**Table 2.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modality** | **No of Studies** | **First author, journal, year** | **Design** | **N** | **Age (years)** | **Sex** | **Duration of recovery** | **Risk of Bias** | **Level of Evidence** | **Result/ comment** | **Confidence in Evidence** |
| **Functional MRI (fMRI)** | **18 Total** 18 Lvl 3 | Borich J Neurotrauma 2015 | Cross Sectional | 12 SRC vs 10 controls | 13-17 | Mixed M/F | Subacute (<2 mo) | NA | 3 | Significant changes remain | Low (no consensus on time for recovery) |
| Chen Neuroimage 2004 | Cross Sectional | 15 SRC vs 8 controls | 27.6 | Male | 1-14 mo | NA | 3 | Significantly less dorsolateral prefrontal cortex activation than controls |
| Chen J Neurol Neurosurg Psych 2007 | Cross Sectional | 9 low PCS, 9 moderate PCS and 10 controls | 26.9 (low)vs 30.8(mod) vs 21.9(high) | Male | Chronic Post Concussion Syndrome (PCS) | NA | 3 | Reduced task related activation patterns in the dorsolateral prefrontal cortex for low and moderate PCS |
| Chen Clin J Sport Med 2008 | Prospective Cohort | 9 SRC vs 6 cntrl | control 20+/-0.9, not improved 29.6+/-5.1, improved 33.8+/-5.6 | Male | Subacute to chronic PCS | 5 | 3 | Symptomatic athletes showed decreased activation of dorsolateral prefrontal cortex. Athletes with PCS resolution showed improved fMRI activation and those with ongoing symptoms did not |
| Czerniak Brain Imaging Behav 2015 | Case Control | 9 SRC vs 12 controls | 18-22 | Mixed M/F | PID 23-185 | 6 | 3 | Significantly increased brain connectivity |
| Dettwiler J Neurotrauma 2014 | Prospective Cohort | 15 SRC vs 15 controls | 19.8 | Mixed M/F | PID3, 2wk, 2mo | 7 | 3 | Significantly increased activation, especially in dorsolateral prefrontal cortex |
| Elbin Brain Injury 2012 | Cross Sectional | 14 SRC vs 14 controls | high school and college | Mixed M/F | 3-23mo | 6 | 3 | No difference in activation between groups |
| Hammeke J Int Neuropsych Soc 2013 | Prospective Cohort | 12 SRC vs 12 controls | 16.5 (SRC) v 16.5 (control) | Male | 7wk | 7 | 3 | Decreased activation seen acutely; gone at 7 weeks |
| Johnson Neuroimage 2012 | Prospective Case Control | 14 SRC (+9 SRC recruited later) vs 15 controls | 20.6 +/- 1.2 (SRC) vs 20.4 +/- 0.8 (control) | Mixed M/F | Time of return to play | 4 | 3 | Decreased connections in default mode network in parietal cortex; increased connections in medial prefrontal cortex |
| Johnson J Neurotrauma 2014 | Prospective Cohort | 12 SRC vs 12 controls | 20.5 (SRC) vs 19.8 (control) | Mixed M/F | Pre/post game | 4 | 3 | Increased connectivity from left supramarginal gyrus to bilateral orbitofrontal cortices and decreased connectivity from right retrosplenial cortex and right dorsal posterior cingulate |
| Keightley J Neurotrauma 2014 | Prospective Case Control | 15 SRC vs 15 controls | 14.47 +/-2.29 (SRC) vs 14 +/- 2.3 (control) | Mixed M/F | PID 9-90 | 6 | 3 | Multiple areas with decreased activation |
| Leddy J Head Trauma Rehab 2013 | Prospective Cohort | 4 PCS treadmill exercise vs 4 PCS placebo stretching vs 4 healthy controls | PCS exercise: 24 (range 18-33); PCS placebo: 21 (range 19-30); healthy control: 21(range 18-29) | Mixed M/F | PCS | 5 | 3 | Changes improve with exercise |
| Lovell Functional Neurosurg 2007 | Prospective Case Control | 28 SRC vs 13 controls | 16.56 (SRC) vs 18.25 (control) | Not described | <1wk | 7 | 3 | Hyperactivation within 1 week correlated with prolonged recovery |
