WEIGHT-BEARING VERSUS ACTIVE PRONE HIP ROTATION RANGE OF MOTION

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Hip rotation range of motion (ROM) is usually measured in a non-weight bearing (NWB) status, however, people participate in sporting activities when in a weight-bearing (WB) condition. Since measuring in a WB status may be more relevant, the purpose of the study was to compare WB hip rotation ROM measures with a NWB active, prone (AP) measure. The investigators measured 112 participant's bilateral hip internal rotation (IR) and external rotation (ER) in both WB and NWB conditions. Paired t-tests ($p < .05$) indicated that AP IR measures (37.0 ± 9.8 and 36.7 ± 8.4) were significantly greater than WB IR measures (20.9 ± 9.4 and 23.2 ± 8.7) and WB ER measures (42.1 ± 11.8 and 38.3 ± 11.4) were significantly greater than AP ER measures (31.1 ± 7.0 and 26.2 ± 5.7). Hip rotation ROM peak values differ significantly between the two measurement methods and should be considered when measuring athletes.

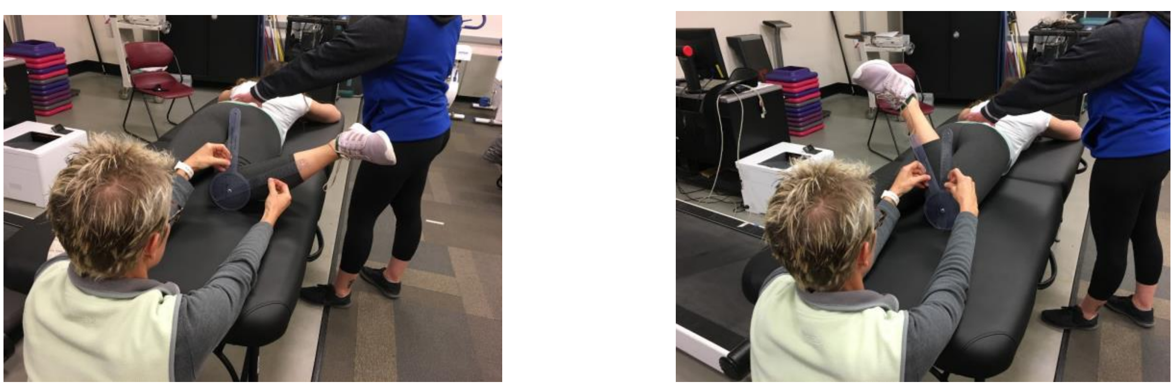
KEYWORDS: hip rotation, range of motion, weight-bearing, prone

INTRODUCTION: Past studies (Hallaceli, et al. 2014; Kouyoumdjian, Coulomb, Sanchez, & Asencio, 2012; Kumar, Sharma, Gulati, Dhammi, & Aggarwal, 2011; Macedo & Magee, 2008; Roaas & Andersson, 1982; et al.) have reported varying values for hip rotation range of motion (ROM). Part of the reason for this is that there has been different methodology regarding the type of motion measured (active vs. passive), and the position (prone, supine, or seated) used during the measurement. Regardless of any differences in ROM values of these previous studies, the commonality is that participants were measured in a non-weightbearing (NWB) status.
Interestingly, most activities of daily living as well as sport activities occur with a majority of the time spent in a weight-bearing (WB) status, but often when assessing available hip joint ROM, the measurement is performed in a NWB status. For example, when a clinician measures available NWB joint ROM with a goniometer or inclinometer, the assessment is often completed bilaterally, and a comparison is made between the two limbs. The goal is to have a patient or athlete not only within a published normal range of values, but also to have side-to-side symmetry. Since a WB measure for hip rotation ROM is novice idea, there is currently little research available in this area One recent study by Aefsky, Fleet, & Myers (2016) did compare a loaded vs non-loaded measures for hip rotation, and Gulgin, Remski, et al. (in print, 2019) established normative WB hip rotation ROM for healthy individuals. There were slight differences in these two studies measurements in the WB condition, as Aefsky, Fleet, & Myers (2016) used a kneeling method and Gulgin, Remski, et al. (in print, 2019) measured in fully standing posture. However, both of the studies were similar in that the measurement in WB condition replicated the same neutral hip position (zero degrees extension) of that when measured in active, prone (AP) method. The purpose of the study was to compare hip rotation ROM in a WB status to ROM in an AP position.

METHODS: 112 healthy athletes (m = 53, f = 59) from a variety of sports volunteered for this study (19.3±1.4 yrs., 174.0±11.9 cm, 73.0±12.6 kg). Participants reported to the lab on one occasion where they were given instructions for testing procedures and provided informed consent approved by the Institution's Human Research Review Board. Inclusion criteria required that participants were free of any history of back or hip surgery and had no recent physical therapy on their hip or back in past six months. Height, weight, age, hand & foot dominance, and ethnicity were recorded as well as what sport they participated in. Participants then performed three trials each of hip internal rotation (IR) and external rotation (ER) bilaterally using the Functional Footprint® device (Figure 1). Previous pilot testing on 15 participants established ICC's for right IR (.817), right ER (.897), left IR (.918), and left ER (.840). The same procedure was used to measure AP ROM with a goniometer (Figure 2) while unloaded on a table. Intra-rater reliability ICC's for goniometer measures for right IR (.984), right ER (.905) left IR (.960), and left ER (.968). Trials were only included if all criteria were met for WB measures (flat feet; hands on hips, straight knees, hips, and shoulders; staring straight forward, and no pelvis movement) and AP measures (ASIS did not lift off from table or no anterior pelvis tilt). The investigators visually watched for extraneous movement on WB measures, as well as watched and felt for movement during AP measures.

a. Internal rotation b. External rotation

Figure 1. WB Hip Rotation ROM



a. Internal rotation b. External rotation

Figure 2. Active Prone ROM

Statistical analysis was completed using SPSS version 24 (IBM Corp, Raleigh, NC). Separate paired t-tests were used to compare the peak values for WB and AP ROM, as well as compare means between right and left limbs. Significance was determined using an alpha of 0.05.

