

# The Bobath Concept (NDT) as rehabilitation in stroke patients: A systematic review

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## ABSTRACT

**Background and Objectives:** The Bobath approach, also known as neurodevelopmental treatment (NDT), is a widely used concept in the rehabilitation of stroke patients with hemiparesis in many countries. This technique is being used since years all over the world; however, strong evidence of its usefulness is still not present. This review is aimed to find out its effectiveness based on the randomized controlled trials in the rehabilitation of stroke patients with motor disability and to compare it with other therapeutic techniques. **Materials and Methods:** A systematic literature search on PubMed Central, Science-Direct, Cochrane, Scopus, Clinical Trial Database, and Indian Clinical Trial Registry in English till 31<sup>st</sup> July 2021 was undertaken. The review is published in Prospective Register of Systematic Reviews (PROSPERO) with registration number "CRD42019125400." Physiotherapy Evidence-based Database (PEDro) score has been used for the quality assessment of the studies. Randomized clinical trials that studied the comparative effect of the NDT/Bobath concept on motor activity outcomes and cognition/behavior in stroke patients in comparison with other rehabilitative techniques were included. **Results:** No strong documentation describing the effectiveness of this neuro-developmental treatment or its supporting neuro-developmental treatment in comparison with other advanced neuro-physiotherapeutic techniques has been found so as to consider it as the recommended treatment for post-stroke hemiplegia/hemiparesis. Methodological aspects of selected studies for further research are suggested. **Interpretation and Conclusions:** This study is inconclusive in determining the effectiveness of the Bobath approach for the movement rehabilitation of stroke patients. These results are similar to the results of previous reviews done on the same topic.

**Keywords:** Bobath Concept, rehabilitation, review, stroke

## Introduction

The Bobath Concept is referred to as the neuro-developmental technique (NDT) worldwide. People working in the field of rehabilitation have developed a special interest in this concept recently, especially for the recovery of stroke patients. Bobath textbooks published in 1970, 1985, and 1990 have mentioned developing, incorporating principles and techniques regarding new concepts and methods for motor improvement.<sup>[1-3]</sup> Bobath

is used as a treatment technique in the rehabilitation of stroke patients and is practiced in several countries. Previous reviews have studied the theoretical approach of NDT/Bobath on stroke rehabilitation and focused on controlled trials only.<sup>[4-10]</sup> Karl Bobath developed this technique in 1990 and she described how motor dysfunctions take place in patients with hemiplegia. Stroke patients shall actively participate in exercises assisted by the therapist. Therapists use key points of handling and reflex inhibiting patterns for performing exercises.<sup>[3]</sup> Bobath approach works on the different types of movement dysfunctions and is based on the active involvement of the patients so that they can develop motor control. Manual handling is holding the patient at specific proprioceptive points, for example, joint compression and distraction, so that patients can respond actively to perform functions. Manual handling can be of different types and is slowly

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removed to make the patient independent in motor activities. This type of therapy incorporates improved functional control and independence.<sup>[10]</sup>

NDT/Bobath concept has been recognized as a treatment for stroke patients with movement dysfunctions, and research to find out its efficacy is required to account for its extensive use by physiotherapists.

Augmentation of the scope of practice of nonphysician health care providers like physiotherapists is required to reduce the waiting times and improve primary care efficiency. In the last few decades, physiotherapists have seen their scope of practice extended in various settings, such as neurology, rheumatology, and primary care clinics.<sup>[11]</sup> The aim and objective of the review are to find out the effectiveness (motor recovery, gait and balance improvement, spasticity reduction, and daily functional activities improvement) of the Bobath approach in comparison with other rehabilitative techniques in acute as well as chronic patients of stroke with hemiparesis/hemiplegia. The results of this study will be helpful for stroke patients in saving their time and efforts when they will arrive at primary care centers, as they will directly be referred by primary care physicians to neuro-physiotherapists who are specialized in advanced neuro-physiological techniques like Bobath.

