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Mediated cognitive rehabilitation after surgically treated intracerebral haemorrhage: a Feuerstein Instrumental Enrichment approach to executive recovery and return to work. Case report and review of the literature

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ABSTRACT

Background: Intracerebral haemorrhage (ICH) accounts for more than a quarter of incident strokes worldwide and carries the highest burden of death and disability among stroke subtypes. In survivors, executive dysfunction rather than motor deficit is a principal barrier to return to work, yet it is rarely the focus of post-neurosurgical care. The Feuerstein Instrumental Enrichment (FIE) programme, based on the theory of Structural Cognitive Modifiability and Mediated Learning Experience, explicitly targets transfer of strategies to daily life but has seldom been reported in stroke.

Case presentation: A 57-year-old man with hypertension, type 2 diabetes mellitus and dyslipidaemia, previously employed in a technical-administrative role, presented with a right temporo-parietal intraparenchymal hematoma with mass effect and was treated neurosurgically. Postoperative neuropsychological assessment showed a predominant dysexecutive profile: impulsivity, execution without planning, anticipation errors and difficulty maintaining spatial constants, with preserved locomotor autonomy. He completed a 12-week mediated programme (2-3 sessions/week) using four sequential FIE instruments: Organisation of Dots, Comparisons, Orientation in Space and Analytic Perception.

Results: At 12 weeks, the patient showed reduced impulsivity, longer response latency, systematic anticipatory planning, greater decisional autonomy and resumed part-time organisational and administrative work.

Conclusion: Motor recovery does not guarantee occupational reintegration after ICH. Structured, mediated cognitive rehabilitation is a feasible, low-cost adjunct to neurosurgical care; controlled studies with standardised outcomes are warranted.

INTRODUCTION

Stroke remains the second leading cause of death and the third leading cause of combined death and disability worldwide. In 2021 there were 11.9 million incident strokes, 7.3 million stroke deaths and 160.5 million

Keywords

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disability-adjusted life-years lost, and 84% of this burden was attributable to modifiable risk factors, led by high systolic blood pressure [1,2]. One in four adults over the age of 25 will have a stroke during their lifetime [3]. Intracerebral hemorrhage (ICH) represents 28.8% of incident strokes globally, a proportion considerably higher in Eastern Europe and Asia than in Western registries, and has the poorest functional prognosis of all subtypes [1,4].

The injury of ICH is not limited to the primary bleed. The expanding hematoma produces mass effect and raised intracranial pressure, followed by perihematoma edema driven by thrombin, iron and hemoglobin degradation products, inflammation and blood–brain barrier breakdown, with secondary ischemia in compressed tissue [5]. These cascades disconnect cortical and subcortical networks, including fronto-parietal circuits that sustain executive control. Surgical strategy continues to evolve: the ENRICH trial showed that early minimally invasive evacuation of lobar hematomas improved 180-day functional outcome [6], and current guidelines recommend multidisciplinary rehabilitation after the acute phase [4].

Cognitive sequelae are frequent and under-recognized. Up to 74% of patients show impairment in at least one cognitive domain in the acute phase, and executive dysfunction alone affects about 39% [7]. After spontaneous ICH, new-onset dementia develops in roughly 14% of previously non-demented patients within the first year [8,9]. Crucially for working-age survivors, cognitive — and especially executive — status predicts return to work better than motor status [10–12]. Reported return-to-work rates among young stroke survivors range from 42% to 86% [11]. Many patients walk independently and manage basic activities of daily living, yet fail when required to plan multi-step tasks, handle simultaneous demands, decide quickly or sustain attention: a motor–executive dissociation that explains a substantial part of occupational failure.

We report a patient with a surgically treated right temporo-parietal ICH whose dominant post-operative deficit was executive, and who was rehabilitated with a mediated programme based on Feuerstein Instrumental Enrichment (FIE). The report follows the CARE guidelines [13].

