The Stabilizer

Abstract

Twenty moderately experienced, though currently non-active, baseball and softball players practiced batting for one week either taking 30 practice cuts using their typical swing or 30 practice cuts a day using the Stabilizer. The players' swings were compared prior to starting practice, immediately following the week of practice and one week after practice ended. Batters who trained with their typical practice swings had greater forward hip motion and a greater forward shift of their weight after the week off as compared to their initial swings. In comparison, batters who trained on the stabilizer did not display additional forward hip motion or a greater shift of their weight after training for a week and taking one week off. These results may indicate that with practice, moderately experienced batters may, over several days of practice, shift their weight more to the front leg with greater forward hip motion. Taking practice swings on the stabilizer appears to prevent this phenomenon.

Purpose: The purpose of this project was to determine if training on the stabilizer for 1 week would have beneficial effects on bat swing biomechanics in moderately experienced ball players as compared to a group of players who did a week of practice swings without the stabilizer.

Methods:

Participants. Twenty participants were recruited from Ithaca College graduate and undergraduate students who had a moderate level of experience playing baseball or softball. To be included in the study the participants had to be healthy with no known injuries precluding swinging a baseball bat. Moreover, they had to have played baseball or softball on a team at some point in their lives. This included little league, recreational leagues, high school junior varsity, or high school varsity. Participants were excluded if they were experienced ball players, which was defined as playing at the collegiate level. In total there were three subjects with experience only at the little league or recreational level, one subject who played only at the junior high level, and one who played only one year of high school ball. The remaining fifteen participants played all four years in high school. There were ten females and ten males. Experience level was split evenly across males and females. The average age was 20.5 years (SD = 3.5 yrs), the average height was 1/72 m (SD = 0.1 m), and the average mass was 72.2 kg (SD = 12.5).

Protocol. Prior to participating, all participants read and signed an informed consent form approved by the Ithaca College Human Subjects Review Board that described the purpose, procedures, risks, and benefits of the study. Each subject completed a short demographic form and then was assigned to either the stabilizer or control condition. The stabilizer group trained for 1 week (5 days) taking 30 swings per day using the stabilizer with the instructions to hit for a home run. The control group took 30 swings a day for 1 week (5 days) without the stabilizer and with the only instruction to hit for a home run. Participants were matched by gender and experience and then randomly assigned to either the stabilizer or control groups.

Prior to beginning training, all participants underwent pre-testing during which 3D motion capture of their swing was performed and then analyzed. For the motion capture, retro-reflective markers were placed on key anatomical landmarks to define head, shoulder girdle, right and left upper arm, right and left forearm, pelvis, right and left upper leg, right and left lower leg, right and left foot, and bat segments. The participants took five swings hitting a stationary (hanging) ball and five swings hitting a soft tossed ball while their swings were captured from seven cameras. During each swing, force data

from the front and back foot were also collected in synchrony with the camera data. Computer models were generated from the camera data for each of the ten swings. From the data, the following variables were calculated: maximum bat speed, total head rotation, forward hip displacement, total hip rotation, total shoulder rotation, initial back foot weighting, maximum weight shift, time of initiation of weight shift, time of end of weight shift, and duration of weight shift.

Immediately after the ten pre-testing swings, the retro-reflective markers were removed from the participants and the participants started their first day of practice swings. If the participant was assigned to the stabilizer group, the stabilizer was adjusted to the participant and they were given basic instructions on proper use of the stabilizer. The participant then took 15 swings from the stationary ball and fifteen swings of a soft tossed ball (in either order). The control group subjects took the same 30 swings without using the stabilizer. The participants then came in for practice the next four consecutive days completing 30 swings each practice.

Following the last practice session on day 5, the retro-reflective markers were placed on the subjects and post testing was completed. Post-testing followed the exact same format as pre-testing. Next, 5 to 7 days following post testing, retention testing was completed. Again, retro-reflective markers were placed on the subject and five swings at a stationary ball and five swings at a soft tossed ball were captured. The stabilizer was only used by the stabilizer group during training. All testing was done of the participant's natural swing without any training devices or instruction besides the prime to hit for a home run.

