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L4-L3 Joint Angle Evaluation of Three Different Police Body Carriers for Officer Duty Equipment

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Abstract: This study evaluated how the placement and mass distribution of Police Duty Equipment configuration impacts police officers' physical performance to complete the task as measured by the L4-L3 lower back joint posture. Three different commonly utilized duty carrier configurations were evaluated by comparing them to the control using 13 male participants from the Indiana University of Pennsylvania (IUP) Criminal Justice Training Center (CJTC). The control is a representation of the standard configuration clothing used in the field (CJTC standard issue cadet uniform) including shirt, undershirt, belt, trousers, socks, and shoes. Treatment 1: Control configuration plus Duty Carrier Belt and Duty Gear. Treatment 2: Treatment 1 plus an undershirt suspender system. Treatment 3: Control configuration plus Carrier Vest and Duty Belt and Duty Gear. Upper Body joint posture for the lower back was analyzed using the Xsens 3D-motion tracking. The participants completed the Shorter Illinois Agility Test which is a modified test derived from the Illinois Agility Test that is used by numerous police departments to evaluate candidates' physical condition. To do so, participants jogged around the course while being evaluated (approximate distance of 49 meters). Participants completed the Control trial and then the three treatments in a random order. They were given at least 15 minutes of rest between trials. At the end of the trials, each participant was asked about their most preferred treatment and to provide any related feedback. A Friedman statistical test was conducted to determine if there were differences between the four groups. If the Friedman test was significant, then Wilcoxon Signed-Rank Test was run to determine specific significance.

Lateral angle changes for the L4L3 in all treatment groups were different from control with all indicating a mean change to the left but no large changes between each of the treatment groups. A similar mean change to the left was also observed for the axial rotation with Treatment 1 exhibiting the largest change from Control (mean change of 0.326 degrees) and Treatment 2 with the smallest change from Control (mean change of 0.057 degrees). The flexion-extension angles for L4-L3 significantly increased forward for Treatment 1 from Control (largest mean change of 2.13 degrees) ($z = -1.417$, $p = .043$) and Treatment 3 from Control (smallest mean change of 1.61 degrees) ($z = -1.333$, $p = .011$). Overall, most participants preferred Treatment 3 (53%) and Treatment 2 (40%). Of the participants that chose Treatment 2, 50% liked both Treatment 2 and Treatment 3, but having to choose, they ultimately picked Treatment 2.

The results of this study indicate Treatments 2 and Treatments 3 were overall closer to Control. Treatments 2 and 3 were perceived by participants to be the most comfortable to their hips, legs and back and their preferred choice while Treatment 1 was selected as the least preferred method to duty carrier gear. These findings could be used by police departments to change related policy to allow officers the choice of duty gear carrier configurations rather than limiting them to only one.

Keywords: Police Officers, Duty Gear, Biomechanics, Posture, Joint Angle, Lower Back

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