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Face-to-Face Versus Telephonic Extended Glasgow Outcome Score Testing After Traumatic Brain Injury

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Objective: The Extended Glasgow Outcome Scale (GOS-E) is used for objective assessment of functional outcome in traumatic brain injury (TBI). In situations where face-to-face contact is not feasible, telephonic assessment of the GOS-E might be desirable. The aim of this study is to assess the level of agreement between face-to-face and telephonic assessment of the GOS-E. **Setting:** Multicenter study in 2 Dutch University Medical Centers. Inclusion was performed in the outpatient clinic (face-to-face assessment, by experienced neurologist), followed by assessment via telephone of the GOS-E after ± 2 weeks (by trained researcher). **Participants:** Patients ± 6 months after TBI. **Design:** Prospective validation study. **Main Measures:** Interrater agreement of the GOS-E was assessed with Cohen's weighted κ . **Results:** From May 2014 until March 2018, 50 patients were enrolled; 54% were male (mean age 49.1 years). Median time between trauma and in-person GOS-E examination was 158 days and median time between face-to-face and telephonic GOS-E was 15 days. The quadratic weighted κ was 0.79. Sensitivity analysis revealed a quadratic weighted κ of 0.77, 0.78, and 0.70 for moderate-severe, complicated mild, and uncomplicated mild TBI, respectively. **Conclusion:** No disagreements of more than 1 point on the GOS-E were observed, with the κ value representing good or substantial agreement. Assessment of the GOS-E via telephone is a valid alternative to the face-to-face interview when in-person contact is not feasible. **Key words:** brain injuries, Extended Glasgow Outcome Scale, traumatic, validation

TRAUMATIC BRAIN INJURY (TBI) imposes a large burden on affected individuals and society.¹ The outcome of patients with TBI covers a spectrum of varying impairments in the physical, behavioral, and cognitive domains, ranging from death to full recovery. An objective assessment of the functional outcome is pivotal to document the long-term sequelae of the injury including persisting disabilities, and may have important implications for further treatment, as well as for insurance or compensation claims. Functional recovery is also a relevant outcome parameter in interventional and observational studies addressing TBI.²

To objectively assess the functional outcome after TBI, the Glasgow Outcome Scale (GOS)^{3,4} and, in particular, the Extended Glasgow Outcome Scale (GOS-E)⁵

are commonly used. This 8-point scale ranges between death (score 1) and "upper good recovery" (score 8), indicating that daily life is not affected by complaints related to the brain injury.

The GOS-E is assessed with a structured interview, usually held face-to-face with the patient, or a proxy such as a close family member if the patient is unable to sufficiently understand or communicate, by a well-trained physician, psychologist, or nurse. However, a face-to-face contact is not always feasible, for example, when patients live far away from their healthcare facilities. Furthermore, it is not practical for large-scale studies in which many patients need to be repetitively followed up across a wide geographic area, or at multiple time points. This may be one of the reasons why TBI studies often focus on in-hospital outcomes and mortality, rather than on functional long-term recovery.^{6,7}

In this context, telephonic interviews could be a useful alternative when face-to-face interviews are not feasible, and several clinical studies have adopted that approach.⁸⁻¹¹ However, to the best of our knowledge, the feasibility of a telephonic interview technique has only been addressed in 1 study: Pettigrew et al¹² report a good agreement between GOS-E scores obtained by telephonic interviews versus face-to-face interviews,

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The authors declare no conflicts of interest.

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with a weighted κ of 0.84.¹² However, in that study, the majority of patients had severe or moderate TBI.¹² Given that the vast majority of patients actually have mild TBI, we sought to independently determine the interobserver agreement between the face-to-face and telephonic assessment of the GOS-E in a more representative sample of patients with TBI of varying severity with predominance of mild TBI.

METHODS

The Institutional Review Board of the Amsterdam University Medical Center, location VUmc, determined that the study is not subject to the Dutch Medical Research Involving Human Subjects Act (WMO), such that formal approval was not required. Nevertheless, written informed consent was obtained from all patients or their proxy in accordance with Dutch privacy legislation (WBP).

Patients 18 years or older who had previously been admitted for inpatient treatment after TBI were prospectively recruited in the University Medical Center Groningen (UMCG) at the neurology outpatient clinic during a routine follow-up examination. Patients with TBI are seen at regular intervals after admission at 3, 6 (for mild TBI), and 12 months (for moderate-severe TBI) after injury. Patients seen by one of the participating study neurologists were consecutively invited to participate, and those who consented (or their proxy) were included. The face-to-face GOS-E examination at the outpatient clinic was performed by 2 trained neurologists (J.v.d.N. and B.J.) with patients or their proxy. Approximately 2 weeks later (exact time depending on the availability and accessibility of the patient), patients or proxies were interviewed via telephone. Telephonic GOS-E examination was performed by 2 researchers of the Amsterdam University Medical Center, who had been previously trained on correct GOS-E examination. These researchers were blinded to the GOS-E score of the face-to-face assessment. We chose an interval of approximately 2 weeks between the face-to-face and telephonic interview to ensure comparability between the measurements (we assumed that the actual neurologic status did not substantially change in the meantime, especially not after 6-12 months after TBI)¹³ while avoiding that patients may exactly recall what they reported in the initial assessment and would simply repeat their own words (which may cause bias toward better agreement if patients are interviewed twice within a very short time frame).