| Meier Brain Imaging Behav 2016 | Prospective Case Control | 43 SRC vs 51 controls | 20.29 +/- 1.31 (SRC) vs 20.26 +/- 1.44 (Control) | Mixed M/F | 1mo | 8 | 3 | Regional Homogeneity [ReHo] changes appear at 1 month |
| Militana Brain Imaging Behav 2015 | Prospective Case Control | 7 SRC vs 11 controls | 19.7 +/- 1.2 (SRC) vs 20.0 +/- 1.6 yrs (control) | Mixed M/F | PID 6 | 8 | 3 | Cerebrovascular reactivity abnormalities |
| Mutch J Neurosurg 2015 | Cross Sectional | 15 PCS vs 17 controls | 18.3 (PCS) v 17.3(Control) | Mixed M/F | PCS/PID327 | NA | 3 | Blood oxygen level dependent (BOLD) changes in response to CO2 challenge, found only with voxel by voxel analysis |
| Talavage J Neurotrauma 2014 | Prospective Cohort | 21 at baseline, 11 with in season evaluations including 3 SRC | 17 (range 15-18) | Male | PID3 or in season no SRC | NA | 3 | Similar fMRI impairments in subjects with sports related concussion as those with lots of hits and no concussion symptoms |
| Zhu J Neurotrauma 2015 | Prospective Case Control | 8 SRC vs 11 controls | 20+/-1.3 SRC vs 20.5+/-1.8 (control) | Male | PID 1,7,30 | 5 | 3 | Connectivity decreases between PID 1 and 7, improves by 30 |
| **Diffusion tensor imaging (DTI) / Diffusion MRI** | **7 Total** 7 Lvl3 | Chamard Brain Inj 2013 | Cross Sectional | 10 SRC vs 10 controls | 21.7 | Female | Chronic <PIM7 | NA | 3 | Increased mean diffusivity (MD) in large white matter tracts; decreased fractional anisotropy (FA) (corpus collosum to motor cortex ) | Low (no consensus on time for recovery) |
| Henry J Neurotrauma 2011 | Prospective Case Control | 16 SRC vs 8 controls | 22.08 +/- 1.72 (SRC) vs 22.81 +/- 1.53 (control) | Male | PID<5;180; controls PIM18 | 3 | 3 | FA & AD increased at PID <5 and 180; MD decreased at PID<5 and 180. No post concussion symptom data reported. |
| Lancaster Human Brain Mapping 2016 | Prospective Case Control | 26 SRC vs 26 controls | 17.6±1.5 (SRC) vs 18±1.5 (control) | Male | PID1,8 | 7 | 3 | Symptoms & cognition worse at PID1, not 8; MD decreased at PID1,8; Axial diffusivity and radial diffusivity decreased more at PID8;Axial kurtosis increased at PID1,8 |
| Mayer J Neurotrauma 2015 | Prospective Cohort | 13 SRC vs 14 controls | 28.23(SRC) vs 28.14 (Controls) | Mixed M/F | 1yr | 8 | 3 | Significant decrease in white matter volume |
| Meier Human Brain Mapping 2016a | Prospective Case Control | 40 SRC vs 46 controls | 20.12(SRC) vs 20.31 (control); | Mixed M/F | PID1,8,32 | 8 | 3 | Increased FA at PID1,8,32; HAM-A & HAM-D worse at PID1,8 but not 32; Symptom frequency and cognitive composite worse at PID1, but not PID8,32 |
| Murugavel J Neurotrauma 2014 | Prospective Cohort | 21 SRC vs 16 control | 20.19 (SRC) vs 19.9 (control) | Male | PID 2, 14, 60 | 8 | 3 | Significantly increased RD and decreased FA at PID 2 compared to PID 14 and compared to control |
| Wright PLoS One 2016 | Prospective Cohort | 45 baseline, 11 SRC | 21.2+/-3.1 years | Mixed M/F | Baseline,PID3,14,60 | 9 | 3 | Myelin water fraction decreased at PID3, trend to decrease at PID14, back to baseline by PID60 |
| **Magnetic resonance spectro-scopy (MRS)** | **10 Total** 1 Lvl2 9 Lvl3 | Chamard Neurosurg Focus 2012 | Prospective Cohort | 45 total, 11 concussions | M (20-26), F (17.5-37.2) | Mixed M/F | 2d,2wk,2mo | 7 | 3 | No changes | Low (no consensus on time for recovery) |
| Chamard Brain Inj 2013 | Cross Sectional | 10 SRC vs 10 controls | 21.7 | Female | >7mo. | NA | 3 | Decreased myoinositol/creatinine ratio (hippocampus, motor cortex); |
