

## **P300 – A cognitive evaluation tool in acute ischemic stroke – A Narrative review**

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### **ABSTRACT**

**Objective:** Cognition is the scientific term for mental processes. These processes include attention, memory, problem solving, making decisions, producing and understanding language. This cognitive function is altered by various conditions like brain damage, ageing etc. Stroke is one of the main cause of cognitive impairment with an incidence ranging between 12 and 56% of affected population. P 300 is a long latency endogenous evoked potential. And it is referred to as cognitive evoked potential or event related potentials. P 300 is a wave form appears about 300ms following task – related endogenous stimuli which require attention and patients co-operation. The P 300 reflects processes related to attention, decision – making and memory updating.

**Materials & Methods:** Research design: Narrative Review.

Study instrument & validation procedure: EEG apparatus, event related potential P 300 wave form.

**Results:** In general, exercise improves the cognitive function. Various types of subjective measures available to assess the cognitive function but there is no direct reliable measure to assess cognitive function in patients. There is a need to find the scientific way of measuring cognitive function. In this review, a neurophysiological measure P 300 is explained to measure the cognitive function improvement after physical therapy management in stroke.

**Conclusion:** P 300 will be a novel way of measuring cognitive function improvement after physical therapy management in stroke.

**Key words:** Cognitive Evoked Potential, Ischemic Stroke, P 300, Physical Therapy

## BACKGROUND

Cognition is the scientific term for mental processes. These processes include attention, memory, problem solving, making decisions, producing and understanding language. This cognitive function is altered by various conditions like brain damage, ageing etc. Stroke is one of the main cause of cognitive impairment with an incidence ranging between 12 and 56% of affected population<sup>1</sup>. Cognitive impairment leads to attention deficits, difficulty in processing environmental stimuli properly and memory deficits which in turn affects functional mobility and rehabilitation outcomes in stroke patients<sup>2</sup>.

Various types of subjective measures available to assess the cognitive function but there is no direct reliable measure to assess cognitive function in patients. There is a need to find the scientific way of measuring cognitive function. In this review, neurophysiological measure P 300 is explained to measure the cognitive function improvement after physical therapy management in stroke.

## RATIONALE

There is no reliable outcome measure to assess cognitive function improvement in physical therapy practice. Very less study has been conducted to find this outcome measure with less explanation.

## OBJECTIVES

To describe the neurophysiological method of assessing cognitive function

## Conceptual/Operational definitions

- Cognition – it is the scientific term for mental processes. These processes include attention, memory, problem solving, making decisions, producing and understanding language.
- P300 – A neurophysiological evoked potential wave form to measure cognitive function.
- Stroke – vascular disorder of the central nervous system.

## MATERIALS & METHODS

Researches about the effect of physiotherapy in improving cognitive function following stroke with the P300 as an outcome measure was analyzed.

The analysis were done for a duration of 6 months, the studies sources include Medline, PubMed, Cochrane reviews and other information sources articles published in conference proceedings, specialized studies, and manual search of articles published in

journals that are not indexed in the major scientific databases which showed the effect of physical therapy in cognitive function were taken into consideration. Studies done on Ischemic stroke cases were taken to validate the study.

**ETHICAL ISSUES:** NA

**METHODOLOGY:** Narrative review about the definition, parameters, method of eliciting and recording of P300, impact of stroke on P 300 and the improvement of cognitive function after physical therapy intervention.

**Feasibility of the proposed research-** Since narrative review is the method of describing the characteristics; it can be done with the analysis of previous researches using review of literatures.

**Expected Outcome:** A novel approach in measuring cognitive function improvement after physical therapy management in stroke.

## INTRODUCTION

Cognition is the scientific term for mental processes. These processes include attention, memory, problem solving, making decisions, producing and understanding language. This cognitive function is altered by various conditions like brain damage, ageing etc. Stroke is one of the main cause of cognitive impairment with an incidence ranging between 12 and 56% of affected population<sup>1</sup>. Cognitive impairment leads to attention deficits, difficulty in processing environmental stimuli properly and memory deficits which in turn affects functional mobility and rehabilitation outcomes in stroke patients<sup>2</sup>.

Various types of subjective measures available to assess the cognitive function but there is no direct reliable measure to assess cognitive function in patients. There is a need to find the scientific way of measuring cognitive function. In this review, neurophysiological measure P 300 is explained to measure the cognitive function improvement after physical therapy management in stroke.

## WHAT IS P 300?

P 300 is a long latency endogenous evoked potential. And it is referred to as cognitive evoked potential or event related potentials. P 300 is a wave form appears about 300ms following task – related endogenous stimuli which require attention and patients co-operation. This wave form generally shows longer latency, higher amplitude and lower frequency.

The P 300 was first reported by Sutton and colleagues (1965). The P 300 reflects processes related to attention, decision – making and memory updating<sup>3</sup>.

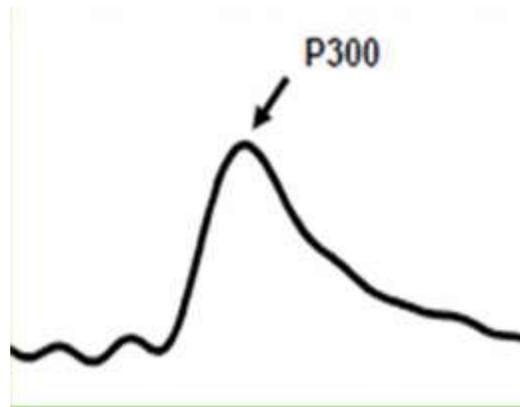


Figure 1. Parameters of P300

Latency – refers to the speed of information processing and short – term working memory. It relates to the function of stimulus evaluation time of the brain, which relates to the recognition and categorization of a stimulus<sup>4</sup>.

