

# A POSITIONAL ASSESSMENT OF FORCE-TIME CHARACTERISTICS ACROSS A COLLEGIATE LACROSSE OFFSEASON TRAINING PROGRAM

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## ABSTRACT

**PURPOSE:** The purpose of this study was to analyze both the individual progression and positional differences in isometric mid-thigh pull force-time outcomes across a collegiate lacrosse offseason training cycle. **METHODS:** 33 collegiate male lacrosse participated in this study, with three positional alignments used: attack (n= 9), midfield (n= 15), defense/goalie (n=11). Participants were assessed during three testing sessions over the course of a 14-week offseason training program, consisting of countermovement rebound jumps and isometric mid-thigh pulls (IMTP), all using Hawkin Dynamics Force Plates (Merrigan et al., 2022). IMTP was performed on a ZEUS XZ4050 Prentiss Field Edition isometric rack set to a neutral grip (Glauser et al., 2023). Participants completed a 5-second isometric pull (Comfort et al., 2015) at a setting aligned to a 135-degree joint angle for knee flexion. Hawkin Dynamics cloud software was used to analyze peak force (PF) output, time to peak force (TTPF), and RFD across two different time points (0-50 ms/0-100 ms) (Bishop et al., 2023). The order of testing for IMTP assessment was randomized across all three testing sessions. Tested metrics were analyzed using Repeated Measures ANOVA for both whole team averages and positional-specific data, with effect size being calculated utilizing a partial eta squared ( $\eta^2p$ ). Statistical Analysis was performed utilizing JASP (JASP Team, 2023). **RESULTS:** Only attack peak force returned a statistically significant result ( $p=.018$ ). However, across the whole team and positional analysis, all metrics except attack TTPF and midfield RFD 0-100 returned medium-to-large effect sizes. **CONCLUSIONS:** While previously stated that only one variable significantly changed, the fact that nearly all variables exhibited a medium to large effect size indicates a robust impact of training over the offseason with this population. Future studies should include a prolonged usage within a concentrated block periodization style in order to maximize effectiveness of the intervention, as well as emphasizing IMTP into weekly programming rather than merely using it as an assessment tool.

## INTRODUCTION

Force-Velocity profiling is an integral component in tracking athlete development and in-season monitoring. Many methods have been used for this purpose, but recently, the usage of portable force plate technology has become more common in a variety of weightroom settings. Hawkin Dynamics (HD) is leading the way in technological advancements for strength and conditioning practitioners and presents a variety of practical assessments for force profiling. Isometric Mid-Thigh Pulls (IMTP) represent a safe and efficient method of max force output assessment, and this particular study focuses on the tracking of various force-time metrics across a men's collegiate lacrosse offseason training cycle.

## METHODS

33 collegiate male lacrosse athletes participated in this study, with three positional alignments used: attack (n= 9), midfield (n= 15), defense/goalie (n=9). Athletes were tested three times throughout an 11 week fall training cycle, consisting of countermovement rebound jumps and isometric mid-thigh pulls (IMTP). Testing dates corresponded to the beginning, middle, and end of the fall 2024 semester. All tests were conducted utilizing Hawkin Dynamics Force Plates (Merrigan et al., 2022). IMTP performance was performed on a ZEUS XZ4050 Prentiss Field Edition isometric rack set to a neutral grip (Glauser et al., 2023). Athletes completed a 5-second isometric pull (Comfort et al., 2015) at a setting aligned to a 135-degree hip-to-knee joint angle. Hawkin Dynamics cloud software was used to analyze peak force (PF) output, time to peak force (TTPF), and RFD across two different time points (0-50 ms/0-100 ms) (Bishop et al., 2023). The order of testing for both IMTP assessment was randomized by group across each assessment day. Tested metrics were analyzed using Repeated Measures ANOVA for both whole team averages and positional-specific data, with effect size being calculated utilizing a partial eta squared ( $\eta^2p$ ). Statistical Analysis was performed utilizing JASP (JASP Team, 2023)

## RESULTS

Only attack peak force returned a statistically significant result ( $p=.018$ ). All metrics except attack TTPF and midfield RFD 0-100 returned medium-to-large effect sizes across whole team and positional analyses.

## CONCLUSION

Tested variables exhibiting a medium to large effect size indicates a robust impact of training over the offseason with this population, despite only one significant variable. Future studies should aim to increase population size, as well as include a prolonged usage of IMTP and isometric training within a concentrated block periodization style in order to maximize effectiveness of the intervention throughout the offseason training cycle. Additionally, examining the usage of isometric training on force output during a competition season



Example of HD Force-Time Curve

## REFERENCES

- Bishop, C., Jordan, M., Torres-Ronda, L., Loturco, I., Harry, J., Virgile, A., Mundy, P., Turner, A., & Comfort, P. (2023). Selecting Metrics That Matter: Comparing the Use of the Countermovement Jump for Performance Profiling, Neuromuscular Fatigue Monitoring, and Injury Rehabilitation Testing. *Strength & Conditioning Journal*, 45(5), 545–553. <https://doi.org/10.1519/ssc.0000000000000772>
- Comfort, P., Jones, P. A., McMahon, J. J., & Newton, R. (2015). Effect of knee and trunk angle on kinetic variables during the isometric midthigh pull: Test–retest reliability. *International journal of sports physiology and performance*, 10(1), 58–63..
- Glauser, J. (2023). *Lacrosse Performance Enhancement: Force-Velocity Characteristics of Collegiate Men's Lacrosse Athletes* (Doctoral dissertation, Concordia University Chicago)
- Merrigan, J. J., Stone, J. D., Galster, S. M., & Hagen, J. A. (2022). Analyzing Force-Time Curves: Comparison of Commercially Available Automated Software and Custom MATLAB Analyses. *Journal of Strength & Conditioning Research*, 36(9), 2387–2402. <https://doi.org/10.1519/JSC.0000000000004275>.

## Slide 1

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**JG1** If the word count allows.  
Consider clarifying this sentence.

Ex. , both were assessed on  
Hawkin Dynamics...

Glauser, Jessi J (Allied Health,  
2025-06-25T14:00:57 568

**JG2** May not need this word. Can  
eliminate to be more concise.

Glauser, Jessi J (Allied Health,  
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**JG3** This is a partial sentence.

Glauser, Jessi J (Allied Health,  
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**JG4** Concise on a poster. We can  
reduce the casual tone this  
way. Makes is sound more  
scholarly.

Consider: FV profiling... athlete  
development and in-season  
monitoring.

Glauser, Jessi J (Allied Health,  
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