Chapter 16: Traumatic Brain Injury and Persistent Postconcussion Symptoms

Online Supplemental Material

Behavioral health interventions for persistent postconcussion symptoms (PPCS)

Patients are frequently referred to behavioral health providers such as neuropsychologists, rehabilitation psychologists, health psychologists and/or psychiatrists, particularly when they are experiencing cognitive, emotional, or behavioral changes that accompany PPCS. A referral to a behavioral or mental health provider for evaluation and treatment is strongly recommended if a patient with PPCS reports the following signs or symptoms that can adversely affect recovery and quality of life: cognitive symptoms, emotional/behavioral symptoms (e.g., psychiatric disorder, difficulty coping), excessive symptoms or worsening symptoms (without underlying medical cause), persisting/chronic pain (e.g., headache, neck or back pain, etc.), substance abuse/dependence, functional impairment (e.g., inability to return to work or school), litigation, disability, or workman's compensation claims. Once referred, behavioral health providers can implement various behavioral health interventions for PPCS, though they may be conceptualized in three distinct ways: **(**a) symptom management (e.g., symptom reduction), (b) cognitive restructuring, and/or (c) preventative treatment.

Symptom management

Treatment for PPCS, like many treatments in medicine, is often geared toward symptom management. Behavioral health specialists help patients develop behavioral programs to facilitate symptom management (e.g., reduction of pain, improving sleep hygiene, using moderation during daily activities that exacerbate symptoms). For example, patients with chronic daily headache or neck pain may benefit from learning progressive muscle relaxation or

biofeedback procedures from a qualified health psychologist. Cognitive rehabilitation may also prove useful in patients experiencing cognitive difficulties and symptoms (e.g., attentional and executive dysfunction) that are commonly reported among PPCS patients.

Cognitive restructuring

Cognitive-behavioral health treatments that focus on cognitive restructuring are like symptom management approaches in that they are delivered to patients that remain symptomatic beyond the window of normal recovery following mTBI. Patients with well-established PPCS frequently develop inaccurate or distorted perceptions of their injury, their recovery, their preserved abilities and their outcome (Ferguson & Mittenberg, 1996; Iverson et al., 2007; Plourde et al., 2020). Because persistent symptoms are nonspecific to PPCS, and because they are so prevalent in normal, healthy and/or non-brain-injured persons (Caccese et al., 2021; Iverson et al., 2015), we know that some patients with PPCS are misattributing symptoms to their injury that are better explained by another source. For example, attention and memory concerns post-injury may be more related to narcotic pain medication or a posttraumatic stress reaction associated with a motor vehicle collision than a mTBI.

Psychotherapies focusing on cognitive restructuring work toward dismantling the distorted self-perceptions that frequently accompany PCS and replacing them with *accurate appraisals* related to one's injury, recovery, preserved ability and outcome postinjury (Ferguson & Mittenberg, 1996; Miller & Mittenberg, 1998). Cognitive behavioral therapies can also assist in attenuating adverse reactions to physiological symptom-driven PPCS and disrupt the negative feedback loop by which physical symptoms cause emotional distress, which elevates one's physiological stress response and compounds symptoms. Ferguson and Mittenberg (1996) developed a six session structured cognitive behavioral therapy program that helps patients

understand how psychological factors can intensify and maintain PPCS, and facilitates development of cognitive behavioral techniques to manage stress and cope more effectively with persistent postconcussion-related symptoms.