Results

The results from the stationary (hanging) ball are presented. In total 300 swings were analyzed. Five swings for 20 subjects, for three conditions (pre-, post-, and retention- testing). The data from the five swings from each participant for each condition were averaged so that each subject has representative average data for each condition. After averaging the five swings per subject per condition, the data were analyzed with a two-way (group by condition) analysis of variance with repeated measures on the condition factor. For significant effects (alpha = 0.05), post hoc multiple comparisons were done using a Bonferoni correction factor.

Bat Speed. Bat speed was consistent both between groups and across conditions, meaning that bat speed did not train after training for either group (Figure 1). The average bat speeds for both groups all conditions ranged from 21.2 ± 5.9 m/s for the pre testing stabilizer group to 22.2 ± 4.8 for the retention testing control group. In other words, there was no change in bat speed after practice and difference in bat speed between groups.

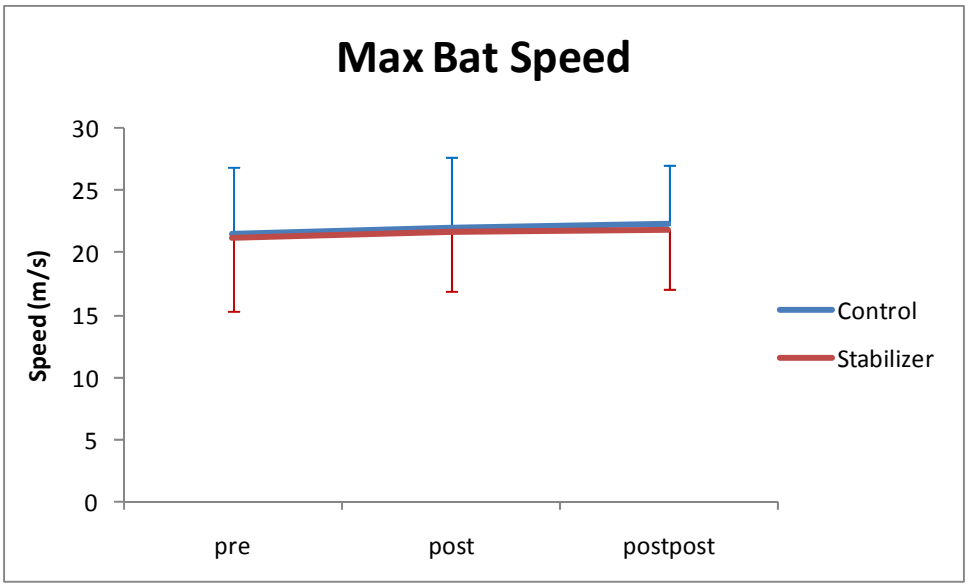

Figure 1 - Average bat speed by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Head Rotation. Head rotation was consistent across condition from pre-, post-, to retention- testing. There was no significant difference between groups (Figure 2). The average head rotation ranged from 49.9 ± 19.5 for the control group post-testing to 69.9 ± 22.3 for the treatment group pre-testing.