| Chamard J Neurotrauma 2014 | Prospective Cohort | 11 SRC vs 10 controls | 21.4 (SRC) vs 21.1 (control) | Female | PID9, 6mo | 7 | 2 | Significantly decreased glutamate/creatinine ratio at >6mo, not at PID9 |
| Henry J Neurotrauma 2010 | Prospective Case Control | 12 SRC vs 12 controls | 23 +/- 0.71 (SRC) vs 22.1 +/- 0.77 (control) | Males | <7d | 3 | 3 | Decreased glutamate/creatinine ratio in motor cortex, decreased NAA/creatinine ratio in dorsolateral prefrontal cortex and motor cortex |
| Henry J BMC Neurol 2011 | Prospective Case Control | 10 SRC vs 10 controls | 22.5 | Not mentioned | Acute, chronic | 3 | 3 | Glutamate/creatinine ratio decreased in motor cortex acutely, but recovers at chronic time point. NAA/creatinine ratio decreased in both. Myoinositol/creatinine ratio increased only chronically |
| Johnson J Neurotrauma 2012 | Prospective Case Control | 28 SRC vs 20 controls | 20.3 +/- 1.53(SRC) vs 20.2 +/- 0.83 (control), | Mixed M/F | d7 or 8-14d or >14d | 5 | 3 | Decreased NAA/choline ratio and NAA/creatinine ratio in genu of corpus callosum, but no time effect |
| Sikoglu Cogn Behav Neurol 2015 | Retrospective Case Control | 14 SRC vs 13 controls | "Adults" | Mixed M/F | mean PID 76.5 | 5 | 3 | Increased energy demand in the prefrontal cortex of concussed brain as measured by gamma-NTP, a phosphorous metabolite |
| Vagnozzi Neurosurg 2008 | Prospective Case Control | 11 SRC vs 11 controls | 24.6+/-6.4 (SRC) vs 25.9+/-5.7 (control) | Mixed M/F | PID 1,15,22,30 | 6 | 3 | NAA/creatinine ratio decreased at PID1,15, recovered by PID30. With 2nd injury in PID1-15, not recovered until PID 45 |
| Vagnozzi Brain 2010 | Prospective Case Control | 13 SRC (3 sustained 2nd concussion) vs 5 controls | 27+/-4.8 | Mixed M/F | PID 3,15,22,30 | 5 | 3 | Decreased NAA/creatinine and NAA/choline ratios at PID3, partial recovery by PID15, recovery PID30 |
| Vagnozzi J Head Trauma Rehab 2013 | Prospective Case Control | 40 SRC (5 pro, 35 non-pro); | 27.6+/-3.58 (SRC) vs 26.5+/-5.53 (control) | Mixed M/F | PID 1,15,30,45 | 4 | 3 | Increased NAA/creatinine ratio at PID 3,15, normalized by PID 30. Decreased NAA/choline ratio at PID 3,15,30, normalized by PID 45 |
| **Cerebral Blood Flow (CBF)** | **8 Total**  1 Lvl2 7 Lvl3 | Barlow J Neurotrauma 2016 | Prospective Cohort | Sx=34 (27 completed study), ASx=26 (24 completed), control=24(21 completed) | 14.03 (Sx) v14.09 (ASx) vs 14.4 (controls | Mixed M/F | PID 40 | 9 | 2 | At PID 40, Symptomatic SRC subjects have increased global CBF vs controls; asymptomatic subjects have decreased CBF vs controls | Low (no consensus on time for recovery) |
| Clausen J Head Trauma Rehab 2016 | Prospective Cohort | 22 | 26+/-3 (SRC)vs 21+/-3 (controls) | Female | Mean 9wks; 6 subjects with 12 wk intervention | 3 | 3 | CBF by transcranial doppler increases during exercise and normalizes after a sub-threshold exercise program |
| DaCosta Front Neurol 2016 | Prospective Cohort | 25 SRC 18 controls | 42.7 (SRC) v38.7 (controls) | Male | mean PID 63, 180 | 6 | 3 | Correlation between decreased gray matter cerebral vasoreactivity indexes & decreased performance on SCAT2 in mTBI at >120d |
| Len Brain Inj 2013 | Case Series | 20 | 19.7±3.3 | Mixed M/F | PID 2,4,8 | NA | 3 | No significant difference in CBF at rest. Hypercapnia leads to impaired cerebral vasoreactivity in SRC athletes, resolved by PID4 |