Preventative treatment

While symptom management and cognitive restructuring approaches are very important for patient health and quality of life, treatment approaches focusing on prevention of PPCS are ideal. Early preventative interventions for PPCS essentially inoculate patients against a purely neurobiological perspective of concussion, which help them take personal control over aspects of their recovery that are modifiable, and view their injury, recovery and symptoms as objectively as possible (Ferguson & Mittenberg, 1996; Miller & Mittenberg, 1998; Mittenberg, et al., 2001). Active rehabilitation approaches also facilitate optimal recovery and reduce risk for PPCS, likely through physiological and psychological means (e.g., reducing anxiety related to fears of provoking and exacerbating symptoms, or inducing further brain injury; Leddy, et al., 2018). Because psychological and behavioral contributors of PPCS are often modifiable, it should not be surprising that mTBI patients who receive brief behavioral health or education treatments very early post-injury (within hours or days) report fewer and less severe PPCS months later relative to control patients with mTBI who do not receive brief behavioral or educational interventions (Borg et al., 2004; Comper, et al., 2005; Mittenberg, et al., 1996; Paniak, et al., 2000; Ponsford et al., 2001, 2002; Rytter et al., 2021) .

Additional References

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory–II*. Psychological Corporation.

Ben-Porath, Y. S., & Tellegen, A. (2008). *MMPI-2-RF (Minnesota Multiphasic Personality Inventory–2–Restructured Form): Manual for administration, scoring, and interpretation*. University of Minnesota Press.

Benedict, R. H. B. (1997). *Brief Visuospatial Test–Revised: Professional manual*. Psychological Assessment Resources, Inc.

Benedict, R. H. B., Schretlen, D., Groninger, L., & Brandt, J. (1998). Hopkins Verbal Learning Test–Revised: Normative data and analysis of inter-form and test–retest reliability. *The Clinical Neuropsychologist, 12*, 43-55.

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). *Behaviour Research and Therapy*, *34*(8), 669–673. https://doi.org/10.1016/0005-7967(96)00033-2

Borg, J., Holm, L., Peloso, P. M., Cassidy, J. D., Carroll, L. J., von Holst, H., Paniak, C., & Yates, D. (2004). Non-surgical intervention and cost for mild traumatic brain injury: Results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *Journal of Rehabilitation Medicine* (43 Suppl.), 76–83. https://doi.org/10.1080/16501960410023840

Caccese, J. B., Iverson, G. L., Hunzinger, K. J., Asken, B. M., Clugston, J. R., Cameron, K. L., Houston, M. N., Svoboda, S. J., Jackson, J. C., McGinty, G. T., Estevez, C. A., Susmarski, A. J., Enrique, A., Bryk, K. N., Broglio, S. P., McAllister, T. W., McCrea, M., Pasquina, P. F., Buckley, T. A., & Investigators, C. C. (2021). Factors associated with symptom reporting in U.S. Service Academy cadets and NCAA student athletes

without concussion: Findings from the CARE Consortium. *Sports Medicine, 51*, 1087–1105. https://doi.org/10.1007/s40279-020-01415-4

Cicerone, K. D., & Kalmar, K. (1995). Persistent postconcussion syndrome: The structure of subjective complaints after mild traumatic brain injury. *The Journal of Head Trauma and Rehabilitation*, *10*(3), 1–17.

Comper, P., Bisschop, S. M., Carnide, N., & Tricco, A. (2005). A systematic review of treatments for mild traumatic brain injury. *Brain Injury*, *19*(11), 863–880. https://doi.org/10.1080/02699050400025042

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *D-KEFS Executive Function System: Examiners manual*. Psychological Corporation.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (2000). *California Verbal Learning* Test (2nd ed.). Psychological Corporation.

Ferguson, R. J., & Mittenberg, W. (1996). Cognitive-behavioral treatment of postconcussion syndrome. In V. B. Van Hasselt & M. Hersen (Eds.), *Sourcebook of psychological treatment manuals for adult disorders* (pp. 615–655). Plenum Press.

Green, P., Allen, L. M., & Astner, K. (2005). *The Word Memory Test: A user's guide to the oral and computer-administered forms: Version 3.00*. CogniSyst, Inc.

Gronwall, D. M. (1977). Paced auditory serial–addition task: A measure of recovery from concussion. *Perceptual and Motor Skills*, *44*(2), 367–373. https://doi.org/10.2466/pms.1977.44.2.367

Heaton, R. K. (1981). *Wisconsin Card Sorting Test Manual*. Psychological Assessment Resources, Inc.