Data were analyzed with STATA 14.1 (StataCorp, College Station, Texas). Normally distributed data are presented as mean (SD); not normally distributed data and ordinal data are presented as median (first and third

TABLE 1 *Patient characteristics*

Category	n (%)
Gender	
Female	23 (46)
Male	27 (54)
Age	
10-19 y	1 (2)
20-29 y	10 (20)
30-39 y	4 (8)
40-49 y	5 (10)
50-59 y	14 (28)
60-69 y	10 (20)
70-79 y	4 (8)
80-89 y	2 (4)
Total	50 (100)
First GCS ^a	
3	1 (2)
7	3 (6)
8	2 (4)
9	1 (2)
10	1 (2)
11	1 (2)
12	2 (4)
13	7 (14)
14	20 (40)
15	8 (16)
E1M1VT	4 (8)
Trauma pattern	
Fall	22 (44)
Traffic	21 (42)
other	7 (14)
Head AIS	
1	4 (8)
2	15 (30)
3	18 (36)
4	10 (20)
5	3 (6)
Injury Severity Score	
<15	31 (62)
≥15	19 (38)
Time from injury to the initial GOS-E assessment	
0-2 mo	11 (22)
3-5 mo	19 (38)
6-8 mo	12 (24)
≥9 mo	8 (16)
Time between face-to-face and telephonic GOS-E	
<14 d	18 (36)
14-21 d	27 (54)
>21 d	5 (10)

Abbreviations: AIS, Abbreviated Injury Score; GCS, Glasgow Coma Scale; GOS-E, Extended Glasgow Outcome Scale.

^aOf the 35 patients with mild traumatic brain injury (GCS 13-15), 22 had complicated mild traumatic brain injuries (pathologic findings on head CT scan) and 5 of those neurologically deteriorated to a GCS <13 during hospital admission.

quartiles). Interrater agreement beyond chance between corresponding in-person and telephonic assessments of the GOS-E was assessed with Cohen's weighted κ .¹⁴ Because disagreements involving adjacent categories on

the ordinal GOS-E (ie, a 1-point difference between the 2 raters) are considered far less problematic than disagreements involving more distant categories, we used a quadratic weighting scheme to increasingly penalize more distant disagreements. Moreover, a similar previous study used the same weighing approach,¹² which facilitates the comparison of results across studies. As a sensitivity analysis, we also separately analyzed the agreement in the subgroups of patients with moderate and severe TBI (Glasgow Coma Scale [GCS] <13), complicated mild TBI (GCS $\geq$ 13 and pathologic findings on head CT scan), and uncomplicated mild TBI (GCS $\geq$ 13 without pathologic findings on head CT scan), respectively.

RESULTS

From May 2014 until March 2018, 50 patients were enrolled. No patients were lost to follow-up, and both the face-to-face and the telephonic interviews were performed in all included patients; 54% were male, with a mean age of 49.1 (SD 18.4) years. 96% ($n = 48$) of the GOS-E questionnaires were obtained from the patient, 4% from their respective proxy. The median first documented GCS in the emergency department was 14 (13, 14). Four patients were intubated at the time of first known GCS determination (classified as “not assessable”), 6 patients sustained severe TBI (defined by a GCS <9), 5 patients had moderate TBI (GCS 9-12), and 35 had mild TBI (GCS 13-15). The median Injury Severity Score was 12.5 (9, 17), with a median head Abbreviated Injury Score of 3 (2, 4). Most patients either sustained a fall or were injured in traffic. See Table 1 for patient characteristics.

The median time between admittance for TBI and face-to-face GOS-E examination was 158 days (99, 235)

and median time between face-to-face and telephonic GOS-E was 15 days (13, 19).

Table 2 shows the results of the GOS-E examinations. Notably, no disagreements of more than 1 point on the GOS-E were observed between corresponding face-to-face and telephonic assessments. Exact matches were observed in 23 paired measurements, the telephonic examination slightly overestimated the GOS-E compared with the face-to-face examination in 19 cases, and slightly underestimated in 8 cases. The quadratic weighted κ was 0.79 (95% confidence interval [CI]: 0.72-0.87). The sensitivity analysis revealed a quadratic weighted κ of 0.77 (95% CI: 0.62-0.93), 0.78 (95% CI: 0.64-0.92), and 0.70 (95% CI: 0.47-0.93) for moderate-severe, complicated mild, and uncomplicated mild TBI, respectively.

