PURPOSE: Although the judo is an official Olympic event that played all over the world, serious head injuries, especially acute subdural hematomas (ASDHs) have occasionally occurred during judo competition or practice in Japan. The acceleration at the head impact is considered as one of the major influencing factors in serious head injuries. On the other hand, the break-fall technique called "*ukemi*" has been developed in judo to prevent head collision against the judo-floor (mat) and to minimize its impairments. However, the head acceleration-decreasing effect of *ukemi* on thrown person has not been fully understood. The purpose of this study was to evaluate head injury criterion (HIC) value as a level of head injury risk by the linear head accelerations and to compare it with the values previously obtained from an anthropomorphic test device (ATD) experiment without *ukemi*
METHODS: One male judo expert (thrower) repeatedly threw another male judo expert (faller) for 4 times by judo technique called *Seoi-nage*that has been linked to the occurrence of ASDHs in judo. The faller took *ukemi* adequately without head collision against mat in all trials. The head axial linear acceleration was measured by a tri-axial accelerometer mounted on the forehead of the faller's head in each trial. In order to evaluate the magnitude of faller's impact of the head, we calculated the HIC value from the head linear accelerations. Kinematic data of the faller's head were also recorded during trials using digital video cameras. The HIC values of ATD thrown by the same judo expert were obtained from our previous study (Murayama et al., 2020).
RESULTS: Kinematic data showed that the faller fell forwards without any head collisions against the mat in throwing technique *Seoi-nage*. In all trials, a large acceleration appeared at the body contact phase to the mat. The peak resultant linear acceleration values of faller ranged from 8.36 to 9.30 G and 9.11 to 30.83 G in ATD. The HIC values of faller (2.08 ± 0.22) were significantly lower than those observed in ATD (24.68 ± 21.23, $p<0.05$).
CONCLUSIONS: According to the findings, mastering proper *ukemi* technique could significantly decrease the HIC value of head impact and the likelihood of severe head injuries in judo.

3011

The Influence Of Arm Slot, Stride Length, And Stride Angle On Baseball Throwing Velocity

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Throwing velocity (TV) is influenced by numerous factors. Better understanding of pitching mechanics can aid coaching staff in designing optimal training programs.
PURPOSE: To evaluate the effect of stride length, stride angle, and arm slot on TV across different levels of play.
METHODS: We enrolled 100 baseball pitchers from 3 different populations: high school (n=7), college (n=75), and professional (n=18). Following a standardized warmup, each subject performed 5 pitches that were analyzed using high-speed motion capture cameras (OptiTrack Prime 17W). Stride length, stride angle, and arm slot were exported. Pitch velocity was captured using a Stalker Sport radar system. We estimated differences in play levels using one-way ANOVA. Linear regression measured the effects of kinematic parameters on TV holding confounders constant.
RESULTS: Across the total sample, subjects were 21.4 ± 2.3 years old, 185.3 ± 7.2 cm tall, and weighed 90.7 ± 10.1 kg. Stride length was $83.6 \pm 5.8\%$ of height (70.4 to 99.6%), stride angle was $1.9 \pm 5.9°$ (-9.2 to 13.3°), and arm slot was $42.2 \pm 7.4°$ (14.2 to 59.8°); none of these differed between levels of play (p>0.125). TV was 84.8 ± 4.7 mph (71.3 to 94.0 mph) and was different between play levels (p=0.002): high school (79.6 ± 4.7 mph), college (84.8 ± 4.4 mph), and professional (86.8 ± 4.8 mph). Stride length (p=0.089), stride angle (p=0.065), and arm slot (p<0.001) were associated with TV. Height was related to stride length (p=0.060) and weakly associated with arm slot (p=0.092), but not stride angle (p=0.981). Height (p=0.012) and weight (p=0.014) were correlated with TV. In the regression analysis, high multicollinearity existed between age and play level; age was retained owing to better significance. Weight (β=-0.043; p=0.398) and stride angle (β=-0.091; p=0.208) were insignificant and removed from the model. Holding age (β=0.665; p<0.001) and height (β=15.474; p=0.007) constant, stride length (β=21.190; p=0.003; 95% CI: 7.245, 35.135) and arm slot (β=-0.218; p<0.001; 95% CI:-0.327 -0.110) were significant predictors of TV (r^2=0.332; p<0.001).
CONCLUSION: Among pitchers across various play levels, increased TV was predicted by a lower arm slot and longer stride length. These kinematic variables should be included in a standard assessment by coaches and other sport professionals.

3012

The Influence Of Shoulder Kinematics On Throwing Velocity In Baseball Players

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(No relevant relationships reported)

Baseball pitching involves substantial rotation and velocity within the glenohumeral joint, placing the shoulder at an elevated risk of injury. Better understanding of joint kinematics during throwing may assist in the development of effective training and injury prevention protocols.
PURPOSE: To test the relationship between throwing velocity (TV) and shoulder mechanics in baseball players.
METHODS: We evaluated 100 pitchers (7 high school, 75 college, 18 professional) using an OptiTrack Prime 17W high-speed motion capture system. After a standardized warmup, subjects were analyzed on 5 consecutive pitches. Kinematic parameters were horizontal abduction angle (HAA), external rotation angle (ERA), and internal rotation velocity (IRV). Maximum values (max) and values at foot plant (fp) were recorded separately. TV was assessed using a Stalker Sport radar system. Linear regression measured the effect of all independent variables on TV holding confounders constant.
RESULTS: Subject age was 21.4 ± 2.3 yr, height was 185.3 ± 7.2 cm, HAA_{max} was $48.0 \pm 12.5°$, HAA_{fp} was $41.9 \pm 13.2°$, ERA_{max} was $168.9 \pm 10.1°$, ERA_{fp} was $47.3 = 21.2°$, IRV_{max} was $4,521.8 \pm 300.1°/s$, and TV was 84.8 ± 4.7 mph. Age (r=0.331; p<0.001), height (r=0.250; p=0.012), IRV_{max} (r=0.331; p<0.001), ERA_{max} (r=0.359; p<0.001), HAA_{max} (r=0.384; p<0.001), and HAA_{fp} (r=0.414; p<0.001) were correlated with TV. HAA_{fp} (r=-0.091; p=0.368) and ERA_{fp} (r=-0.035; p=0.729) were unrelated. In the regression analysis, age and level of play were highly correlated (VIF>2.5); age was retained owing to better significance. In the full model, HAA_{max} was insignificant (p=0.787) and was removed. Holding age (p<0.001) and height (p<0.001) constant, significant predictors of TV were IRV_{max} (β=0.005; p<0.001; 95% CI: 0.003, 0.007), ERA_{max} (β=0.088; p=0.024; 95% CI= 0.012, 0.163), HAA_{fp} (β=0.126; p<0.001; 95% CI= 0.063, 0.190), and ERA_{fp} (β=0.042; p=0.028; 95% CI= 0.005, 0.079). The model was significant (r^2=0.500; p<0.001). HAA_{fp} and ERA_{fp} were only significant with confounders controlled; HAA_{max} was only significant without confounders controlled.
CONCLUSIONS: The three most robust predictors of TV were HAA_{fp}, ERA_{max}, and IRV_{max}. Consideration should be given to exercise and injury prevention programs that focus on these parameters.

3013

Effects Of Wrist Pronation Angle, Elbow Flexion Angle, And Elbow Extension Velocity On Fastball Speed