Assessing Treatment Efficacy: Brief vs. Ultra brief Pulse Widths in Bitemporal Modified Electroconvulsive Therapy

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Date of Submission:26th February 2025 Date of Acceptance: 7th October 2025 Date of Publication: 15th December 2025

Abstract

Introduction: Modified electroconvulsive therapy (MECT) is widely utilized for severe psychiatric disorders, with ongoing exploration of stimulus parameters to maximize efficacy. The pulse width in electroconvulsive therapy (ECT), specifically brief pulse (1.5 ms) versus ultra brief pulse (0.5 ms), may significantly influence clinical outcomes. However, comparative data on efficacy in rural Indian settings are limited.

Objective: To compare the clinical efficacy of brief and ultra brief pulse widths in bitemporal modified ECT in patients with severe psychiatric disorders.

Materials and Methods: This prospective, randomized comparative study was conducted at a rural tertiary care hospital in Northern India. Sixty-six patients aged between 18 and 60 years, diagnosed with schizophrenia, schizoaffective disorder, bipolar disorder, or severe depression, were randomly allocated to receive either brief or ultra brief pulse bitemporal MECT. Clinical efficacy was measured using standardized symptom rating scales including PANSS, BDI, YMRS, and CGI-S, administered pre- and post-treatment.

Results: Both brief and ultra brief pulse width groups demonstrated comparable clinical efficacy across schizophrenia, schizoaffective disorder, bipolar disorder, and severe depression, with no statistically significant differences observed in symptom reduction between the two groups ($p > 0.05$).

Conclusion: Brief and ultra brief pulse widths in bitemporal modified ECT exhibited similar clinical efficacy in the treatment of major psychiatric disorders. Given their equivalence in therapeutic outcomes, both pulse widths may be considered viable options for clinicians. Further studies with larger samples and diverse populations are recommended to reinforce these findings.

Keywords: Electroconvulsive Therapy, Brief Pulse Width, Ultra brief Pulse Width, Clinical Efficacy, Psychiatric Disorders, Modified ECT.

INTRODUCTION

Electroconvulsive Therapy (ECT) has long been established as a highly effective treatment modality for severe psychiatric disorders, particularly in cases unresponsive to pharmacological interventions[1]. First introduced in the 1930s, ECT involves the administration of controlled electrical stimuli to induce therapeutic seizures[2]. Over the decades, ECT techniques have significantly evolved, incorporating general anesthesia and muscle relaxants, collectively known as Modified Electroconvulsive Therapy (MECT), enhancing patient safety and comfort[3].

Clinical efficacy in ECT depends on various technical parameters, including electrode placement, dosage, and notably, pulse width. Pulse width refers to the duration of each electrical stimulus delivered during ECT. Typically, pulse widths are categorized as brief pulse (ranging from 0.5 to 2.0 milliseconds) and ultra brief pulse (less than 0.5 milliseconds)[4]. There is ongoing debate regarding the comparative effectiveness of these pulse widths in achieving optimal clinical outcomes across different psychiatric diagnoses[5].

Despite considerable advancements in ECT procedures, definitive guidelines for selecting pulse width parameters remain unclear[6]. Clinicians frequently face uncertainty due to inconsistent evidence regarding the therapeutic efficacy of brief versus ultra brief pulse widths[7]. Furthermore, existing literature predominantly represents urban or well-equipped healthcare

Access this article online

Website: https://www.nepjol.info/index.php/NJN

DOI: https://doi.org/10.3126/njn.v22i24.77305

HOW TO CITE
Yadav, V., Abhishek Pathak, Rahul Singh, Manish Singh, & Yogi Rana. Assessing Treatment Efficacy: Brief vs. Ultra brief Pulse Widths in Bitemporal Modified Electroconvulsive Therapy. NJNS. 2025;22(4):11-15

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ISSN: 1813-1948 (Print), 1813-1956 (Online)

settings, which may not adequately reflect the practical challenges and clinical realities of rural tertiary care centers[8–9].

This study aims to address this knowledge gap by conducting a comparative analysis of the clinical efficacy of brief pulse (1.5 ms) and ultra brief pulse (0.5 ms) bitemporal modified ECT. Conducted at a rural tertiary care hospital in Northern India, this research involves patients diagnosed with schizophrenia, schizoaffective disorder, bipolar disorder, and severe depression. Through systematic evaluation using standardized symptom rating scales, this study seeks to provide clinically meaningful insights to guide optimal pulse width selection, particularly in rural healthcare settings.