## Materials and Methods

### Search strategy and selection criteria

A systemic literature search was performed in the following databases: PubMed, Science-Direct, Cochrane, Scopus, Clinical trial database, and Indian clinical trial registry. Medical Subject Headings (MeSH) terminology was used in PubMed for finding the studies on required interventions and humans only. In other databases, free-text terms were applied. MeSH headings, and keywords used for the search were “stroke,” “Cerebral Vascular Accidents,” “Ischemic Stroke,” “Hemorrhagic Stroke,” “Neurodevelopmental Technique (NDT),” and “Bobath Approach.” Two assessors searched all databases up to July 2021. The review process was registered and published in Prospective Register of Systematic Reviews (PROSPERO) ([www.crd.york.ac.uk/PROSPERO](http://www.crd.york.ac.uk/PROSPERO)) website with registration number “CRD42019125400.”

### Inclusion criteria

1. Complete studies were included for the systematic review.
2. Articles in the English language only.
3. Only those randomized control trials (RCT) that compared the Bobath approach/NDT with other rehabilitation techniques and evaluating the outcomes related to motor recovery, gait, spasticity, activities of daily living (ADLs) in stroke patients with hemiparesis.

### Exclusion criteria

1. Editorial and conceptual papers.

2. Studies on patients with post-traumatic hemiplegia, subarachnoid hemorrhage, and cerebral venous sinus.

### Study selection and data extraction

Two reviewers (NR and AP) carried out the data extraction independently from all mentioned sources based on study content. Disagreements, related to study selection, were resolved by discussion and consensus with each author.

### Assessment of the study quality

The Physiotherapy Evidence-based Database (PEDro) scale was used that has moderate reliability for (interclass correlation = 0.56, 95% confidence interval (CI) 0.47–0.65).<sup>[12,13]</sup> The PEDro scale evaluates the methodological nature of clinical preliminaries corresponding to their inward legitimacy. It comprises 11 items; however, only ten points are scored considering the criteria for scoring (maximum score 10). Each piece has 1 and 0 points based on yes or no, respectively. The obtained score reveals the value of the studies: high quality (9–10), good quality (6–8), moderate (4–5), or poor (<4).<sup>[14]</sup> Table 1 shows the PEDro score for all trials.

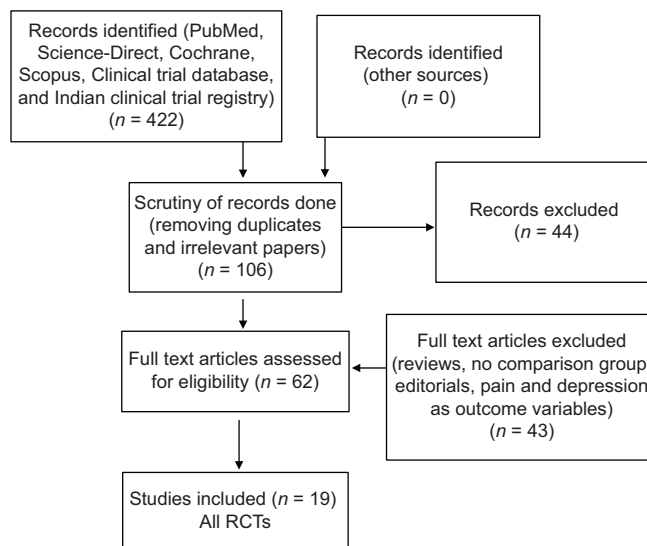
## Results

### Search result

We found 425 articles (up to July 2021) with Bobath as an intervention along with another control group or comparison group. After a detailed review, 19 articles were selected according to eligibility criteria. Figure 1 represents the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flow diagram of the study process. Table 2 shows the summary of all the studies.

### Quality assessment result

We assessed the methodological quality of the studies with the help of PEDro scoring, and final evaluation/grouping for



**Figure 1:** PRISMA flow diagram of the study process. PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis

Table 1: Quality of the trials (PEDro)