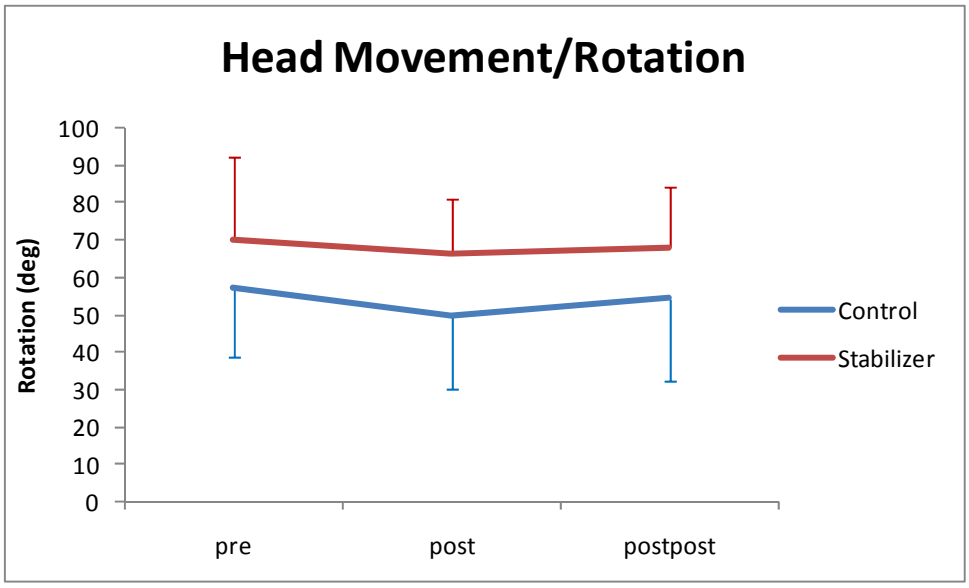

Figure 2 - Average head rotation by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Forward Pelvis Displacement. There was significantly greater forward hip displacement (0.72 ± 0.06m) for the control group in the retention testing as compared to the pre-testing. At post testing, a 0.59 ±0.07 m increase in forward hip displacement for this group was not significant. There was no change in hip forward displacement from pre-, post-, to retention testing for the stabilizer group (Figure 3). In other words, following 1 week of practice hitting there was a non-significant increase in forward hip displacement of 0.59 ± 0.07 m, for the control group. Following 1 week off, the control groups forward hip displacement increased significantly by 0.72 ± 0.06 m as compared to the pre-testing. On the other hand, the stabilizer group did not show any increase in hip forward displacement after practice or following a week off. This may suggest that with practice, batters tend to use more and more forward hip movement and that the stabilizer is effective and prohibiting this phenomena.

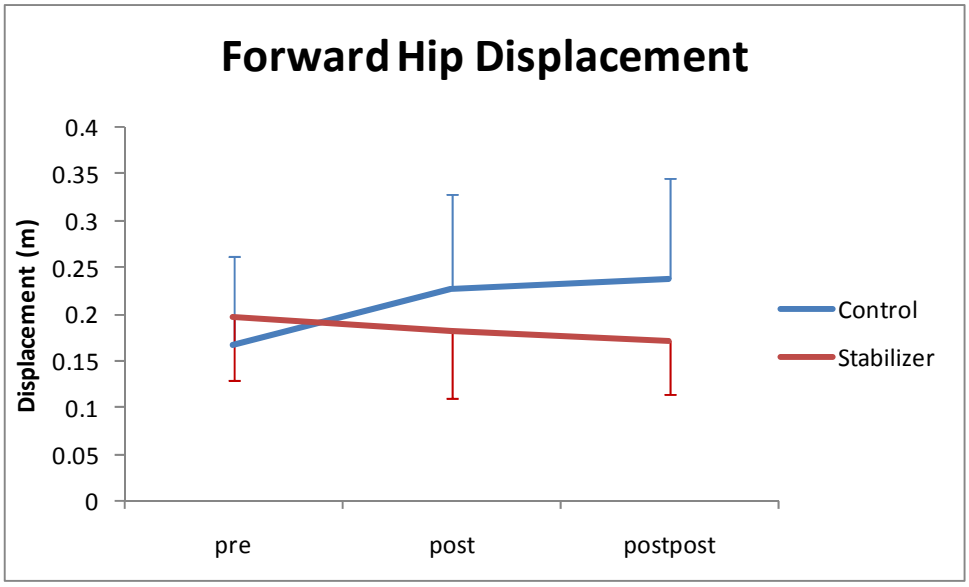

Figure 3 - Average forward hip displacement by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Hip Rotation. Total hip rotation was consistent across condition from pre-, post-, to retention- testing. There was no significant difference between groups (Figure 4). Hip rotation range of motion ranged from 119.3. ± 39.6 for the treatment group retention--testing to 132.0 ± 30.6 for the control group post-testing.

