It’s Been a TRACK-TBI LONG Time Coming, but Well Worth the Wait [re: WNL-2023-000331]

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More than a decade of effort is reflected in the TRACK-TBI LONG (Transforming Research and Clinical Knowledge in TBI Longitudinal study) results presented by Brett et al. in this issue of Neurology.¹ The study is an extension of the prior TRACK-TBI studies, which have already made outstanding contributions to the field of acquired brain injury research. Now even greater scope is achieved in TRACK TBI LONG: With its broader 7-year timeline, this study raises the important point that TBI recovery is a dynamic process that continues to evolve well beyond the initial 12 months post-injury.¹ The data amassed in TRACK-TBI LONG differs from other large TBI data sets in several important ways. It represents a large proportion of mild TBI (mTBI) cases, unlike the TBIMS-NDB² (Traumatic Brain Injury Model Systems National Database) that has focused on more severe TBI. It also captures more varied domains of function including patient-reported measures such as headache, fatigue, diplopia, sleep disturbances and mood dysregulation that often limit longer-term function, but are not well represented in prior studies that have relied on more global disability measures like the GOSE (Glasgow Outcomes Scale Extended). Lastly, there have been few prospective studies examining post-injury outcomes on this longer timescale, especially in mild TBI, making this an important and novel body of work.

The study enrolled 917 mild TBI (mTBI), 193 moderate/severe TBI (msTBI) and 154 orthopedic trauma controls (OTC, without evidence of head injury) from the initial sample of 2,996 TRACK-TBI participants. These 1,264 participants eligible for TRACK TBI LONG then had 7 yearly follow-ups to obtain scores on the GOSE (Glasgow Outcome Scale-Extended), BSI (Brief Symptom Inventory-18), and BTACT (Brief Test of Adult Cognition by Telephone), as well as a self-reported perception of function interview. Change scores on these measures were calculated relative to each participant’s last recorded score from TRACK TBI at each follow-up time point. Score patterns were then classified for the GOSE, BSI and BTACT, according to their direction of change, as stable, improved or declined. Outcomes were also assessed
based on the self-reported perception of function interview, where patterns of change were
dichotomized as “declined” (if a decline was reported at any follow-up point) or “not declined” (if no
decline was reported at any follow-up point). ¹

Key findings are summarized here and presented graphically in the figure. Among the GOSE, BSI and
BTACT the most commonly occurring score pattern was seen on the GOSE where stable scores occurred
in 48 - 58% of Mild, and 30 - 51% of Moderate/Severe cases. However, there was also a substantial
proportion of patients who showed a pattern of decline on the GOSE, suggesting they may have needed
more ongoing medical monitoring, rehabilitation, or supportive services to prevent decline. This decline
pattern was most prevalent in the mild TBI group (occurring in up to 30% of cases for a given time point).
In terms of recovery, the most notable pattern of improvement occurred on the GOSE. There were
substantial proportions of patients in both severity groups who showed this pattern of improvement,
demonstrating ongoing recovery that further rehabilitative or medical services could potentially
enhance. This improvement pattern was more prevalent in the Moderate/Severe TBI group (occurring in
up to 44% of cases for a given time point), challenging the commonly held clinical belief that recovery in
these cases is limited and plateaus at 6-12 months. In addition to the longitudinal findings summarized
descriptively here, there are also several statistically significant contrasts of interest for the mTBI group
including the association of decline in functional independence measures with age (p<.001) and pre-
injury employment status (p<.001) (see Table 5 and discussion in the manuscript).

In terms of the study’s limitations, one major consideration is for bias due to missing data, a common
problem in longitudinal studies that can skew results and reduce precision. ³ The authors have taken care
to reduce the influence of bias from confounding factors by using inverse probability weighting, and are
well-versed in these methods. ⁴ However, since disparities in the availability of outcomes data for specific
groups may reflect important factors of relevance to healthcare access and equity, a complementary
approach would be to assess the patterns of missingness themselves to gain greater insight on the factors driving them, rather than using statistical means only to correct for or replace missing data.⁵

Despite these limitations, the study effectively demonstrates that changes in function across multiple domains continue to occur well-beyond the conventionally tracked 6-12 month period of injury recovery. Departing from prior conceptions of TBI as a discrete medical event where sequelae initially improve and thereafter remain static, this concept of TBI recovery as a longer-term, more dynamic process can inform how we counsel patients and families on prognosis, arrange for neurorehabilitation services, and monitor for ongoing symptoms. Physician advocacy efforts with insurers to cover ongoing post-injury services will also be bolstered by these study findings. Effective TBI research requires cooperation among multiple specialties including neurology, neurosurgery, neurocritical care, PM&R, rehabilitation therapies, and psychology to facilitate long-term follow-up and implement detailed outcome measures. TRACK-TBI and TRACK-TBI LONG have set an excellent precedent in this regard and have also led the field in defining more detailed recovery phenotypes and gathering novel covariates and predictors. Now taking the TRACK-TBI LONG approach as an exemplar, if research teams in other acquired brain injury areas such as stroke can likewise go LONG, they will surely go far.


Figure: Outcomes of Patients in Mild and Moderate/Severe TBI Groups
During the 7-year followup, a substantial proportion of patients in both the Mild and Moderate/Severe TBI groups showed:

- A decline pattern on the GOSE and Interview measures, suggesting they may have needed more ongoing medical monitoring and, rehabilitation or supportive services to prevent worsening.
- An improvement pattern on the GOSE, suggesting opportunities for recovery that further rehabilitative or medical services might have enhanced.