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Journal of Musculoskeletal Surgery and Research

Saudi Orthopedic Association

Article in Press

Case Report

Measuring one's ability to alter, change, and reduce lumbar flexion on call and underload part II

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Received: 12 September 2024
Accepted: 03 December 2024
Epub ahead of print: 18 January 2025
Published:

DOI
10.25259/JMSR_397_2024

Quick Response Code:

ABSTRACT

While deadlifting, flexing the spine is inevitable; however, can it be minimized? The research question is, "Can a skilled, experienced weightlifter reduce their lumbar flexion under load by incorporating a structured warm-up?" An expert-level weightlifter performing flexion under 60 kg of load (on an Olympic Elieko Barbell) was observed, and his lumbar spine was measured on two separate occasions. Day 1 had no warm-up, and day 14 included a specific, structured warm-up. A digital inclinometer was positioned over the S1/S2 and L5/T12 for all measurements. The participant flexed 26° (61.9% of total flexion range of motion [TFROM]) on day 1 and 11° (18.6% of TFROM) on day 14. Implementing the warm-up not only increased both extension and flexion range of motion but also seemed to enhance the lifter's ability to alter, change, and reduce lumbar flexion on call, under load, and on demand.

Keywords: Biomechanics, Deadlift, Lumbar flexion, Range of motion, Weightlifting

INTRODUCTION

Research on lumbar flexion as a strong injury predictor *in vivo* is mixed. Although the mechanism of disc herniation has been well established in an isolated system (*in vitro* and cadaver studies),[1-6] the breadth of research on humans is more heterogeneous due to the vast array of variables.[1-7] When considering how one should interpret the data and/or research on this specific topic, caution is advised due to the large difference in measurement from study to study; this makes it almost impossible to derive any meaningful data or draw hard conclusions.[6,7] In our previous work, we explored different measurement starting points, which included a loaded neutral or attempting to calibrate the lifter into a 0° disc neutral position-this once again alters the output data.[8] In this case study, we follow a more traditional guideline for measuring lumbar flexion kinematics. In Part I of this case study, we explored how a powerlifter could change lumbar flexion under a heavy load (150 kg) simply by being requested to do so.[8] In this case series, our research question is: "Can a skilled, experienced weightlifter reduce their lumbar flexion under load by incorporating a structured warm-up?"

How to cite this article: Williams B, Horsching A. Measuring one's ability to alter, change, and reduce lumbar flexion on call and underload part II. J Musculoskelet Surg Res. doi: 10.25259/JMSR_397_2024

CASE REPORT

A 38-year-old advanced-level weightlifter with no current injuries and 20 years of training experience was used in this case. Performing lumbar flexion under 60 kg of load (Olympic Elieko Barbell), he was observed, and his lumbar spine was measured on two separate occasions. Day 1 had no warm-up, and Day 14 included a specific, structured warm-up consisting of the McGill Big 3, single-leg touchdown squats, belt squats, Romanian deadlifts, and the lock lat pull [Figure 1 and Table 1]. A digital inclinometer was used to measure the sacrum and lumbar spine.

It was positioned over the S1/S2 and L5/T12 for all measurements [Figure 2]. On day 1 (no warm-up), an unloaded neutral (UN) position was measured at −16° while the participant was standing. Max flexion (MF) was then measured at 26° as the participant was asked to touch his toes. The total flexion range of motion (TFROM) in this study is defined by the loaded neutral standing point (−16°) + the absolute end range of flexion (26°), resulting in −16° + 26° = 42° of total TFROM. The participant was instructed to hold a 45° torso-angled isometric hip-hinge position (IHP) (mid-way deadlift) with as little lumbar flexion as possible for 10 s, which was recorded on day 1 at 10° (flexing 26°). On day 14 (with a warm-up), the UN standing position was measured at −28°. MF was then measured at 31°. The TFROM was −28° + 31° = 59°. The participant held the IHP with as little lumbar flexion as possible for 10 s, which was recorded at 11°. The participant flexed 26° (61.9% of TFROM) on day 1 and 11° (18.6% of TFROM) on day 14.

Figure 1: Digital inclinometer measurement technique example.

