Comparison of Ground Reaction Forces on Different Types of Goalkeeper Dives

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**Abstract**

The purpose of this study was to determine if a goalkeeper’s landing, when using a taught diving technique, created a softer landing than a landing performed just on the side of the body. Often a goalkeeper’s specific skills, such as diving, are over looked when conducting research, so literature was limited. To create a more game-like dive landing, techniques taught by most coaches were used. This landing involved having the ball and forearm land first compared to just landing on the side of the body. A soccer ball was thrown away from the subject so that they would have to perform a dive, and then applied both landing techniques onto force platforms. The peak ground reaction forces (GRF) were 3185.1 N when landing on the side of the body first and 4364.7 N when landing on the ball and forearm first. Impulse was also calculated at 334306.7 N and 263456.6 N respectively. Higher peak GRF during the ball and forearm landing could be attributed to the smaller surface area the GRF has to act on. An interesting finding was that during the side of the body landing, another spike in GRF occurred. It was thought that it could be possible that the subject’s body rebounded up some and hit the force platform again. It would have been best if video analysis had been used in tandem with the force platforms to see the subject’s body actions during the landing.
Introduction

Soccer research based on position generally focused on field players (forwards, midfielders and defenders) due to the high risk of anterior cruciate ligament injury and the need to seek prevention (Alentorn-Geli, et al., 2009). More research focused on physical fitness (Boone, et al., 2011), physiology (Stolen, et al., 2005) and time-motion analysis (Sporis, et al., 2009) described soccer players in all field positions and goalkeepers. Even though a goalkeeper’s characteristics have been reviewed in research, other areas such as the goalkeeper’s specific skills are more limited (Lees & Nolan, 1998).

Spratford, et al. (2009) researched one of the goalkeeper’s specific skills – diving. They analyzed a goalkeeper’s preferred and non-preferred diving side and their movement pattern during the dives. It was found that the non-preferred diving side had significant over-rotational differences compared to the preferred side; attributed to greater peak knee joint moments, lower peak ankle joint moments, less hip extension at take-off and for the center of mass to travel slower and less directly to the ball (Spratford, et al., 2009).

Schmitt, et al. (2010) then did further research on the loading of the hip of goalkeeper’s while diving. They found that while landing the peak force values corresponded to 4.2 – 8.6 times the body weight and that peak ground reaction forces (GRF) ranged from 3 to 8 kN (Schmitt, et al., 2010). While the study was performed, they found a rolling action during the landing lowered the peak forces incurred on the hip (Schmitt, et al., 2010). While looking at the pictures provided by Schmitt, et al. (2010), the dive they had their subjects perform was modified from the dive technique according to Alagich (2010) so that the subjects landed mostly on their hip.
A widely popular landing after a lateral dive in goalkeeping is taught by coaches. Alagich (2010) explains the landing after the catch as – “first contact with the ground is made with the ball and forearm, bent and relaxed elbow and shoulder joints then follow in cushioning the fall to cancel the heavy fall of the body, the shoulder, hip and then thigh make contact with the ground.” This technique will have a soft landing and allow the goalkeeper to maintain possession. The dive should be sideways and not with the stomach facing the ground (Alagich, 2010). So far no studies have been conducted on whether or not this technique will actually create a softer landing, compared to just landing on the shoulder and hip or side of the body.

The purpose of this study was to look at a soccer goalkeeper’s simulated goal-saving lateral dive and determine if landing with the ball and forearm hitting the ground first, as taught to many goalies, actually creates a softer landing for the body than landing on the side of the body first.

Methods

In this study one female colligate soccer goalkeeper (age 21 years, height 155.9 cm, body mass 57.8 kg) gave consent to participate. The subject was asked to perform two different types of landings while simulating a lateral dive to make a save and each type will be performed twice. The first was to land on the side of the body from the shoulder to the hip. The second was to land by have the ball and forearm hit the ground first then the rest of the body following Alagich’s (2010) technique for performing the dive. For both lateral dives, a size five soccer ball was thrown to the subject to help create a more game-like save.

The landing area comprised of two force platforms (OR6-5-2000 & OR6-7-2000; Advanced Mechanical Technology, Inc. [AMTI], Watertown, MA) laid side by side and covered
by a 10 cm foam pad. Data was collected at 1000 Hz using AMTI-Net Force Software (AMTI, Watertown, MA). To determine GRF peaks, the force data from the two force platforms were summed together.

To analyze the data, the peak GRF of the higher of the two landings for each type of dive was looked at. After the peak GRF is determined, the impulse for the dives was found. This was done by taking the force reading from when the force platform first started to register the force of the landing, until the force stabilized back to the subject’s body weight.

Results

The peak GRF for landing on the subject’s side of her body was 3185.1 N. For the landing with the soccer ball and forearm hitting first, the peak GRF was 4364.7 N (Figure 1). The impulse for the landing with the side of the body first and the landing with the ball and forearm first are 334306.7 N over time and 263456.6 N over time respectively (Figure 1). The dive with the side of the body landing first is 1.3 times greater than the dive with the ball and forearm landing first.

Discussion

The peak GRF for both dive landings found in the current study, 3185.1 N and 4364.7 N, fall within the range of peak GRF, 3 – 8 kN, from past literature (Schmitt, et al., 2010). It was unexpected that the landing technique having the ball and forearm land first created a higher peak GRF (4364.7 N) than when the subject performed the landing technique that involved just landing on the subject’s side (3185.1 N). It could be possible that the higher peak GRF was due to the smaller surface area created by just the ball and forearm compared to the side of the body.
However, the impulse data was the opposite. It was higher for the side of the body landing (334306.7 N) than the ball and forearm landing (263456.6 N). The time of the side of the body landing was 1.6 times greater than the ball and forearm landing. Due to this, the force occurred over a longer period of time for the side of the body landing than compared to the ball and forearm landing. What was interesting was that in Figure 1 the side of the body landing shows a second spike at the time the ball and forearm landing was stabilizing at the subject’s body weight. It was possible that the subject’s body rebounded after landing on her side and then hit the force platform again and then stabilized at the subject’s body weight.

To determine what actions the body was going through during the landing after a dive has occurred, further research should include video analysis in tandem with force readings. With additional research looking into the goalkeeper’s specific skills, such as diving, a greater understand of what the goalkeeper’s body goes through can be achieved. This information could then be relayed to goalkeeper coaches to provide better injury prevention programs for their athletes.
References


Figure 1: Peak ground reaction forces (N) of both dives’ landing, side of the body first and ball and forearm first, and areas under each curve used for impulse (N over time).
Preparation of the manuscript for The Journal of Biomechanics

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