THEORETICAL FRAMEWORK: THE FEUERSTEIN METHOD

FIE derives from the theory of Structural Cognitive Modifiability (SCM), which holds that the cognitive structure of an individual can be reorganized through systematic mediated intervention, irrespective of age, aetiology or severity of impairment [14]. Change is attributed not to repetition but to the Mediated Learning Experience: a mediator deliberately selects, orders and frames stimuli, guides analysis and strategy formulation and makes the learner aware of his own thinking. Three mediation criteria are considered essential — intentionality and reciprocity, mediation of meaning, and transcendence, the explicit bridging of a strategy to situations beyond the exercise. FIE instruments are content-free paper-and-pencil tasks, which limits the influence of pre-morbid knowledge and makes deficient cognitive functions (impulsive exploration, lack of planning, episodic grasp of reality) directly observable.

Evidence for FIE outside developmental populations is still emerging. In older adults with mild cognitive impairment, 30 FIE sessions were associated with increased grey-matter volume and improved verbal and non-verbal memory [15]; a community pilot [16] and a preliminary randomized controlled trial targeting self-awareness [17] have followed in the same population, which shares age and vascular risk profile with stroke survivors. Meta-analytic data, drawn mainly from educational settings, show small and heterogeneous effects [18], supporting individualized rather than uniform application.

CASE PRESENTATION

History and imaging

A 57-year-old right-handed man was admitted through the emergency department of the Sibiu County Clinical Emergency Hospital with an acute stroke syndrome. His history included arterial hypertension, type 2 diabetes mellitus and dyslipidaemia. He was employed in a technical-administrative position. Non-contrast cranial CT showed a right temporo-parietal intraparenchymal hematoma with perilesional edema and mass effect (Figure 1). The hematoma was treated neurosurgically, and after an uneventful postoperative course the patient was referred for psychological and cognitive evaluation.

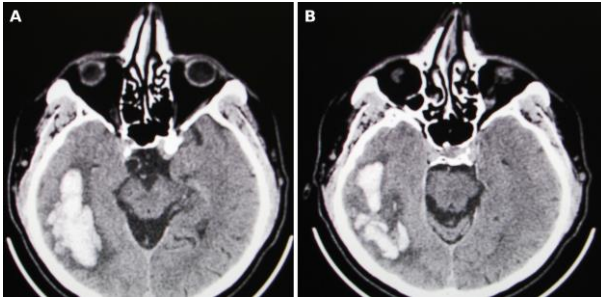


Figure 1. Pre-operative axial non-contrast CT (A, B): right temporo-parietal intraparenchymal hematoma with perilesional hypodense edema and local mass effect (radiological convention: patient's right on image left).

Neuropsychological assessment

A structured pre-intervention assessment of attention, memory and executive functions combined standardized testing with systematic observation of task behaviour. Motor function and basic activities of daily living were largely preserved. The profile was dominated by executive dysfunction: increased impulsivity, execution without prior planning, frequent errors due to lack of anticipation, cognitive rigidity when a strategy failed and difficulty maintaining spatial constants — the last consistent with disruption of right-hemisphere fronto-parietal attention networks [19]. The deficit was judged to have a major impact on occupational organization.

Intervention

A 12-week programme of 2–3 individual sessions per week was delivered by a trained mediator. Stated task-level objectives (correct and faster resolution of exercises) were deliberately subordinated to process-level objectives: longer response latency before acting, anticipatory planning, reduced impulsivity, systematic analysis and transfer to real-life and work activities. Four FIE instruments were applied sequentially (Table 1). Each session ended with a "bridging" discussion in which the patient generated examples of the same strategy in his professional tasks.

Table 1. Sequence of Feuerstein Instrumental Enrichment instruments (12 weeks, 2–3 sessions/week).

Phase / instrument	Targeted processes and mediation focus
1. Organization of Dots	Systematic exploration of an unstructured visual field; inhibition of impulsive responding; use of the model figure as a constant reference; verbalizing the plan before execution.
2. Comparisons	Comparison of figures by direction, number and structure; identification of the essential element; inhibitory control of errors; self-monitoring.