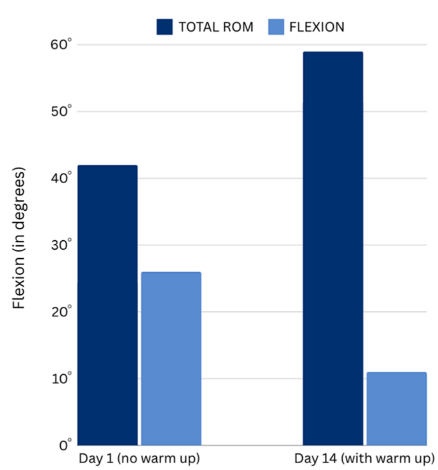

Figure 2: Day 1 versus day 14. ROM: Range of motion

DISCUSSION

The participant flexed 26° (61.9% of TFROM) on day 1 and 11° (18.6% of TFROM) on day 14. Implementing the warm-up increased both extension and flexion range of motion (ROM) and also seemed to enhance the lifter's ability to alter, change, and reduce lumbar flexion on call and under load. Which aspect of the warm-up had the most impact is unknown, but it can be hypothesized that performing movements that target proximal trunk stability may improve performance.[9] Moreover, performing full ROM under load (albeit with lighter warm-up loads) enhances ROM. It likely has a "warm-up" effect on soft tissue in terms of metabolism (heat and energy pathways) and neurology (cortical drive and neural output).[10] Similar to the post-activation performance enhancement (PAPE) phenomenon, which has been shown in previous research to be effective, this impacts muscle function, activation, and passive tissue compliance (PAPE refers to the execution of specific, predetermined movements that are designed to enhance the subsequent primary exercise).[11,12] Additionally, residual core stiffness resulting from the McGill Big 3 may positively impact limb control and, in turn, change spinal biomechanics.[9] The idea of "stability" has certainly been challenged throughout the biomechanical and sports performance industries lately. The research required to associate stability work with direct improvements in performance is considered lacking by some, although not nonexistent. One key issue lies within the definition of "stability" and how research is conducted to test it. Lee and McGill (2016) highlighted the importance of core stiffness and saw an improvement in distal athleticism through the improvement in striking force from fighters following isometric core exercises.[9] Williams and Johnson (2024) described joint stability as a reflection of the neural control system of Panjabi (1992).[13,14] Stating a direct relationship between one's functional capacity and joint stability. Some leading experts in the industry simply classify strength and stability as a "skill," which seemingly corresponds nicely to the other authors above. The stability component is likely an important one, but other factors must also be considered.

Table 1: Warm-up protocol.

Exercise	Repetitions	Sets	Duration or Weight
McGill Big 3 (Curl up, side plank, bird dog)	4 per movement	1	Each rep is held for 10 s
Single-leg step up (18 inches high)	5	2	Body weight @ 5 s pauses
Belt squat	20	2	75kg (165lbs)
Lock lat row	5 per side	2	Medium band
Romanian deadlifts	10	2	Empty 20 kg bar

Other research has shown improvements in speed and strength following "warm-up" protocols; more notably, specific warm-ups yield better performance outcomes than general warm-ups.[10,12] Specificity matters when preparing for any movement or athletic performance-based activity.[10-12] Spinal control, like any other movement, can be conditioned and improved as a skill, especially under load.[13] By integrating similar movements in your warm-ups to your target exercise (hip hinging of some sort), you'll likely improve your body's awareness of that motor pattern and, thus, performance output through metrics of speed, control, or strength.[10-13]

Additionally, these findings highlight the importance of incorporating a structured warm-up when examining spinal biomechanics. Research in this area remains limited, and variability in study designs complicates the interpretation of spinal flexion data, making it challenging to draw consistent conclusions. Differences in measurement techniques and calculation methods can significantly influence results, underscoring the need to standardize these approaches. This case report suggests that the specifics of how and when participants perform their warm-ups are crucial factors that should be considered. This underscores the necessity of including detailed warm-up protocols in studies of spinal flexion to better understand and accurately assess their impact.

Limitations

This case study has several limitations that should be acknowledged. First, the sample size was limited to a single experienced weightlifter, which may not fully represent the broader population of weightlifters or individuals engaging in similar physical activities. In addition, the study only assessed lumbar flexion under a specific load (60 kg) and may not account for variations in flexion response at different loads or exercise types. 60 kg was selected as we required enough weight to load the spine but did not want to expose the participant to any excess risk. The impact of each component of the warm-up protocol on lumbar flexion was not individually analyzed, leaving uncertainty about which specific exercises contributed most to the observed improvements. Furthermore, the study's short duration (14 days) may not capture long-term effects or adaptations from the warm-up routine. The participant was selected through a convenient sampling method, and this, plus the lifter's age, could also impact the results we observed. Finally, the absence of a control group and other more sophisticated measurement devices (Electromyography, ultrasound, etc.) limits the ability to conclusively attribute the observed changes solely to the warm-up routine, as other external factors might have influenced the outcomes. These limitations suggest that further research with a larger, more diverse sample and longer duration is needed to validate and expand upon these findings.

CONCLUSION

One's ability to alter, change, and reduce lumbar flexion under load or in preparation for load may act as a viable movement modification for current injuries or pain triggers or as a strategy for injury prevention. Utilizing appropriate and specific-to-task warm-ups may yield better performance outcomes; this is consistent in the case of spinal position and control, especially under load. Future research should delve deeper into the underlying mechanisms of these benefits and examine how incorporating specific structured warm-up routines can be effectively utilized in injury prevention and rehabilitation.

AUTHORS' CONTRIBUTION

Both authors were involved in all aspects of this study and have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

This case report is an educational activity of which the results cannot be extrapolated to a general population nor constitute contributing to "generalizable knowledge". It does not meet the Department of Health and Human Services definition of "research" and, therefore, does not require Institutional Review Board approval.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

FINANCIAL SUPPORT AND SPONSORSHIP

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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