| Maugans Pediatrics 2012 | Prospective Case Control | 12 SRC vs 12 Controls | 13.4 | Mixed M/F | PID <3,14,>30 | 8 | 3 | Decreased CBF at PID3. 27% resolved by PID14 and 64% resolved at PID>30 |
| Meier JAMA Neurol 2015 | Prospective Cohort | 17 SRC vs 27 Controls | 20.57 (SRC) vs 20.65 (Controls) | Male | PID 1,7,30 | 8 | 3 | Decreased CBF via Arterial Spin Labelling in right insular cortex, superior temporal sulcus at PID7, recovered at 1mo. |
| Mutch J Neurosurg 2015 | Cross Sectional | 15 PCS vs 17 controls | 18.3 PCS vs 17.3 (controls) | Mixed M/F | mean PID 327 (33-993) | NA | 3 | No difference in global CBF. |
| Wang J Neurotrauma 2016 | Prospective Case Control | 18 SRC vs 19 controls | 17.72+/-1.53(SRC) vs 18+/-1.76 (controls) | Male | Baseline, PID 1,8 | 9 | 3 | Decreased CBF on Arterial Spin Labelling in right supplementary motor area at PID1, more diffuse decreases in CBF at PID8. Neurocognitive recovery by PID8. |
| **Electro-physiology** | **15 Total**  3 Lvl2 12 Lvl3 | Baillargeon Brain Inj 2012 | Cross Sectional | 96 | 9–12, 13–16, and "adults" | Male | >6mo. | NA | 3 | Decreased P3b amplitude | Low (no consensus on time for recovery, and incomplete longitudinal follow-up) |
| Barr Brain Inj 2012 | Prospective Cohort | 59 SRC vs 31 controls | "high school" | Male | PID1,8,45 | 7 | 2 | MTBI-discriminant score index increased on PID 1, 8, not 45. Clinical recovery by PID8 |
| Broglio J Neurotrauma 2009 | Cross Sectional | 46 SRC vs 44 controls | 19.7 +/-1.3 | Mixed M/F | 3.4yr | NA | 3 | Decreased N2, P3b amplitude |
| Cao IEEE Trans Neural Syst Rehabil Eng 2008 | Prospective Cohort | 61 baseline, 30 SRC | 18-25 | Mixed M/F | PID 30 | 5 | 2 | Persistent changes at PID30 on novel algorithm |
| Cao IEEE Trans Neural Syst Rehabil Eng 2010 | Case Series | 160 Baseline, 29 SRC | 18-25 | Mixed M/F | PID 30 | NA | 3 | Persistent changes at PID30 on novel algorithm |
| Cao Clin Neurophysiol 2011 | Prospective Cohort | 260 baseline (30 SRC v 30 control) | 18-25 | Mixed M/F | PID7,30 | 6 | 2 | Persistent changes at PID30 of EEG nonstationerity |
| Dupuis Neuroreport 2000 | Retrospective Case Control | 10 symptomatic v 10 asymptomatic vs 10 controls | 21.5, 21.4, 21.6 | Male | Chronic | 6 | 3 | Decreased P3 amplitude in chronically symptomatic subjects vs asymptomatic subjects or controls |
| Gosselin Neurosurg 2006 | Prospective Case Control | 20 SRC vs 10 controls | ctrl = 22.0 +/-1.8; Case:ASx = 26.1 +/- 6.1; Case:Sx = 25.7 +/- 7.0 | Mixed M/F | 5.3+/-3.1wk | 4 | 3 | Decreased amplitude early and late ERP components |
| Gosselin Neurosurg Focus 2012 | Prospective Case Control | 46 SRC vs40 control | Exp = 30.3 +/- 11.1; ctrl = 28.6 +/- 10.5 (inclusion: 16-60) | Mixed M/F | 7.6+/-8.4mo | 4 | 3 | Decreased amplitude N1, P2, P3 chronically |
| Lavoie J Clin Exp Neuropsychol 2004 | Cross Sectional | 10 Sx vs 10 ASx vs 10 controls | 21.4y Sx vs 21.5y ASx vs 21.6y controls | Male | 0-6mo | 7 | 3 | Decreased amplitude of P3 in symptomatic vs asymptomatic subjects or controls. |
| McCrea J Head Trauma Rehab 2010 | Prospective Case Control | Baseline 396 (28 SRC vs 28 controls) | "high school and college age" | Male | PID8,45 | 8 | 3 | QEEG significantly different at PID8, recovered by PID45 |
| Prichep J Head Trauma Rehab 2013 | Prospective Cohort | 65SRC (Mild51, Moderate14) | 17.9 (15.1-23.2) | Male | PID1,8,45 | 6 | 3 | “TBI-Index” different between mild, moderate SRC |