Amplitude – it is related to the subjective probability of the stimulus, stimulus meaning and information processing described by Johnson in 1986.

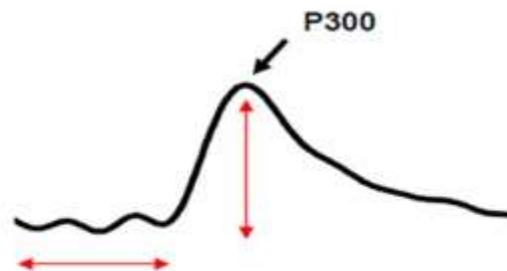
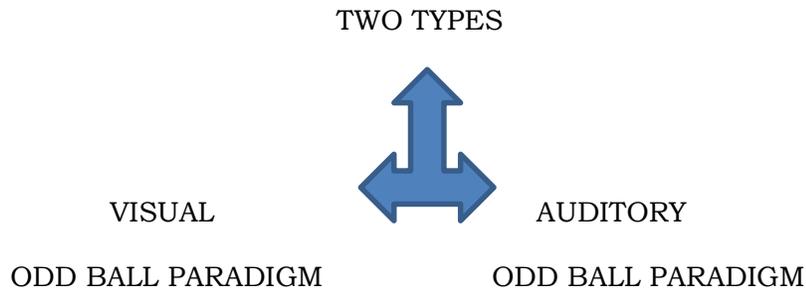


Figure 2. Eliciting P300

The P 300 can be elicited by any stimulus but the most common being an unexpected or infrequent stimulus<sup>5</sup>.

The P300 is not elicited passively but requires the active participation of the subject attending to specific stimuli in an ongoing train of standard stimuli<sup>4</sup>.

ODD BALL PARADIGM: - This involves the presentation of unexpected, infrequent stimuli randomly interspersed among frequent stimulus.



### **METHOD OF RECORDING P 300**

Surface recording electrode over the scalp placed over the Fz, Cz, and Pz according to the 10-20 system of electrode placement and are referred to link mastoid and ground electrode placed over FPz<sup>6</sup>.

Auditory odd ball paradigm can be delivered by two types of stimuli: target (infrequent) and non-target (frequent) are used; the target stimulus which appears randomly<sup>7</sup>. The patient is asked to count mentally or raise the fingers or press button in response to stimulus.

### **P 300 IN STROKE**

Stroke is one of the main causes of vascular cognitive impairments. The cognitive ability of the person is declined following stroke this leads to alterations in the P300 wave forms. P300 event related potential using visual stimuli in 16 patients with cerebro-vascular accident. The results show that the amplitude was reduced compared to the normal subjects. The latency was not altered<sup>8</sup>. Picton et al conducted a study to find the values of P300 in the diagnosis of cognitive impairment in stroke<sup>4</sup>. They recorded reaction time and P300 in 43 healthy normal and 24 stroke patients. The patients with cognitive impairment showed a significant change in their latency, significant correlation between the P300 and the reaction time was found. They concluded the P300 latency can be used to differentiate demented from non-demented stroke patients<sup>9</sup>. Recording P300 using auditory odd ball paradigm in 38 brain infarcted patients and 29 healthy control subjects, the study revealed that brain infarction slightly prolonged the p300 latency. A study to find the characteristics of cognitive function in patients after traumatic brain injury using visual and auditory event related potentials. They concluded visual ERP's are a potential useful marker for evaluating cognitive dysfunction in patients after TBI<sup>10</sup>.

### **PHYSICAL THERAPY AND COGNITIVE FUNCTION IN STROKE:**

In general, exercise improves the cognitive function. Christine Cullen found that aerobic fitness and athletic participation will improve executive functioning. Keito Kamijo et al,

findings suggest light and moderate aerobic exercise improves the cognitive function in older adults. Hillman et al studied the impact of acute aerobic exercise on mental functioning, following a 30 minute period of jogging the P300 was measured, it revealed the amplitude of P300 was significantly higher after acute exercise<sup>11</sup>.

Many studies explain the effect of physical therapy in improving cognitive function after stroke. A study conducted by Jurate et al, concluded that rehabilitation improves the cognitive function and psychomotor reactions<sup>12</sup>. Yu Qian et al recently conducted a study to assess the effect of motor relearning program on recovery of event –related potential in 99 cerebral infarction patients, in that 52 patients received motor relearning program and 47 patients received no treatment, after 12 weeks of training they assessed using P300, the results of this study shows motor relearning program can effectively retrieve the ERP P300 and motor ability of cerebral infarction patients<sup>13</sup>.

## CONCLUSION

This narrative review on P300 has stated that there is decline in cognitive function following stroke. Physical therapy intervention has an impact of improving cognitive function in stroke patients. The P 300 is a neurophysiological objective assessment method of cognitive function. Therefore, cognitive functional changes following physical therapy management in stroke patients can be assessed by using an objective outcome measure P300.

## LIMITATIONS

The study method involved is subjective, so the opinions and views of the articles selected and authors perspectives on the study leads to a conclusion which may be subjected to further researches. Also, Problem in determining and integrating complex interactions (that may exist) when large set of studies are involved.

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