RESULTS: Participant demographics are reported in Table 1. Paired differences between WB and AP measures were found to be significant for both IR and ER ROM ($p < 0.05$, Table 2). When comparing means, AP measures were found to be significantly greater than WB measures for IR ROM ($p <0.05$, Table 2) while AP measures were significantly smaller than WB measures for ER ROM ($p <0.05$, Table 2). Additionally, there were significant differences between the right and left limbs in all measures except AP prone IR (Table 2).

Table 1. Participant Demographics

	Age	Ht (cm)	Wt (kg)	BMI
Total (n = 112)	19.3 ± 1.4	174.0 ± 11.9	73.0 ± 12.6	23.6 ± 2.9

Table 2. Peak Hip Rotation ROM (Degrees)

N = 112	Right IR	Left IR	Right ER	Left ER
WB ROM	20.9 ± 9.4	23.2 ± 8.7^{+}	42.1 ± 11.8	38.3 ± 11.4^{+}
AP ROM	37.0 ± 9.8	36.7 ± 8.4	31.1 ± 7.0	26.2 ± 5.7^{+}
Difference	16.1*	13.5*	11.0*	12.1*

*Significant difference between measurement condition ($p < 0.05$)
$^{+}$Significant difference between right and left limbs

DISCUSSION: The purpose of this research was to determine if WB hip rotation ROM differs from when measured in AP position. Both of these positions maintain the hip in the neutral position (zero degrees extension) and measures were completed actively, thus they should allow for similar ROM. However, the results demonstrate that measuring hip rotation ROM in a WB status significantly differs from measures in an AP position. And, while Aefsky, Fleet, Myers, & Butler (2016) reported on reliability and validity of novel method to measure hip rotation ROM (did not determine significance between modes of measurements), they found similar results in that there is a difference in peak hip rotation ROM between loaded and unloaded conditions.

For IR, our values for WB hip rotation ROM were 20.9 ± 9.4 (right) and 23.2 ± 8.7 (left), compared to Aefsky, Fleet, Myers, & Butler (2016) values of 22.6 (right) and 21.1 (left). Thus, these appear to be very similar. When comparing each of the respective studies AP measurements, our study had values of 37.0 ± 9.8 (right) 36.7 ± 8.4 (left) and Aefsky, Fleet, Myers, & Butler (2016) reported values of 36.0 (right) and 34.3 (left), which again appear very similar not only in peak values, but in agreement in that the WB ROM is lower than when measured in standardized AP mode. If we compare these WB ROM values for IR to the unpublished normative values (Gulgin, Remski, Peyton, 2019) we find they are very similar with 21.2 ±10.1 (right) and 22.6 ± 9.6 (left) respectively. Thus, coaches, athletes, and clinicians should be informed that the available hip rotation ROM appears to be less when shift to a more functional WB position that is utilized in sporting activities. Thus, there may be a risk for injury if what is available in a WB condition is not adequate during the sport skill.

For ER, our values for WB hip rotation ROM were 42.1 ± 11.8 (right) and 38.3 ± 11.4 (left). Aefsky, Fleet, Myers, & Butler (2016) reported values of 27.8 (right) and 25.8 (left) for ER. Thus, our values for ER differ by about 13-14 degrees, with our values being higher. When comparing each of the respective studies AP measurements, our study had values of 31.1 ± 7.0 (right) and 26.2 ± 5.7 (left) with Aefsky, Fleet, Myers, & Butler (2016) reporting values of 46.5 (right) and 46.0 (left). Our values for AP ER were much lower than their results. Furthermore, we only observed differences of 11-12 degrees when compared to our WB ROM, whereas Aefsky, Fleet, Myers, & Butler (2016) report almost 20-degree difference between the two different modes of measurement for ER. Our values for ER were higher in WB condition, whereas Aefsky, Fleet, Myers, & Butler

(2016) had higher values for AP condition. These differences may be the result of slightly different methodology. Aefsky, Fleet, Myers, & Butler (2016) measured their loaded condition in a kneeling position (aiming to eliminate pelvic movement) creating a frontal plane tilt whereas as our WB condition was measured in fully upright position keeping the pelvic level.

In summary, both studies had lower values for peak IR in WB condition than when measured in AP. But, the current study observed the opposite for WB ER, in that these peak values were higher than when measuring in AP position, which is contrary to Aefsky, Fleet, Myers, & Butler (2016).

While both of the hip rotation ROM measures were completed actively and in neutral hip position, and thus should be similar, the resulting differences may be a result of the muscles stability requirements when in WB status, which may influence mobility. As such, assessing ROM in NWB status may underestimate the ROM that joints undergo during sporting activities.

CONCLUSION: Peak values for hip rotation ROM differs between WB and AP conditions. Athletes appear to have less IR ROM than the AP method, and more ER in the WB condition. Coaches, athletes, and clinicians may want to adopt the more functional way to measure hip rotation ROM (WB status) and compare those values to the established norms in evaluation of performance or injury risk.

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