Phase / instrument	Targeted processes and mediation focus
3. Orientation in Space	Distinguishing constant from variable parameters; formulating hypotheses; flexible strategy change when blocked (reduction of cognitive rigidity).
4. Analytic Perception	Organized decomposition of wholes into parts; symbolic labelling; systematic work habits; verbalizing the problem-solving process.

Outcome

Progress was documented qualitatively across instruments. During the Comparisons phase a clear shift from impulsive to planned, deliberate problem-solving was observed; Orientation in Space reduced perseverative, rigid responding; by Analytic Perception the patient spontaneously verbalized his plan and checked his work against the model. At 12 weeks he showed reduced impulsivity, increased anticipatory planning and greater autonomy in decision-making. He resumed his professional activity part-time, with adapted organizational and administrative tasks. Written informed consent for publication was obtained from the patient.

DISCUSSION

This case illustrates three points relevant to neurosurgical practice. First, it is consistent with the return-to-work literature showing that executive rather than motor status determines occupational reintegration after stroke [10–12]. Our patient was ambulatory and independent in basic self-care, yet unable to organize work until his executive strategies were rebuilt. Routine postoperative screening of executive function in working-age ICH survivors is therefore justified, particularly after lobar or right-hemisphere hematomas.

Second, the mediated approach addresses the main weakness of current cognitive rehabilitation: limited generalization. Systematic reviews of randomized trials after stroke show moderate, often domain-specific gains for restorative and computer-based training, good functional effects of compensatory strategies and errorless learning, but weak transfer to untrained activities [20–22] (Table 2). A Cochrane review found insufficient evidence that any intervention improves executive function after stroke [21], while the highest-level recommendation for dysexecutive syndromes is metacognitive strategy training [20]. Goal Management Training, the best-studied metacognitive programme, yields small-to-moderate, durable effects on executive measures [23]. FIE shares the metacognitive core of these

methods (stop–plan–check cycles, self-verbalization) but adds a structured sequence of content-free instruments and an explicit requirement for transcendence, which may explain the transfer observed in our patient.

Table 2. Main cognitive rehabilitation approaches after stroke (GMT, Goal Management Training; FIE, Feuerstein Instrumental Enrichment; RCT, randomized controlled trial).

Approach	Mechanism	Evidence signal after stroke
Restorative / process training	Repeated drill of an impaired process (e.g., attention)	Moderate, largely domain-specific gains [20,22]
Compensatory strategies	External aids and task adaptation	Effective for functional independence [20]
Computer-based training	Standardized adaptive digital exercises	Mixed; limited transfer [22]
Errorless learning	Error-minimized skill acquisition	Effective, especially with memory impairment [20,22]
Metacognitive strategy training (e.g., GMT)	Stop–plan–check cycles, self-monitoring	Practice standard for executive deficits; small-to-moderate durable effects [20,23]
Mediated learning (FIE)	Mediator-guided restructuring of strategies with explicit transfer	Strong theoretical transfer rationale; stroke RCTs lacking [15–18]

Third, the result is biologically plausible. Experience-dependent plasticity requires specificity, repetition, intensity and salience of training [24], all features of a 12-week mediated programme, and structural MRI changes after FIE in older adults with vascular risk [15] suggest a possible substrate. These changes were not measured here, and our observations are directionally consistent with, not a replication of, those findings.

Limitations

This is a single case without a control condition; spontaneous recovery within the first months after ICH cannot be separated from the effect of the intervention. Outcomes were largely qualitative, and follow-up beyond 12 weeks is lacking. Future work should use standardized pre- and post-intervention executive measures, validated occupational outcomes and controlled designs, ideally within the organized, interdisciplinary stroke rehabilitation recommended by international guidelines [4,25].

CONCLUSIONS

Executive dysfunction is a principal obstacle to professional reintegration after ICH, and motor recovery does not guarantee return to work. In this surgically treated patient, a structured 12-week Feuerstein-based mediated programme was feasible and was followed by reduced impulsivity, better planning and part-time return to work. Integrating

neuropsychological evaluation and mediated cognitive rehabilitation into the neurosurgical pathway may help convert survival and motor recovery into functional and occupational recovery.

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