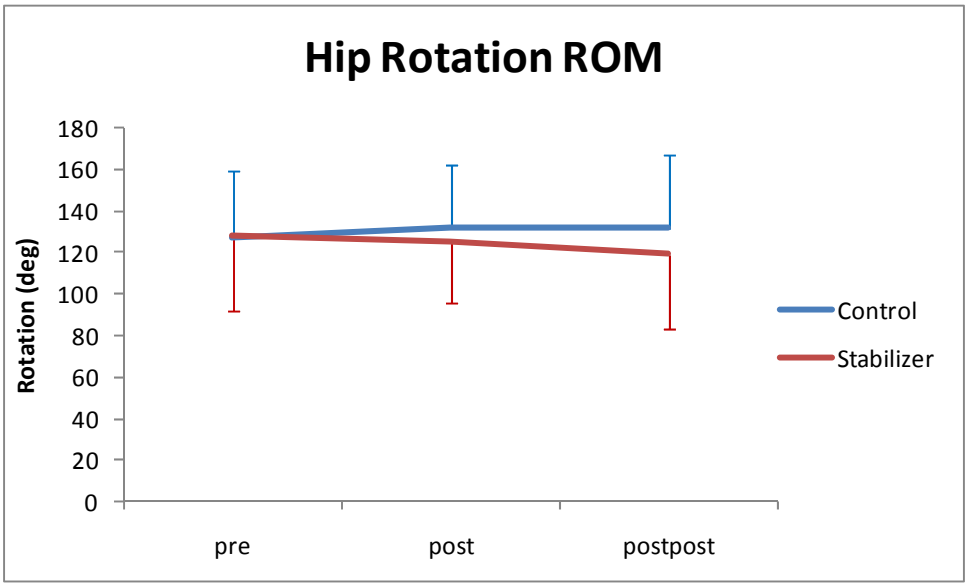

Figure 4 - Average hip rotation range of motion by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Shoulder Rotation ROM. Total shoulder rotation was consistent across condition from pre-, post-, to retention- testing. There was no significant difference between groups (Figure 5). Shoulder rotation range of motion ranged from 151.3 ± 51.4 for the control group post--testing to 176.6 ± 45.8 for the treatment group pre-testing.

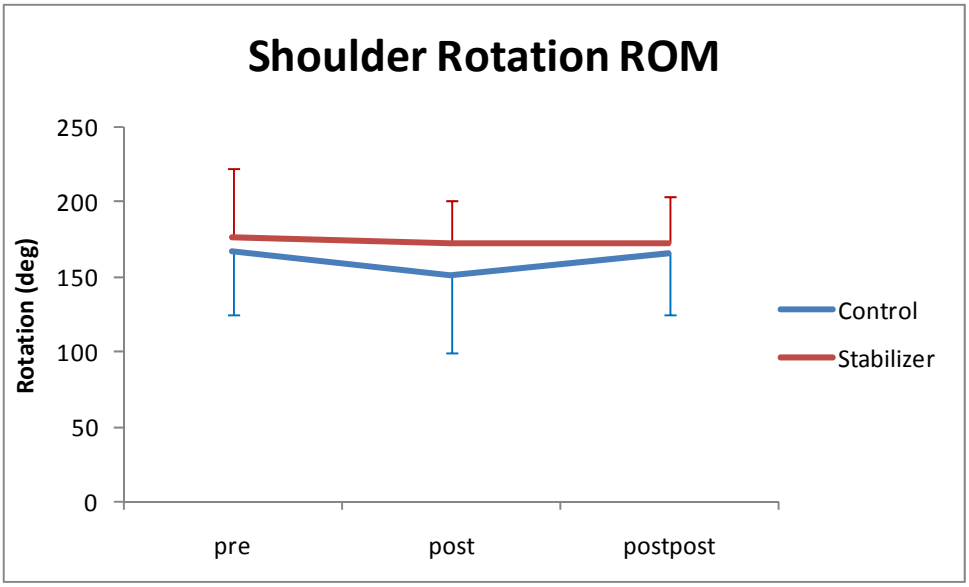

Figure 5 - Average shoulder rotation range of motion by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Weighting of back foot. The weighting of the back foot at the start of swing was consistent across condition from pre-, post-, to retention- testing. There was no significant difference between groups (Figure 6). Back foot weighting ranged from 95% ± 13 BW for the control group post--testing to 101 ± 3 BW for the treatment group retention testing. BW stands for body weights. Essential participants had all their weight on their back foot at the start of the swing, which was defined as the point of maximum unweighting. Values can be just barely higher than 100% due to small fluctuations in force readings of an unloaded force plate.

