. This indicates that ice hockey training may not lead to major asymmetries in dynamic balance. However, the difference between body sides was larger for the more challenging single leg lateral jump task. The other two tasks which require a more explosive action and coordination between body segments showed specific differences which appear to be related to the individual's injury history. This observation might indicate that specific exercises in such a test battery are more sensitive to certain adaptations. However, the predictive value of such systems needs to be assessed in long-term clinical outcome studies.

The lack of significant findings for single leg landing balance for this sample may result from the particular off-ice training the players have performed in the preceding 6 weeks of the testing. This was motivated by the suggestion that strength training should focus on reducing asymmetries (Carvalho et al., 2016) and all players have been training under this premise in collaboration with the team conditioning coach.

We are currently including the testing of teams which have not partaken in this specifically designed training to ascertain if differences in training programs would be reflected in the test results from this battery of exercise. We are also experimenting to include further tests which encompass dual task tests and ice hockey specific cognitive tests which appear to be relevant.

A study on soccer players has shown that females are more likely to sustain ACL injuries on their preferred supporting leg, whereas males are more likely to sustain ACL injuries on their preferred kicking leg (Brophy et al., 2004). The approach illustrated in this study, or discipline-specific variants thereof, have therefore a potentially high relevance in other team sports. Further, the role of asymmetry needs further investigation in relation to performance and injury prevention in specific sports disciplines.

**CONCLUSION:** A test battery for general testing of dynamic balance and performance tasks was proposed in this study. It appears that individual results pointed at the injury history of athletes and that symmetry might be influenced by specific training programs. We plan to present additional results from this ongoing study at ISBS to discuss further implications for performance and injury screening in ice hockey as well as implications for other sports disciplines.

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