METHODS AND MATERIALS

Study area- This study was conducted at Tertiary Care Centre, Sitapur

Study design- This study was a prospective comparative study

Study period- 18 months (12 months period for data collection and 6 months period for data analysis)

Sampling method- Randomization was performed using a chit-based method conducted by a staff nurse to ensure unbiased allocation to either the Ultra brief Pulse ECT group (0.5 ms) or the Brief Pulse ECT group (1.5 ms).

Sample size-

Sixty six, both sexes, aged 18 to 60 years.

Sample size was calculated by using "Sample size formula for comparing two means" derived from Cohen's sample size formula.

$$n = \frac{(Z\alpha + Z1\text{-}\beta)^2\ \sigma^2}{d^2}$$

where, d = difference of mean between two parameters

at 80% power of test

$Z1\text{-}\beta = 0.84$

α at 5% level of significance

$Z\alpha = 1.96$

$\sigma = 3.5$

Ethical Approval: Ethical clearance for the study was obtained from the Institutional Ethics Committee (Approval No.: IHEC-HIMSA/MD/MS-22/RD-16/07-23). Informed consent was obtained from all participants and their legal guardians before enrolment.

Inclusion criteria:

1. All the patients who had psychiatric diagnosis of schizophrenia/schizoaffective disorder/BPAD (Mania/ Depression)/ Severe depression as per the International Classification of Diseases-10 (ICD-10)
2. Patients who were prescribed MECT.
3. Males and Females within the age group of 18–60 years.
4. Patients and or relatives who had given consent for the study.

Exclusion criteria:

1. Patients with mental retardation, substance use disorder (except nicotine), major neurological disorder and history of MECT in the past six months were excluded.
2. All the patients who had psychiatric diagnosis of Catatonia.
3. Patients who required urgent attention for serious medical problems.
4. Patients without reliable information.

Instruments:

Clinical efficacy was assessed using standardized rating scales: the Positive and Negative Syndrome Scale (PANSS), Young Mania Rating Scale (YMRS), Beck Depression Inventory (BDI), and Clinical Global Impressions-Severity Index (CGI-SI).

Data collection: A total of 66 participants diagnosed with schizophrenia, schizoaffective disorder, bipolar disorder (mania or depression), or severe depression were recruited from a rural tertiary care hospital. Ethical guidelines were strictly adhered to, ensuring informed consent and confidentiality. Patients with mental retardation, substance use disorder (excluding nicotine), major neurological disorders, or a history of ECT within the past six months were excluded. Eligible participants were randomly allocated to either the Ultra brief Pulse ECT group (0.5 ms) or the Brief Pulse ECT group (1.5 ms) using a chit-based randomization method administered by a staff nurse. Standardized clinical rating scales were completed prior to the first ECT session and following the final session, and all data were systematically recorded.

Data analysis: Data analysis was performed using SPSS version 26. Descriptive statistics were used to summarize demographic and clinical variables. Independent t-tests and chi-square tests assessed between-group differences at pre- and post-treatment time points, while paired t-tests evaluated within-group changes over time. A significance level of $p < 0.05$ was considered statistically significant. Effect sizes, calculated using Cohen's d, were reported to complement p-values and provide insight into the practical relevance of the results.

RESULTS

Table 1: Distribution of Patients by Age

Age Group (years)	Ultra Brief Pulse ECT	Brief Pulse ECT
18-35	12	10
35-45	10	12
45-60	11	11

Table 2: Distribution of Patients by Gender

Gender	Ultra Brief Pulse ECT	Brief Pulse ECT
Male	15	16
Female	18	17
45-60	11	11

Table 3: Distribution of Patients by Psychiatric Disorder

Psychiatric Diagnosis	Ultra Brief Pulse	Brief Pulse
Schizophrenia	6	6
Schizoaffective Disorder	5	5
Severe depression	7	8
Bipolar Disorder (Mania)	9	8
Bipolar Disorder (Depression)	6	6