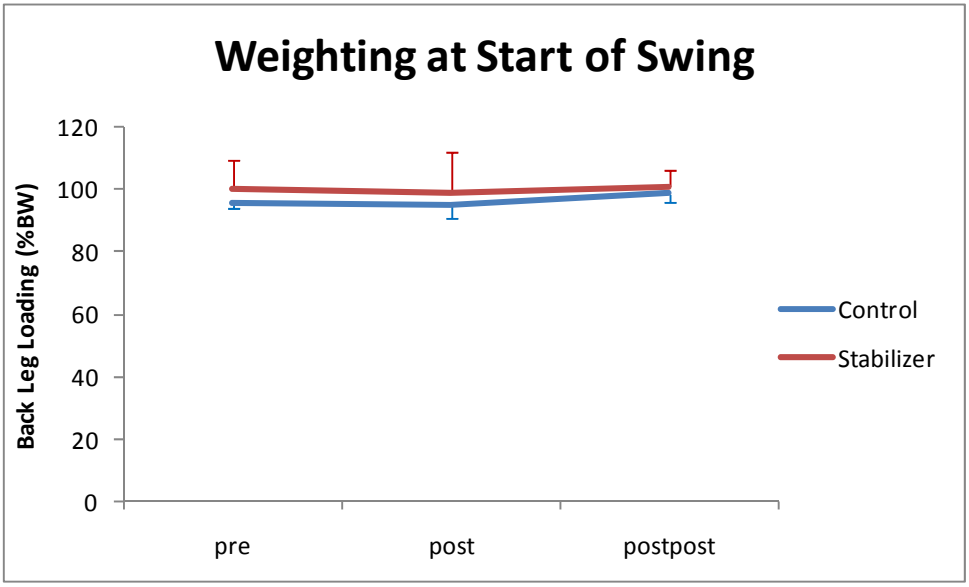

Figure 6 - Back foot weighting by group for pre-, post- and retention- testing. Error bars represent standard deviations.

Max Weight Shift. Maximum weight shift off the back foot increased significantly 9.5% from pre to retention testing. The 7.9% increase in weight off the back foot from pre-to post-testing for the control group was not significant (Figure 6). There was no significant difference in max weight shift off the back foot from the pre, post, to retention testing for the stabilizer group. Nor was there a difference in weight shift off the back foot between the stabilizer and control groups during pre-testing. During post and retention testing, the control group had greater weight shift off the back foot than the stabilizer group due to their increase in weight shift from pre to post and pre to retention testing. In other words, the stabilizer group kept their weight shift consistent from pre- to post- to retention testing with 23 to 26% of their weight on their back foot at a minimum during their swing. The control group, on the other hand, had 19 ± 8% of the weight on their back foot after their weight shift pre-testing, and following one week of practice swings and 1 week off, they had only 10 ± 7% of their weight on the back leg at a minimum.

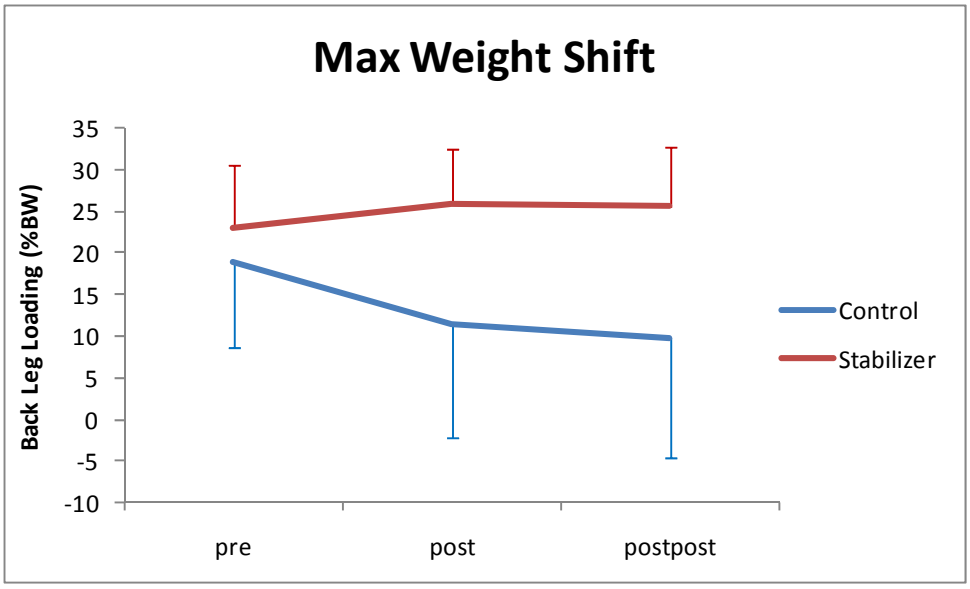

Figure 7 - Maximum weight shift by group for pre-, post- and retention- testing. Error bars represent standard deviations. Values are percent of weight on the back foot when the back foot is loaded minimally.