References	PEDro score											Total
	1	2	3	4	5	6	7	8	9	10	11	
K N Arya <i>et al.</i> 2012	1	1	1	1	1	0	1	1	1	1	1	9
Burcu Ersoz Huseyinsinoglu <i>et al.</i> 2012	1	1	0	1	0	0	1	1	0	1	1	6
Birgitta Langhammer <i>et al.</i> 2011	1	1	0	0	0	0	1	1	0	1	0	4
Kim Brock <i>et al.</i> 2011	1	1	1	1	0	0	1	1	1	1	1	8
D. Dias <i>et al.</i> 2007	1	1	0	1	0	0	1	1	0	0	1	5
Alain P. Yelnik <i>et al.</i> 2008	1	1	0	1	0	0	1	1	1	1	1	7
M. H. Thaut <i>et al.</i> 2007	1	1	0	1	0	0	1	1	1	1	0	6
Jolanta Krukowska <i>et al.</i> 2016	1	1	0	0	0	0	0	1	0	0	0	2
Muhammed Kilinc <i>et al.</i> 2015	1	1	0	1	0	0	1	1	1	1	0	6
Dickstein <i>et al.</i> 1986	1	1	0	0	0	0	0	1	0	0	0	2
Basmajian <i>et al.</i> 1987	1	1	0	0	0	0	0	1	0	0	1	3
Gelber <i>et al.</i> 1995	1	1	0	0	0	0	0	1	0	0	0	2
Langhammer and Stanghelle 2000	1	1	1	0	1	0	1	1	1	1	1	9
Platz T <i>et al.</i> 2005	1	1	1	0	0	0	1	0	1	1	1	6
Van Vliet PM <i>et al.</i> 2005	1	1	1	0	1	0	1	0	1	1	1	7
Lum PS <i>et al.</i> 2002	1	1	0	0	1	0	1	1	1	1	1	7
Wang RY <i>et al.</i> 2005	1	1	1	0	0	0	1	0	1	1	1	6
J. H. van der Lee <i>et al.</i> 1999	1	1	1	1	1	0	1	1	1	1	1	9
Tang QP <i>et al.</i> 2005	1	1	0	0	0	0	0	0	1	1	1	4

The PEDro scale criteria are as follows: (1) eligibility criteria, (2) random allocation, (3) concealed allocation, (4) baseline comparability, (5) blinding of patients, (6) blinding of the therapist, (7) blinding of the assessor, (8) adequate follow-up, (9) intention-to-treat analysis, (10) between-group comparison, (11) point estimate and variability. The first item (eligibility criteria) is related to the external validity, and all other items are related to internal validity and interpretability. Therefore, the first item score is not added to the total score.

defining the level of evidence was based on the study.<sup>[14]</sup> The scoring ranged from 2 to 9. Three studies were high quality studies,<sup>[17,18,30]</sup> nine were good quality<sup>[19,21-23,25,26,28,29,31]</sup>, and three were moderate quality studies.<sup>[20,24,27]</sup> All 19 RCTs identified the process of random allocation and defined eligibility criteria. The majority of the studies did a between-group comparison and mentioned point estimates and variability. Seven trials concealed the allocation of treatment.<sup>[17,18,21-23,28,30]</sup> In 14 studies,<sup>[17-19,21-31]</sup> assessor was blind and in 12,<sup>[17-23,25,26,28,30,31]</sup> intention to treat analysis was performed.

### Other techniques more effective than Bobath (n = 10)

Langhammer and Stanghelle, in a randomized trial, compared Bobath therapy with Motor Relearning Program (MRP) on motor power in stroke patients. Motor Relearning Program is a rehabilitation training focusing on motor function recovery post-stroke. They conducted two studies, one in 2000<sup>[18]</sup> looking at the number of stays in hospital (n = 61) and another one in 2011<sup>[28]</sup> (n = 61) with the motor function at 3 months follow-up. In the first study, the patients treated with MRP stayed lesser days in the hospital ( $P = 0.008$ ). Though there was no difference in improvement in activities of daily living; however, in the case of female patients, MRP was more beneficial. According to the second study done by the same authors, conducted in 2011, arm ( $P = 0.04$ ) and hand functioning ( $P = 0.01-0.03$ ) were improved in the MRP group compared to the Bobath group. Other lower limb functions like walking and stair climbing showed no differential benefits between the groups.

In one randomized trial, J. H. Vander Lee *et al.*<sup>[19]</sup> reported a significant improvement of motor power in the forced use group than the Bobath group (n = 66). In the Forced Use group, patients

were forced to use the affected hand by keeping normal hand immobilized with a resting splint. After 2 weeks of treatment, forced use therapy was superior over Bobath therapy in all aspects of the movement of both the upper as well as lower limb.