DISCUSSION

In this study, we compared face-to-face and telephonic examination of the GOS-E at about 6 months after injury. No disagreements of more than 1 point on the GOS-E were observed, and the κ value of 0.79 is commonly considered good or substantial agreement,^{15,16} close to the threshold of 0.80 above which the agreement is considered very good or almost perfect. A sensitivity analysis showed similar levels of agreement for patients with moderate and severe TBI and patients with mild TBI. While the κ point estimates differed between the subgroups, they all consistently represent good agreement.^{15,16}

Notably, the observed (dis-)agreement reflects 2 sources of variability: (1) face-to-face versus telephonic interview; and (2) different raters who performed the first versus second interview. The agreement between face-to-face and telephonic interviews would therefore likely be even higher after removal of the interrater component

TABLE 2 GOS-E results face-to-face versus telephone^a

	GOS-E telephone					Total
	4 (Upper severe disability)	5 (Lower moderate disability)	6 (Upper moderate disability)	7 (Lower good recovery)	8 (Upper good recovery)	
GOS-E face-to-face						
4 (Upper severe disability)	1	1	0	0	0	2
5 (Lower moderate disability)	2	4	6	0	0	12
6 (Upper moderate disability)	0	3	5	6	0	14
7 (Lower good recovery)	0	0	1	8	6	15
8 (Upper good recovery)	0	0	0	2	5	7
Total	3	8	12	16	11	50

Abbreviation: GOS-E, Extended Glasgow Outcome Scale.

^aNumbers on the diagonal (no shading) indicate exact agreements. A disagreement of ± 1 point on the scale is considered acceptable (light gray shading), whereas off-diagonal values involving more distant categories are considered increasingly problematic (increasingly darker shading). Linear and quadratic weighted κ values are 0.58 (moderate agreement) and 0.79 (good agreement), respectively.

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(ie, if the same raters would perform both interviews). However, it is practically impossible to blind a rater on his/her first rating. This could bias the results toward high agreement and we therefore chose the conservative approach to use different raters. As we particularly see a role for telephonic interviews in the context of clinical research, we used trained clinical researchers rather than neurologists to perform the telephonic interviews. In this context, Wilson et al³ previously demonstrated a very high interrater agreement for face-to-face assessment of the GOS-E between psychologists and research nurses (quadratic weighted $\kappa = 0.92$), suggesting that it is less important who interviews the patient as long as the interviewer is appropriately trained.

While several studies have previously investigated the test-retest reliability¹⁷ or the interrater agreement³ of the GOS-E, the agreement between face-to-face and telephonic interviews was only studied previously once, by Pettigrew et al.¹² In this previous study, the majority of patients had severe or moderate TBI, while in clinical practice, most patients actually have mild TBI. To complement the previous data, we therefore focused on those patients with mild TBI while still covering the entire spectrum of TBI severity. Moreover, given the well-known fact that published research findings are often not reproducible,^{18,19} the need for confirmatory research is widely acknowledged.²⁰ For these reasons, we sought to independently reproduce the results by Pettigrew et al in a different patient population with focus on mild TBI.

Pettigrew's study actually consisted of 2 parts. In the first part, test-retest reliability of face-to-face versus telephonic interviews was tested, with the same psychologist performing both interviews within a few days. This may bias the results toward high agreement as described above, and the weighted κ was 0.92. The second part of Pettigrew's study more closely resembles our study, because face-to-face and telephonic interviews were performed by 2 different raters with a mean time interval of approximately 2 weeks (16 days) between the 2 measurements. For this part of the study, 56 head-injured participants (46 male, mean $\pm$ SD age: 39 $\pm$ 16 years)

were recruited after a mean of 192 days after injury. Pettigrew's sample primarily consisted of patients with moderate to severe TBI ($n = 31$), while our study focused more on mild TBI. Due to this different focus, our study has a relatively higher percentage of moderate and good recovery results. Regardless of these differences, the quadratic weighted κ of 0.79 was comparable to the 0.84 reported in Pettigrew's study.

Hence, the results from our study confirm previous research, extend the previous findings to a patient population of predominantly mild TBI, and strengthen the evidence that a telephonic interview provides a reliable means of scoring the GOS-E. This may be particularly useful in situations where a face-to-face contact is not feasible (eg, when patients are unable or unwilling to show up at a treatment facility). Telephonic assessment of the GOS-E may also facilitate research and improve follow-up in studies addressing outcomes after TBI.

The results of our study should be interpreted carefully in the context of its limitations. First, the sample size of 50 patients is limited, and while the confidence interval around the κ estimate is quite narrow, more patients would even have provided a more precise estimate. Second, we included only those patients who showed up for a routine postinjury examination at the outpatient clinic, and our sample may therefore not be representative of the general population of patients with TBI. Nonetheless, those patients who were included—primarily with mild-moderate TBI—should allow a valid assessment of the agreement between a face-to-face and telephonic interview in this patient category. Third, the agreement could actually differ between patients with severe versus mild or moderate TBI. Our sensitivity analysis was consistent between the subgroups, but a larger sample size in each subgroup would be necessary to draw stronger inferences on this sensitivity analysis.

CONCLUSION

Assessment of the GOS-E via telephone seems a valid alternative to the face-to-face interview when in-person contact is not feasible.

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