Table 4: Clinical Characteristics

Variable	Ultra brief	Brief
Duration of Current Episode (weeks)	23.9 ± 6.4	19.1 ± 5.8
Seizure Threshold (mC)	68.2 ± 7.9	107 ± 8.9
First ECT Dose (mc)	187 ± 10.3	179 ± 7.6
Last ECT Dose (mC)	268 ± 19.1	210 ± 9.1
EEG Seizure Length (1st Treatment)	35.9 ± 5.1	35.9 ± 4.3
EEG Seizure Length (Final Treatment)	23.9 ± 4.9	27.1 ± 5.6

Table 4 compares clinical characteristics of patients treated with Ultra brief and Brief Pulse ECT, focusing on episode duration, seizure threshold, dosing, and EEG seizure length. The Ultra brief group had a longer mean episode duration (23.9 ± 6.4 weeks) than the Brief group (19.1 ± 5.8 weeks). Seizure threshold was notably lower in the Ultra brief group (68.2 ± 7.9 mC vs. 107 ± 8.9 mC), aligning with existing evidence of lower thresholds for shorter pulses. Initial ECT doses were slightly higher in the Ultra brief group, but final doses increased more substantially (268 ± 19.1 mC vs. 210 ± 9.1 mC), indicating dose escalation over sessions. EEG seizure durations were similar at the first treatment, while final seizures were shorter in the Ultra brief group (23.9 ± 4.9 seconds vs. 27.1 ± 5.6 seconds). These findings confirm baseline comparability and expected dose adjustments related to pulse width differences.

Schizophrenia Clinical Efficacy

Table 5: Schizophrenia efficacy

Measure	Brief Pulse Width (1.5 ms)	Ultra brief Pulse Width (0.5 ms)	p-value
PANSS pre-ECT	80.5	80.38	0.22
PANSS post-ECT	58.2	57.56	0.16
CGI-SI pre-ECT	6	5.76	0.12
CGI-SI post-ECT	3.6	2.65	0.33

Table 5 compares Brief and Ultra brief Pulse ECT in schizophrenia using PANSS and CGI-SI scores. Baseline scores were similar (PANSS: 80.5 vs. 80.38; CGI-SI: 6 vs. 5.76). Post-treatment, both groups showed improvement, with no significant differences (PANSS: 58.2 vs. 57.56; CGI-SI: 3.6 vs. 2.65). Independent and paired t-tests confirmed comparable efficacy between pulse widths ($p>0.05$).

Schizoaffective Disorder Clinical Efficacy

Table 6: Schizoaffective efficacy

Measure	Brief Pulse Width (1.5 ms)	Ultra brief Pulse Width (0.5 ms)	p-value
PANSS pre-ECT	80.2	80.67	0.16
PANSS post-ECT	57.9	57.25	0.26
YMRS pre-ECT	28.7	29.40	0.23
YMRS post-ECT	18.7	19.52	0.27
CGI-SI pre-ECT	6.1	6.27	0.34
CGI-SI post-ECT	3.6	3.97	0.20

Table 6 compares Brief and Ultra brief Pulse ECT in schizoaffective disorder using PANSS, YMRS, and CGI-SI scores. Baseline and post-treatment scores improved in both groups, with no significant differences ($p > 0.05$). Independent and paired t-tests confirmed significant improvement within each group but no efficacy difference between pulse widths.

Severe depression Clinical Efficacy

Table 7: Severe depression efficacy

Measure	Brief Pulse Width (1.5 ms)	Ultra brief Pulse Width (0.5 ms)	p-value
BDI pre-ECT	23	23.87	0.15
BDI post-ECT	15.2	14.32	0.43
CGI-SI pre-ECT	6.3	7.06	0.37
CGI-SI post-ECT	3.8	3.27	0.24

Table 7 compares Brief and Ultra brief Pulse ECT in severe depression using BDI and CGI-SI scores. Both groups had similar baseline scores, and post-treatment improvements were seen in both, with no significant differences ($p > 0.05$). Independent and paired t-tests confirmed significant symptom reduction within groups but no difference between pulse widths.