Start of Weight Shift. There were no differences in the timing of when the batters started shifting their weight forward between groups or from pre- to post- to retention testing. On average, the weight started to shift forward 8± 9% for the control group post testing to 13 ± 12% for the stabilizer group post testing into the swing.

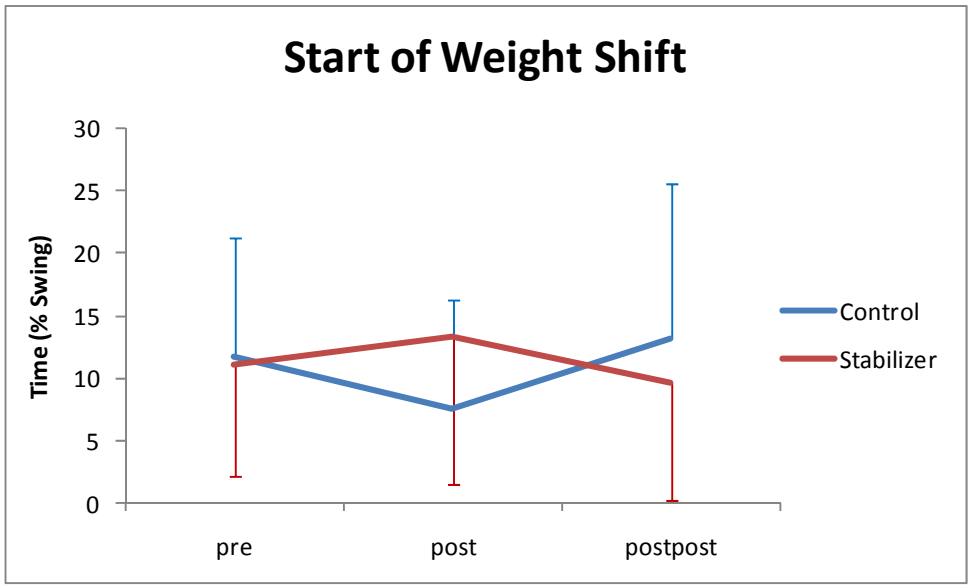

Figure 8 - Start of weight shift as a percent of swing by group for pre-, post- and retention- testing. Error bars represent standard deviations. Values are percent of weight on the back foot when the back foot is loaded minimally.

Time of Max Weight Shift. The time that the subjects reached maximum weight shift as measured from the start of the swing ranged from 48 ± 9% for the control group pre-testing to 61 ± 21% for the control group post testing. The difference in time to maximum weight shift for the control group pre-testing (48 ± 9%) to the control group retention testing (56 ± 10%) was significant. This means that the control group reached maximum weight shift (8% longer into the swing measured as a percent of swing, not in absolute seconds. The 13% increased from pre- to post-testing for the control group was not significant due t the larger variability in time to maximum weight shift for the post testing for this group. There were no other significant differences. The stabilizer group had no changes in time to weight shift from pre- to post- to retention testing. Remember the stabilizer group did not have a change in the magnitude of weight shift. On the other hand, the control group, had a bigger weight shift, more weight coming forward, during retention testing as compared to pre-testing and this weight shift took place over a longer percent of the swing.