| Slobounov Neurosci Lett 2005 | Case Series | 8 | 18-25 | Male | PID10,30 | NA | 3 | Movement related cortical potentials affected at PID30 in patients with recovered balance |
| Slobounov Clin Neurophysiol 2009 | Prospective Cohort | 265 baseline, 21 SRC | 18-25 | Mixed M/F | PID7 | NA | 3 | Decreased EEG-IQ beyond day of clinical recovery (PID7) |
| Slobounov Clin Neurophysiol 2012 | Prospective Cohort | 380 baseline, 49 SRC | 18-25 | Mixed M/F | PID7 | NA | 3 | Alpha power suppression from sitting to standing postures increased on average 33.3 ± 10% |
| **Heart rate (HR)** | **4 Total**  1 Lvl2 3 Lvl3 | Abaji J Neurotrauma 2015 | Cross Sectional | 12 SRC vs 12 controls | 21.4 +/- 1.1 (SRC) vs 22.1 +/- 1.6 (controls) | Male | PID 95+/- 63 | NA | 3 | No significant changes in mean heart rate, intervals, approximate entropy, absolute power low frequency bands. SRC had decreased power high frequency bands & increased low/high frequency band ratio during exercise. | Low (no consensus on time for recovery) |
| Gall Med Sci Sports Exer 2004 | Prospective Cohort | 14 SRC vs 14 controls | 18.1 (SRC) v 18.8 (controls) | Male | PID2 & when ASx (PID?) | 6 | 2 | Heartbeat variability decreases after concussion |
| LaFontaine Autonom Neurosci 2009 | Prospective Case Control | 3 SRC and 3 controls | 19±2 | Mixed M/F | (n=3/3) PID2,14 | 6 | 3 | Heart rate complexity decreases during isometric hand grip test at PID2 |
| LaFontaine Front Neurol 2016 | Prospective Case Control | 10 SRC vs 7 controls | 19.4±1.1 (SRC) 20±1.4 (controls) | Mixed M/F | PID2,7 | 7 | 3 | Stroke volume decreased at PID2,7. Prolonged recovery subjects had lower stroke volumes |
| **Exercise** | **2 Total**  2 Lvl3 | Kozlowski J Athl Training 2013 | Prospective Case Control | 34 PCS vs 22 control | 25.9 +/- 10.9 (SRC) vs 23.3 +/- 6.2 (controls) | Mixed M/F | Chronic PCS | 6 | 3 | Exercise duration, heart rate, and Systolic BP were lower, and diastolic BP higher than controls | No conclusion (only chronic PCS vs controls) |
| Leddy Clin J Sports Med 2011 | Case Series | 21 SRC vs 10 controls vs 10 actors | 29.8 +/- 14.8 (SRC); healthy: 26.5 +/- 8.2 (controls) | Mixed M/F | Chronic PCS | 6 | 3 | Balke treadmill test was reliable to identify chronic PCS patients with symptom exacerbation |
| **Bio-markers** | **10 Total**  10 Lvl3 | Dambinova Mili Medicine 2013 | Cross Sectional | 33 SRC (6 with 6mo f/u) v 91 controls (41 athletes, 51 non) | 21+/-3.3 (SRC)vs 21+/-3.0(controls) | Mixed M/F | Unk (3 in 6m) | 8 | 3 | AMPA receptor increases after concussion | Low (most change post SRC; some don’t;  some correlate with clinical – SNTF, Tau-A, GFAP; some conflicted s100b, Tau) |
| Gill J Head Trauma Rehab 2015 | Prospective Case Control | 31 (15 concussed athletes, 16 non-concussed athletes as ctrl) | 19.44+/-1.51 (SRC) vs 18.53 =/- 0.41 (controls) | Mixed M/F | BL, PIH6,168 | 6 | 3 | Genome changes at post injury hour(PIH) 6,168 |
| Kiechle PLoS One 2014 | Prospective Cohort | 46 total enrolled (30 munich, 16 rochester), 22 with concussion, 30 post-exertion | 25.4 +/- 5.5 | Mixed M/F | Pre-S, PIH3, PID2,3,7; also exertion no C# | 5 | 3 | s100b increased at PIH3, not PID2,3,7 or after exertion |
| Mannix J Neurotrauma 2014 | Case Series | 13 Concussed | 14.7±2.2 | Mixed M/F | PIH<24;24-72 | NA | 3 | GFAP PIH<24h correlated with Rivermead Post-Concussion Symptom Questionnaire |