Lum P S *et al.*<sup>[20]</sup> (n = 27) compared Robot-Assisted Movement Therapy (RAMT) with Bobath therapy. In RAMT, movement activities and exercises are performed using robotic assistance. Here, the patients did various reaching movements for 20 min. They reported more extensive improvements in strength and mobility for the upper limb in the RAMT group after 2 months ( $P < .05$ ) of treatment.

Tang Q P *et al.*<sup>[21]</sup> did a randomized trial on 47 patients to compare Problem-Oriented Willed Movement therapy (POWM) and Bobath therapy. POWM approach works based on patients' identified cognitive and movement problems. After 8 weeks of intervention, they reported improvement in both groups; however, POWM therapy was more effective in improving lower extremity ( $P < 0.05$ ) and basic mobility ( $p < .01$ ).

Platz T *et al.*<sup>[22]</sup> described the difference between augmented exercise therapy based on the Arm BASIS training (ABT) (n = 20) that includes repetitive task practice and Bobath therapy training (n = 20). This study concluded that the ABT group had more arm function improvement than Bobath ( $P = 0.04$ ) after 1 month of treatment.

D. Dias *et al.*<sup>[25]</sup> compared the Gait Training and Bobath therapy in a randomized trial on 40 patients and reported that the Gait training group showed more improvement after 1 and 3 months of treatment in improving balance and motor power in stroke patients.

Table 2: Summary of studies in the systematic review

References (Year of publication)	Number of Subjects	Duration of intervention	Follow-up	Bobath-NDT Intervention	Control Intervention	Outcome Measure	Main Finding
R Dickstein <i>et al.</i> 1986 <sup>[15]</sup>	131 patients	6 weeks	N/A	38 patients treated with the BT	36 with the PNF	BI, passive movements of the extremities, Active ROM, Ambulatory status	No improvement in both groups
Basmajian <i>et al.</i> 1987 <sup>[16]</sup>	29 patients	4 weeks	9 months	16 patients in the BT group	13 in the IBPT group	Upper extremity function test	Both equally effective
Gelber <i>et al.</i> 1995 <sup>[17]</sup>	27 patients	25 days	6 months 1 year	15 patients in the BT group	12 in the TFR group	FIM, Gait parameters, Box and Block and Nine Hole Peg test	Both treatment therapies were equally efficacious.
Langhammer and Stanghelle 2000 <sup>[18]</sup>	61 patients	3 months	N/A	28 patients in the BT group	33 patients in the MRP group	MAS, SMES, NHP, BI	MRP is more beneficial than Bobath Exercise program.
J. H. van der Lee <i>et al.</i> 1999 <sup>[19]</sup>	66 patients	2 weeks	3, 6 weeks, 6 months, and 1 year	31 patients were given Bimanual task training based on the BT	31 patients in the Forced use therapy	ARAT, FMAS, MAL, MCID, A Problem Score	Forced Use Therapy was superior to Bobath Therapy in all aspects of improvement
Lum PS <i>et al.</i> 2002 <sup>[20]</sup>	27 patients	1 month 2 months	6 months	14 patients in the BT group	13 in the Robot therapy group	FMA, FIM <sup>™</sup> instrument, biomechanic measures of strength and reaching kinematics	Robot therapy showed more improvement than Bobath therapy
Tang QP <i>et al.</i> 2005 <sup>[21]</sup>	47 patients	2 months	N/A	22 patients in the BT group	25 in the Problem-Oriented Willed Movement Therapy	MMSE and STREAM	POWA is more effective
Platz T <i>et al.</i> 2005 <sup>[22]</sup>	40 patients	1 month	N/A	20 patients in Bobath basis augmented exercise Therapy group	20 in the Arm basis augmented exercise therapy	FMA, ARAT, Fugl meyer arm sensation and joint motion/pain scores, the Ashworth Scale	Augmented exercise therapy time in the form of the Arm basis training was effective.
Van Vliet PM <i>et al.</i> 2005 <sup>[23]</sup>	120 patients	1, 3, and 6 months	N/A	60 patients in the BT group	60 in the Movement Science Based Therapy	RMA, MAS1, THPT, SMWT, MAS, NSA, BI, EADLS	Both treatment therapies were equally efficacious.
Wang RY <i>et al.</i> 2005 <sup>[24]</sup>	44 patients	1 month	N/A	21 patients in the BT group	23 in the Orthopaedic Approach	SIAS, MAS1, BBS, SIS	Bobath was superior.
D. Dias <i>et al.</i> (2007) <sup>[25]</sup>	40 patients	1 month	3 months	20 patients underwent the BT.	20 patients used the GT	ASS, BBS, FMSS, MI, TMS, MFAC, RMI, BI, 10 meters TU&G, 6MST	Both groups showed improvement. GT group identified significant improvement on right after treatment and on follow up assessment, whereas BT group only showed improvement right after treatment. That means Gait training is more useful than BT.
M. H. Thaut <i>et al.</i> (2007) <sup>[26]</sup>	78 patients	3 months	N/A	35 patients were given the BT	43 patients had the RAS	FMS and BI	The results showed that RA is effective rehabilitation.
Alain P. Yelnik <i>et al.</i> (2008) <sup>[27]</sup>	68 patients	5 weeks	3 months	30 patients got the BT	30 patients received the MST	Posturography, gait velocity, double stance phase, climbing 10 steps, amount of walking per day, BBS, FIM, and NHP	They noted slight improvement in BT group, but results were not significant. MST also came out to be little effective but not as much as the BT.
Langhammer and Stanghelle (2011) <sup>[28]</sup>	61 patients	2 weeks and 3 months	1 year	28 patients in the BT Group	33 patients in the MRP Group	MES, MAS, BI, NHP	MRP is more beneficial over BT.

