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A Comparison of the Front and Back Squat with analysis of Trunk and Knee joint angles

Abstract

This study takes a closer look at how the front squat and back squat compare in terms of body movement around the trunk and knee. Using Dartfish motion analysis software, we broke down video footage to measure how the trunk and knees move during the parts of the front and back squat. The goal was to better understand the biomechanical differences between the two and what those differences might mean for performance and injury risk. The data showed clear contrasts in how much people leaned forward and how deeply they bent their knees, suggesting that each squat places different demands on posture and muscle use. These findings highlight the value of choosing the right squat variation based on a person's training goals and body mechanics.

Introduction

Squatting is one of the core movements in most strength and conditioning programs, and it's a go-to exercise for building lower body strength, power, and mobility. The front squat and back squat are two popular variations, each placing different demands on the body in terms of movement and muscle use (Gullett et al., 2009). Knowing how these two styles differ in how the body moves can help coaches and athletes make smarter training choices and lower the risk of injury. In a back squat, the barbell rests across the upper back, which often results in greater trunk lean and hip flexion to maintain balance (Comfort et al., 2011). On the other hand, the front squat places the barbell across the front of the shoulders, requiring a more upright posture and greater demand on the quadriceps (Yavuz et al., 2015). The aim of this study is to look at how the body moves during the front and back squats, with a specific focus on the angles of the trunk and knee at different points in movement. The main question we wanted to answer was: How do the trunk and knee joint angles change between the front and back squat as the movement progresses?

Methods

The participant performed both front and back squats while being recorded using Dartfish software. Key points were pinpointed in the squats and measured how the trunk and knee joints moved at each stage. The front back squat was broken down into key stages: the start, the descent, the bottom of the movement, and the ascent. At each of these points, the angles of the trunk and knee were measured in degrees. These

measurements were then plotted into graphs and analysed to spot any differences in posture and how much the joints moved during each phase.

Results

Tables 1 and 2 display the participants' trunk and knee joint angles for the front and back squat across the movement.

Table 1: Trunk and Knee angles - Back squat

Phase	Trunk Angle (Degrees)	Knee Angle (Degrees)
Start	176.1	178.9
Descent	160.3 - 172.5	153.7 - 166.3
Bottom	116.1 - 132.4	115.7 - 132.7
Ascent	132.4 - 166.3	138.2 - 172.3

Table 2: Trunk and Knee angles - Front squat

Phase	Trunk Angle (Degrees)	Knee Angle (Degrees)
Start	176.1	177.4
Descent	160.6 - 172.1	137.8 - 168.2
Bottom	118.2 - 126.1	110.6 - 133.6
Ascent	133.6 - 167.4	150.4 - 167.4