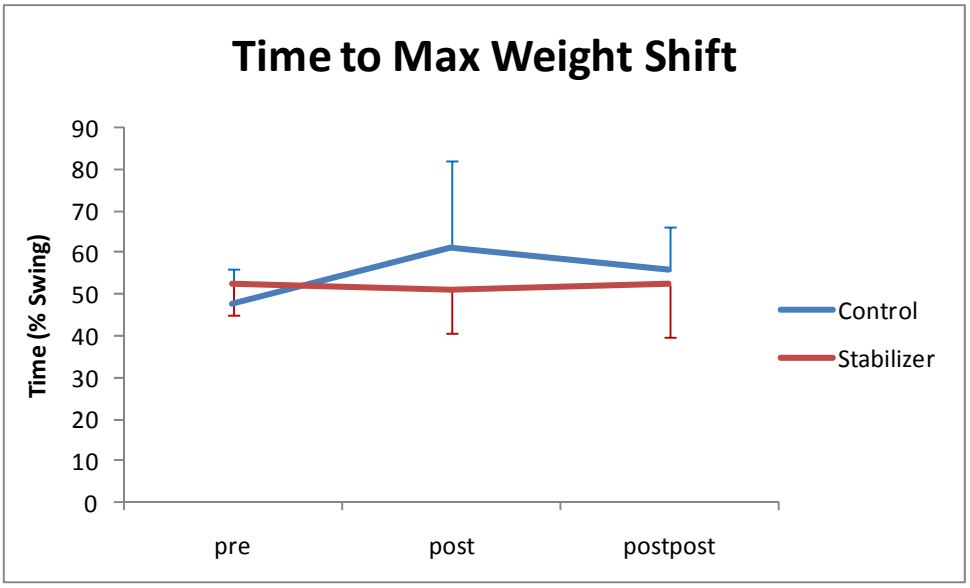

Figure 9 - Time to maximum weight shift as a percent of swing by group for pre-, post- and retention-testing. Error bars represent standard deviations. Values are percent of weight on the back foot when the back foot is loaded minimally.

Duration of Weight Shift. The duration of the weight shift as measured from the start of weight shift (when weight started to come off the back leg) to maximal weight shift (when the batter reached the minimum amount of weight on the back leg) had a significant interaction. This means that the control and stabilizer groups did not display the same pattern in the amount of time they took to shift their weight from the back to front leg from pre- to post- to retention-testing (Figure 9). However, upon further inspection of the data, there were no differences in the duration, or time of the weight shift, from pre to post to retention testing for either the control or stabilizer groups. However, the duration of the weight shift for the control group during post testing was 19.2 percent longer than pre testing, but this was not significant (0.051). By retention testing the duration of weight shift was back to within 3.5% of pre testing duration for the control subjects. In other words, even though the control group

reached maximum weight shift later in the swing in their retention testing as compared to their pre-testing as measured from the start of the swing, when measured from the start of weight shift the difference was no longer significant.

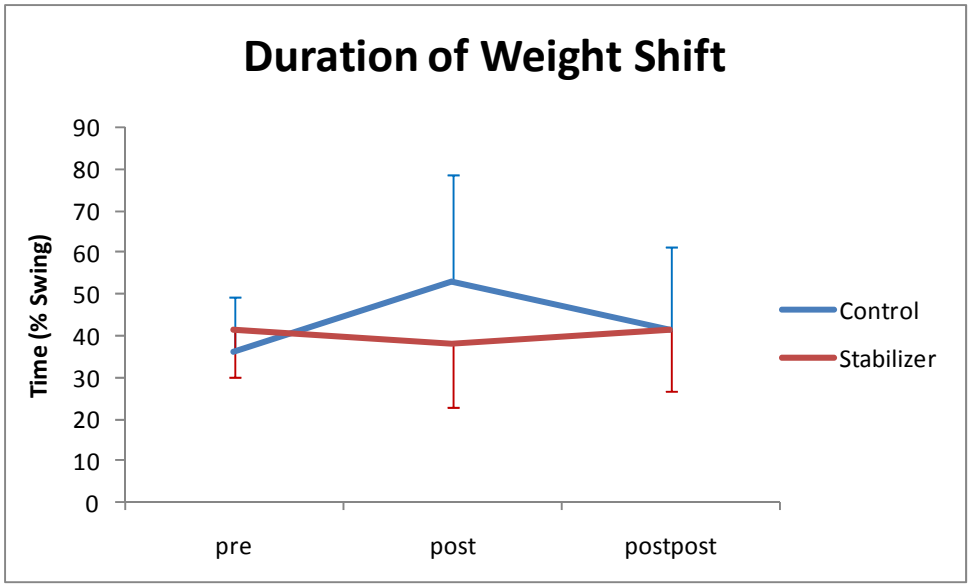

Figure 10 - Duration of weight shift as a percent of swing by group for pre-, post- and retention- testing. Error bars represent standard deviations. Values are percent of weight on the back foot when the back foot is loaded minimally.

Summary

After 1 week of practice swings followed by a week off, batters displayed greater forward hip motion and a greater forward shift of their weight as compared to their initial swings. This additional forward motion and weight shift lasted longer into the swing. In comparison, batters who trained on the stabilizer did not display additional forward hip motion or a greater shift of their weight after training for a week and taking one week off. These results may indicate that with practice, moderately experienced batters may, over time as they start practicing, shift their weight more to the front leg with greater forward hip motion. Taking practice swings on the stabilizer appears to prevent this phenomenon.