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Effects of Weightlifting Training on Isometric Mid-Thigh Pull Rate of Force Development

CHANGES IN ISOMETRIC RATE OF FORCE DEVELOPMENT DURING SPECIFIC PHASES OF A BLOCK PERIODIZED TRAINING CYCLE IN WEIGHTLIFTERS

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Abstract

PURPOSE: To examine the influence of three distinct training phases on isometric mid-thigh pull (IMTP) measures in well-trained weightlifters.

METHODS: Pre- and post-block IMTP data from 11 collegiate weightlifters was used for analysis. The mean of the best two attempts from each athlete for measures of PF and RFD from 0-50ms, 0-100ms, 0-150ms, 0-200ms, and 0-250ms were used for comparison. In total, results from five timepoints for each of the 11 athletes were examined in order to compare the effects of the three training phases.

RESULTS: A repeated measures ANOVA revealed no statistically significant ($p \geq 0.05$) effects of training on any of the variables measured. When comparing post block values from each phase to pre-training cycle values, the largest increase in RFD200 (d = 0.22) and RFD250 (d=0.22) occurred post strength-power (SP) phase, while the peak in RFD50 (d = 0.32), RFD100 (d = 0.31), and RFD150 (d = 0.22) occurred after the peak/taper (PT) phase.

CONCLUSIONS: Based on the results of the study, it is possible that changes in IMTP RFD may reflect the expected adaptations of block periodization. Rather than examining RFD changes at only one time-band, it may be valuable to monitor RFD across multiple time bands as changes in early and late RFD may not occur proportionally during a peak/taper phase.

Introduction

- Competitive success in strength-power sports like weightlifting is highly reliant on an athlete's ability to generate high magnitudes of force during critical time-points.[1,2]
- Weightlifters benefit from only competing a few times per year allowing distinct training phases to be emphasized throughout the training process.
- Block periodization serves as a framework for sequentially eliciting these specific adaptations across training phases, culminating in a "peak," where the athlete has the greatest potential of demonstrating a successful performance on the day of competition.[3]
- The IMTP is a relatively quick, safe, and less fatiguing alternative for monitoring changes in strength and explosiveness throughout the training process compared to one repetition maximum tests.[4,5]
- Isometric RFD has been shown to be more responsive to changes in training compared to PF.[6]
- Previous research suggests that various training strategies potentially affect various RFD time bands differently.[8,9]
- Changes in early RFD time bands (<100ms) have been more closely associated with improvements in neural function[7] and shifts in fiber type[8] making them especially important to monitor during peaking phases.
- Therefore, the aim of this study was to examine the influence of three distinct training phases on multiple IMTP measures.

Methods

- Subjects consisted of eleven collegiate weightlifters, 6 males and 5 females (22±3 y; 75±16 kg; 165±8 cm).
- All subjects were familiar with the testing procedures and the data was collected as part of an ongoing athlete monitoring program.
- Pre- and post-block monitoring results from three distinct training phases were selected for comparison.
- The first training phase examined was a *strength-endurance* phase (SE) and consisted of high volumes of low to moderate relative intensities. The second training phase was a *strength-power* phase (SP) and consisted of moderate volumes at higher intensities. The final training phase was a *peak/taper* phase (PT) and consisted of one week of increased volume (planned overreach) followed by a three-week taper.
- Isometric mid-thigh pull testing (Figure 1) was conducted as described previously.[10] The mean of the best two attempts for measures of PF and RFD from 0-50ms (RFD50), 0-100ms (RFD100), 0-150ms (RFD150), 0-200ms (RFD200), and 0-250ms (RFD250) were taken from each testing.
- Isometric mid-thigh pull testing for the first and last time point (T1 and T5) took place 3-5 days after a major competition. The remaining testing timepoints (T2-T4) were conducted on the first day of each block >24 hours after the last training session and often after a planned reduced training week.
- A 5x5 (testing x RFD time band) repeated measures analysis of variance (ANOVA) was performed ($p \leq 0.05$).
- Effect estimates such as percent changes, effect sizes (Cohen's d), and visual representations are reported to relay trends and small changes that are important to advanced athletes.
- Effect sizes were interpreted using the following scale 0.0-0.2 (trivial); 0.2-0.6 (small); 0.6-1.2 (moderate); and 1.2-2.0 (large).[11]

Figure 1. Isometric mid-thigh pull (IMTP)