Figure 1: Scatter graph of trunk angles - Front vs back squat

Trunk - FS vs. Trunk - BS

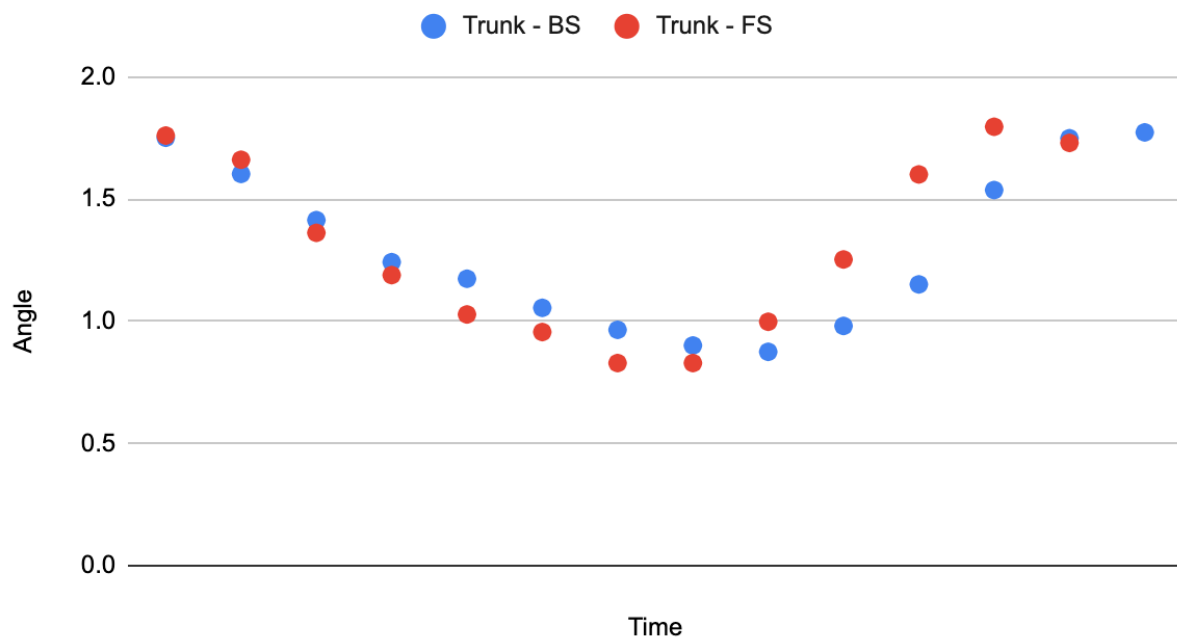
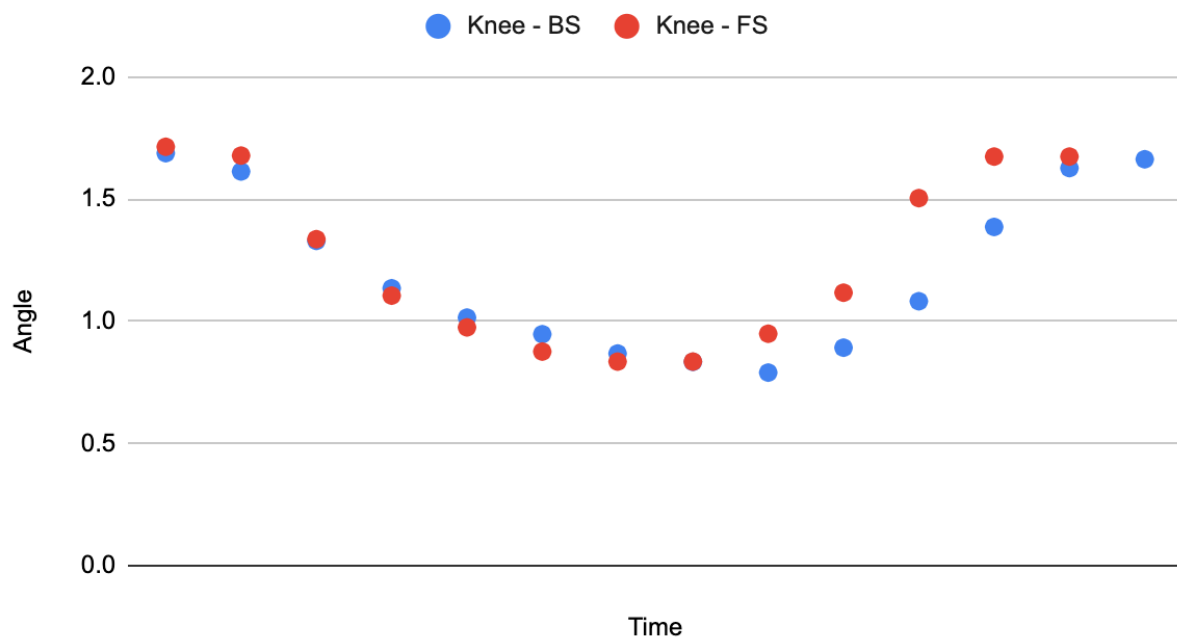


Figure 2: Scatter graph of Knee angles - Front vs back squat

Knee - FS vs. Knee - BS



These graphs show how the joint angles shift throughout the movement, highlighting the key differences in how each squat variation affects the body.

Discussion

The data reveals a clear difference in how much the trunk leans forward during each squat. In the back squat, there was noticeably more forward lean down to 116.1 degrees compared to the front squat, which stayed more upright at a minimum of 126.1 degrees. This supports previous findings that the back squat requires more hip flexion and trunk recruitment (Gullett et al., 2009). Knee flexion was also slightly greater in the front squat at the bottom phase, showing increased quadriceps demand. This backs up the findings of Yavuz et al. (2015), which suggests the front squat might be a better choice for targeting the anterior chain. The front squat showed smoother changes in trunk angle throughout the movement, which suggests it's a more stable and controlled pattern, potentially reducing lower back strain. These results support what Comfort et al. (2011) found, suggesting that front squats might be a safer option for people with spinal issues.

Conclusion

This analysis showed that the front squat requires a more upright trunk posture and greater knee flexion, while the back squat involves more trunk lean and posterior chain activation. These differences can help guide which squat variation to choose based on someone's training goals and body mechanics. Front squats may be more suitable for quadriceps strength and reduced spinal loading, whereas back squats may benefit hip and posterior chain development.

Word count - 900

Reference list

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