| Marchi Plos One 2013 | Case Series | 67 Baseline; 15 in season 10 withDTI | 18-23 | Male | BL, PIH1,24, also preseason, postseason & 6mo+ | 8 | 3 | s100b increased at PIH1 and correlates with head head index questionnaire; s100b autoantibodies increase with head head index, correlate with DTI & maybe BESS |
| Neselius Brain Inj 2013 | Prospective Cohort | 30 SRC vs 25 controls | 22 (17-34) (SRC) vs 22 (17-30) (Controls) | Mixed M/F | Pre-bout no contact>14d, PID<6 | 5 | 3 | Tau increased at PID<6 & decreases over time; BDNF, Abeta-42 & s100b had no change |
| Oliver J Exp Neurosci 2015 | Prospective Cohort | 110 preseason, 6 SRC | College | Male | Preseason BL, PID1,2,3, 4,14 | 7 | 3 | Urine marinobufagenin changes after concussion (n=5/6) |
| Shahim JAMA Neurol 2014 | Prospective Cohort | 28 SRC vs 28 controls | "Adult" | Male | BL, PIH1,12,36,48, 144 | 7 | 3 | T-tau increases after concussion; T-tau increase at PIH144 correlates with PCS>6d, not PCS<6d; T-tau predicted symptom resolution; s100b & NSE did not |
| Shahim J Neurotrauma 2016 | Prospective Cohort | 28 SRC vs 47 controls | "Adult" | Male | BL, PIH1,12,36,48,144 | 7 | 3 | Tau-A no change after concussion; Tau-C increased after concussion; Tau-A correlates with PCS/return to play>10d |
| Siman J Neurotrauma 2015 | Prospective Cohort | Baseline 288; 24 SRC | 27.6 SRC vs 27.2 control | Male | Preseason, PIH1,12,36,144 | 8 | 3 | SNTF increased at PIH1,12,36,144; not return to play |
| **Transcranial Magnetic Stimulation (TMS)** | **4 Total**  1 Lvl2 3 Lvl3 | DeBeaumont J Athl Training 2011 | Cross Sectional | 21 SRC vs 15 controls | 22.3 ±3.45 | Male | Chronic (PIM>9) | NA | 3 | SRC worsens balance, and correlates with more motor cortex intracortical inhibition | Low |
| Livingston J Clin Neurophysiol 2012 | Prospective Case Control | 9 SRC vs 9 controls | 20.4±1.3 (SRC) vs 20.8±1.5 (controls) | Mixed M/F | PID1,3,5,10 | 7 | 3 | TMS motor evoked potentials post SRC show longer Median latencies at PID10 than PID1; shorter Ulnar latencies at PID3 thanPID5. No correlation with symptoms or cognition. |
| Pearce J Sci Med Sport 2015 | Retrospective Case Control | 8SRC vs 15 controls | 25+/-4.5 | Male | PID 2,4, 10 | 7 | 2.5 | Increased corticospinal inhibition with TMS at PID 2,4, but not 10 |
| Powers Brain Inj 2014 | Retrospective Case Control | 8 SRC vs 8C controls | 20+/-1.4 | Male | PID 6-34 (after recovery/return to play) | 6 | 3 | SRC lowers intracortical facilitation, lowers maximum voluntary muscle activation, and causes greater perception of force |
| **Accelero-metry** |  | Auerbach Clin J Sports Med 2015 | Prospective Cohort | 84 | 13-18 | Male | BL, PID<3 | 6 | 3 | Abnormal pattern on cranial accelerometry in 10/13 SRC vs 3/82 non SRC controls | No conclusion |
| **FNIRS** |  | Kontos Brain Imaging Behav 2014 | Prospective Case Control | 9 SRC vs 5 controls | 22.73 +/- 1.32 (SRC) vs 22.00 +/- 0.28 (controls) | Mixed M/F | Single session | 6 | 3 | Decreased brain activity seen by FNIRS, associated with lower neurocognitive scores | No conclusion |

* **Table 2: List of each article included in the final systematic review. Table includes study design, characteristics of study population, risk of bias, level of evidence, and study results. Risk of bias determined using Newcastle Ottawa Scale. Cross sectional studies and case series are un-ratable, and are labeled NA. Level of evidence determined by Strength of Recommendation Taxonomy (SORT). Frequently used abbreviations in this table include Sports related concussion (SRC), Post injury day (PID), and Post Concussion Syndrome (PCS).**