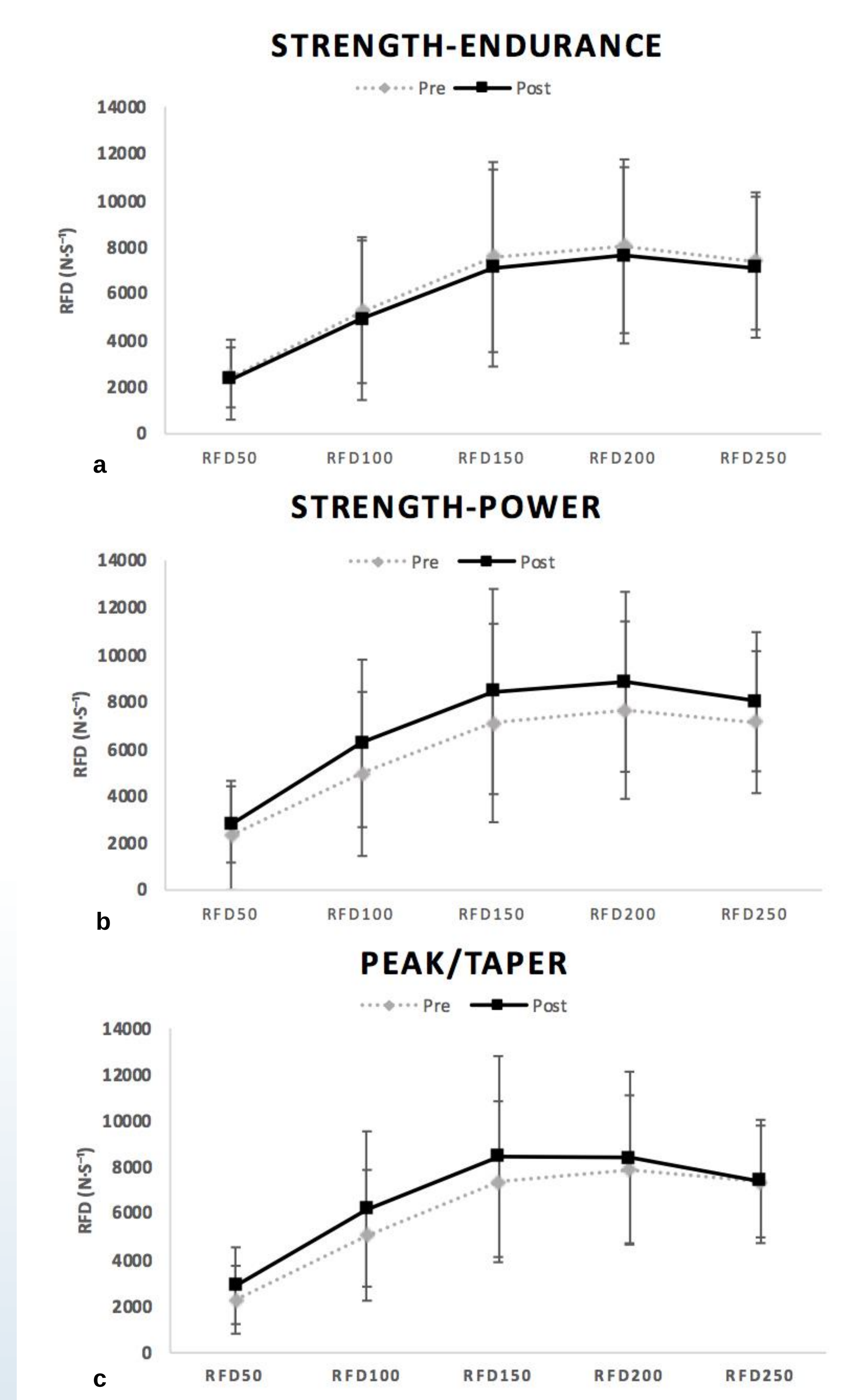

Figure 2. Phase specific changes in rate of force development
*All data are represented as mean ± SD

Results

- A repeated measures ANOVA revealed no statistically significant ($p \geq 0.05$) effects of testing on any of the variables measured.
- Although effect sizes were trivial (d = 0.06-0.11), all IMTP variables decreased from T1-T2. From T2-T3 there was a trivial increase in PF (d = 0.13) as well as small increases in all RFD time bands (d = 0.28-0.37). Between T3-T4 there was a trivial decrease in PF (0.05) and small decreases in RFD (d = 0.22-0.36). From T4-T5 there was small (d = 0.28-0.39) increases in the earlier (<150ms) RFD time bands, a trivial increase (d = 0.16) in RFD200, no effect (d = 0.00) on RFD250, and a trivial decrease (d = 0.11) in PF.
- When comparing the post block values from each phase to pre-training cycle values (Table 1.), the largest increase in RFD200 (d = 0.22) and RFD250 (0.22) occurred post SP phase, while the peak in RFD50 (d = 0.32), RFD100 (d = 0.31), and RFD150 (d = 0.22) occurred after the PT phase.