Bipolar Mania Clinical Efficacy

Table 8: Bipolar Mania efficacy

Measure	Brief Pulse Width (1.5 ms)	Ultra brief Pulse Width (0.5 ms)	p-value
YMRS pre-ECT	29.1	28.63	0.20
YMRS post-ECT	19	18.92	0.38
CGI-SI pre-ECT	6.2	5.23	0.11
CGI-SI post-ECT	3.7	3.99	0.40

Table 8 compares Brief and Ultra brief Pulse ECT in bipolar mania using YMRS and CGI-SI scores. Baseline and post-treatment scores improved in both groups, without significant differences ($p > 0.05$). Independent and paired t-tests confirmed significant within-group improvements but no difference between the two pulse widths.

Bipolar Depression Clinical Efficacy

Table 9: Bipolar Depression Efficacy

Measure	Brief Pulse Width (1.5 ms)	Ultra brief Pulse Width (0.5 ms)	p-value
BDI pre-ECT	24.1	24.93	0.44
BDI post-ECT	16	16.03	0.37
CGI-SI pre-ECT	6.4	7.09	0.29
CGI-SI post-ECT	3.9	4.67	0.21

Table 9 compares Brief and Ultra brief Pulse ECT in bipolar depression using BDI and CGI-SI scores. Both groups showed similar baseline scores and comparable symptom improvements after treatment ($p > 0.05$). Independent and paired t-tests confirmed significant improvement within each group, with no difference between pulse widths.

DISCUSSION

In this study, we aimed to explore and compare the clinical effectiveness of Brief Pulse (1.5 ms) and Ultra brief Pulse (0.5 ms) bitemporal Modified Electroconvulsive Therapy (MECT) among individuals diagnosed with schizophrenia, schizoaffective disorder, bipolar disorder, and severe depression. The primary outcome showed that both pulse widths were equally effective across these psychiatric conditions, with substantial symptom improvements noted on standard rating scales (PANSS, YMRS, BDI, and CGI-SI), and no significant differences between the two groups.

Our findings are in line with previous research, which has similarly reported equivalent clinical outcomes when using brief or ultra brief pulse widths across various psychiatric conditions[4,5]. Notably, the ultra brief pulse group required significantly lower seizure thresholds, which agrees with prior evidence suggesting shorter pulses demand lower electrical stimulation[10]. Interestingly, higher final ECT doses were needed in the ultra brief group, indicating the necessity of adjusting dosages during treatment to ensure therapeutic effectiveness. This observation has been previously noted, emphasizing the importance of personalized dose adjustments throughout therapy[11].

We also found no significant differences in EEG seizure duration at the initial treatments, consistent with earlier studies indicating minimal influence of pulse width variations on initial seizure quality[12]. However, the final seizure duration was slightly shorter in the ultra brief pulse group, suggesting that clinicians should closely monitor and adjust treatment settings over time to sustain effectiveness[13].

Our study contributes important insights from a rural healthcare context, highlighting how local demographic characteristics and clinical resources can differ substantially from urban settings. Such differences underscore the need for contextually relevant evidence to guide treatment decisions in diverse environments[14].

Despite these valuable insights, our study does have limitations, including a relatively small sample size and potential limitations regarding its applicability beyond rural settings in India. Future research with larger and more diverse populations and long-term follow-up is necessary to further validate these findings.

Ultimately, our results support the idea that clinicians may select pulse widths based on patient-specific factors, such as seizure threshold and individual tolerability, rather than significant efficacy differences alone. This patient-centered approach could potentially enhance clinical outcomes and overall treatment satisfaction.

CONCLUSION

This study evaluated the clinical efficacy of Brief Pulse (1.5 ms) versus Ultra brief Pulse (0.5 ms) bitemporal modified electroconvulsive therapy in patients with schizophrenia, schizoaffective disorder, bipolar disorder, and severe depression. Both pulse widths achieved comparable reductions in psychiatric symptoms across all diagnostic groups, with no significant differences observed at baseline or following treatment. These findings establish the clinical equivalence of Brief and Ultra brief Pulse ECT, reinforcing that treatment decisions can be guided by patient-specific factors rather than assumed efficacy differences. By directly addressing the study objectives, these results offer actionable insights for clinicians, supporting flexibility in pulse width selection within ECT protocols. To strengthen these conclusions, future research should incorporate larger, multicentric cohorts and extended follow-up periods to evaluate long-term effectiveness, relapse prevention, and potential impacts on individualized treatment pathways.

ACKNOWEDGMENT

Special thanks to Dr. Jaymin Pandav and Dr. Divya Kushwaha who helped in conducting this study.

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