Iverson, G. L., Silverberg, N. D., Mannix, R., Maxwell, B. A., Atkins, J. E., Zafonte, R., & Berkner, P. D. (2015). Factors associated with concussion-like symptom reporting in high school athletes. *JAMA Pediatrics*, *169*(12), 1132–1140. https://doi.org/10.1001/jamapediatrics.2015.2374

King, N. S., Crawford, S., Wenden, F. J., Moss, N. E., & Wade, D. T. (1995). The Rivermead Post Concussion Symptoms Questionnaire: A measure of symptoms commonly experienced after head injury and its reliability. *Journal of Neurology*, *242*(9), 587–592. https://doi.org/10.1007/BF00868811

Lezak, M. D., Howieson, D., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological assessment* (5th ed.). Oxford University Press.

Miller, L. J., & Mittenberg, W. (1998). Brief cognitive behavioral interventions in mild traumatic brain injury. *Applied Neuropsychology*, *5*(4), 172–183. https://doi.org/10.1207/s15324826an0504_2

Mittenberg, W., Canyock, E. M., Condit, D., & Patton, C. (2001). Treatment of post-concussion syndrome following mild head injury. *Journal of Clinical and Experimental Neuropsychology*, *23*(6), 829–836. https://doi.org/10.1076/jcen.23.6.829.1022

Mittenberg, W., Tremont, G., Zielinski, R. E., Fichera, S., & Rayls, K. R. (1996). Cognitive-behavioral prevention of postconcussion syndrome. *Archives of Clinical Neuropsychology*, *11*(2), 139–145. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14588914

Paniak, C., Toller-Lobe, G., Reynolds, S., Melnyk, A., & Nagy, J. (2000). A randomized trial of two treatments for mild traumatic brain injury: 1 year follow-up. *Brain Injury*, *14*(3), 219–226. https://doi.org/10.1080/026990500120691

Plourde, V., Kung, J. Y., Gates, A., Jun, S., Brooks, B. L., & Sebastianski, M. (2020). How perceptions impact recovery from concussion in childhood and adolescence: A systematic review. *Neuropsychology Review*, *30*(1), 142–163. https://doi.org/10.1007/s11065-020-09430-y

Ponsford, J., Willmott, C., Rothwell, A., Cameron, P., Ayton, G., Nelms, R., Curran, C., & Ng, K. (2001). Impact of early intervention on outcome after mild traumatic brain injury in children. *Pediatrics*, *108*(6), 1297–1303. https://doi.org/10.1542/peds.108.6.1297

Ponsford, J., Willmott, C., Rothwell, A., Cameron, P., Kelly, A. M., Nelms, R., & Curran, C. (2002). Impact of early intervention on outcome following mild head injury in adults. *Journal of Neurology, Neurosurgery, and Psychiatry*, *73*(3), 330–332. https://doi.org/10.1136/jnnp.73.3.330

Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *Journal of Clinical and Experimental Neuropsychology*, *20*(3), 310–319. https://doi.org/10.1076/jcen.20.3.310.823

Reitan, R. M. (1992). *Trail Making Test: Manual for administration and scoring*. Reitan Neuropsychology Laboratory.

Rey, A. (1941). L'examen psychologique dans les cas d'encephalopathie traumatique [The psychological examination of cases of traumatic encephalopathy]. *Archives de Psychologie*, *28*, 21.

Smith, A. (1982). *Symbol Digit Modalities Test (SDMT): Manual* (Rev.). Western Psychological Services.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests: Administration, norms, and commentary*. Oxford University Press.

Tombaugh, T. N. (1996). *Test of Memory and Malingering: TOMM*. Multi-Health Systems Inc.

Wechsler, D. (1997). *Wechsler Memory Scale* (3rd. ed.). Pearson.

Wechsler, D. (2008). *Wechsler Adult Intelligence Scale* (4th ed.). Pearson.

Wechsler, D. (2009). *Wechsler Memory Scale* (4th ed.). Pearson.