Table 1. Comparison of each timepoint to pre-training cycle values

	T1-T2	T1-T3	T1-T4	T1-T5
PF %**Δ**	-3±14	-5±7	-1±9	-1±14
PF d	0.11	0.03	0.02	0.12
RFD50 %**Δ**	-9±31	22±24	-1±66	25±55
RFD50 d	0.06	0.25	0.09	0.32
RFD100 %**Δ**	-11±29	24±10	20±115	38±96
RFD100 d	0.09	0.30	0.05	0.31
RFD150 %**Δ**	-8±34	15±2	15±87	29±91
RFD150 d	0.11	0.21	0.05	0.22
RFD200 %**Δ**	-3±34	10±8	9±56	19±70
RFD200 d	0.10	0.22	0.04	0.11
RFD250 %**Δ**	-1±31	6±8	8±41	12±57
RFD250 d	0.09	0.20	0.00	0.00

PF = peak force, RFD = rate of force development, %**Δ** = percentage change, d = effect size; T1 = pre, T2 = post strength-endurance, T3 = post strength-power, T4 = pre peak/taper, T5 = post peak/taper

Conclusions

- As previously reported[6] RFD displayed a much greater sensitivity to changes in training compared to PF.
- Monitoring changes in IMTP RFD may give insight into whether the desired kinetic adaptations to specific training phases are actually occurring in well-trained weightlifters.
- Although none of the group changes reached statistical significance, the overall trends in the SE (Figure 2a) and SP (Figure 2b) phases responded as would be expected, but the PT phase (Figure 2c) resulted in increases only in the early RFD time bands, leading to the possibility that a taper may have unique effects on earlier RFD time bands.
- Based on the results of the study, it may be important to measure RFD across multiple time bands, especially during a taper where changes in early and late RFD may not occur proportionally.

References

1. Kipp, K., Redden, J., Sabick, M. B., & Harris, C. (2012). Weightlifting performance is related to kinematic and kinetic patterns of the hip and knee joints. The Journal of Strength & Conditioning Research, 26(7), 1838-1844.
2. Stone, M. H., O'bryant, H. S., Williams, F. E., Johnson, R. L., & Pierce, K. C. (1998). Analysis of bar paths during the snatch in elite male weightlifters. Strength & Conditioning Journal, 20(4), 30-38.
3. DeWeese, B. H., Hornsby, G., Stone, M., & Stone, M. H. (2015). The training process: Planning for strength–power training in track and field. Part 2: Practical and applied aspects. Journal of Sport and Health Science, 4(4), 318-324.
4. Beckham, G., Mizuguchi, S., Carter, C., Sato, K., Ramsey, M., Lamont, H., . . . Stone, M. (2013). Relationships of isometric mid-thigh pull variables to weightlifting performance. Journal of Sports Medicine and Physical Fitness, 53(5), 573-581.
5. Stone, M. H., Sands, W. A., Pierce, K. C., Carlock, J., Cardinale, M., & Newton, R. U. (2005). Relationship of maximum strength to weightlifting performance. Medicine and Science in Sports and Exercise, 37(6), 1037-1043.
6. Hornsby, W. G., Gentles, J. A., MacDonald, C. J., Mizuguchi, S., Ramsey, M. W., & Stone, M. H. (2017). Maximum strength, rate of force development, jump height, and peak power alterations in weightlifters across five months of training. Sports, 5(4), 78.
7. Maffiuletti, N. A., Aagaard, P., Blazevich, A. J., Folland, J., Tillin, N., & Duchateau, J. (2016). Rate of force development: physiological and methodological considerations. European Journal of Applied Physiology, 116(6), 1091-1116.
8. Andersen, L. L., Andersen, J. L., Zebis, M. K., & Aagaard, P. (2010). Early and late rate of force development: differential adaptive responses to resistance training? Scandinavian Journal of Medicine & Science in Sports, 20(1).
9. Blazevich, A. J., Horne, S., Cannavan, D., Coleman, D. R., & Aagaard, P. (2008). Effect of contraction mode of slow-speed resistance training on the maximum rate of force development in the human quadriceps. Muscle & Nerve, 38(3), 1133-1046.
10. Kraska, J. M., Ramsey, M. W., G. Gregory, H., Nate, F., Sands, W. A., Stone, M. E., & Stone, M. H. (2009). Relationship between strength characteristics and unweighted and weighted vertical jump height. International Journal of Sports Physiology and Performance, 4(4), 461-473.
11. Hopkins, W., Marshall, S., Batterham, A., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. Medicine and Science in Sports and Exercise, 41(1), 3.

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