Near Point Convergence as a Clinical Predictor for Exercise Tolerance and Progression Through the 5 Step Active Rehab Protocol

Authors: **Tyler Marx BS[1,2], [2]Mo Mortazavi MD, [1,2]Daniel Hekmatian BS, [2]Jon Minor MD, [3]Hirsch Handmaker MD**

Institutions: [1]Department of Physiology, University of Arizona, AZ, USA, [2]SPARCC Sports Medicine, AZ, USA, [3]CACTIS Foundation, AZ, USA

Background and Purpose: Exercise tolerance protocols have been previously used in the rehabilitation of concussed patients. We believe that near point of convergence (NPC) can be utilized as a clinical predictor for exercise tolerance with a lower NPC correlating with a higher exercise tolerance.

Methods and Study Design: This was a retrospective cohort study of patients who had a clinical visit to a private practice for concussion symptoms between 11/17/17 and 5/6/19. All patients included in the study were between the ages of 12-42 and visited the clinic within 200 days of injury. These patients went through a 5 Step Active Rehab Protocol (ARP) exercise tolerance test during each clinical visit. Each step increased in intensity and duration with 1 being the lightest and 5 the most intense. NPC was measured with a digital ultrasonic device and clinician during each visit to observe their relationship with ARP.

Results: A total of 150 patients with 500 clinical visits were included in the study. The mean NPC for patients in an ARP Step 1-5 was 16.38 ± 1.32, 16.23 ± 1.39, 12.9 ± 1.29, 9.86 ± 0.93, and 8.48 ± 0.64 cm respectively. The mean NPC for patients in ARP Steps 1-4 is significantly higher than normal NPC, 8 cm, at the 5% level ($p = <.00001$, $<.00001$, $<.00001$, and .00007 respectively). The mean NPC for patients in ARP Step 5 was not significantly higher than normal NPC ($p = .0719$). The proportion of patients in ARP Step 5 with normal convergence was 64.28%. The proportion of patients with normal NPC in ARP Step 1, 9.21% ($p = <.00001$), ARP Step 2, 12.5% ($p = <.00001$), ARP Step 3, 29.07% ($p = <.00001$), and ARP Step 4, 48.45% ($p = .0076$) were all significantly lower than patients in ARP Step 5.

Conclusion: A negative correlation was observed between ARP Step and NPC. Patients with an NPC 8 cm or less will most likely exhibit high exercise tolerance with majority tolerating maximal high intensity interval exercise. The easily performed NPC oculomotor test can be used as a clinical predictor for exercise tolerance.