Contd...

Table 2: Contd...

References (Year of publication)	Number of Subjects	Duration of intervention	Follow-up	Bobath-NDT Intervention	Control Intervention	Outcome Measure	Main Finding
Kim Brock <i>et al.</i> (2011) <sup>[29]</sup>	26 patients	2 weeks	N/A	14 patients received the BT	15 patients received the STP	Ramp and uneven surface walking, 6MWT, BBS and gait velocity	Bobath is more effective.
Burcu Ersoz Huseyinsinoglu <i>et al.</i> (2012) <sup>[30]</sup>	24 patients	10 days	N/A	11 patients in the BT Group	13 patients in the CIMT group	MAL-28, WMFT, FIM and MES	CIMT AND BT came out to be equally effective, but CIMT is more beneficial.
K N Arya <i>et al.</i> (2012) <sup>[31]</sup>	103 patients	1month	2months	52 patients received the BMT and the BT	51 were assigned to the MTST	FMA, ARAT, GWMT, and MAL	The MTST group had a positive improvement while BMT and BT group had not.
Muhammed Kilinc <i>et al.</i> (2015) <sup>[32]</sup>	22 patients	3months	N/A	12 patients in study Group given the BT based trunk exercises	10 patients in control group given CEP	TIS, STREAM, and a 10-m walking test, BBS, FRT and TU&G	BT exercises of trunk are more effective than CEP in improving trunk function.
Jolanta Krukowska <i>et al.</i> (2016) <sup>[33]</sup>	72 patients	6 weeks	N/A	38 in the BT group	34 in the PNF group	Stabilometer platform.	They found the greatest improvement in the BT group.

BT: Bobath Therapy; BA=Bobath Approach; BR=Bobath Rehabilitation; SMES: The Sodring Motor Evaluation Scale, THPT-the ten hole peg test, NSA-Nottingham Sensory Assessment, EADLS- Extended Activities of Daily Living Scale, SIAS-Stroke Impairment Assessment Scale, SIS-Stroke Impairment scale, FMAS-the upper extremity section of the Fugl-Meyer Assessment scale, MCID-The minimal clinically important difference, N=No. of Subjects; IBPT-Integrated Behavioral Physical Therapy, THR- Traditional Functional Retraining, POWA-Problem Oriented Willed Movement; RAS: Rhythmic Auditory Stimulation; GT: Gait Trainer; MST: Multisensorial Treatment; MTST: Meaningful Task Specific Training; CIMT: Constrained Induced Movement Therapy; PNF: Proprioceptive Neuromuscular Facilitation; CEP: Conventional Exercise Program; MRP: Motor Relearning Program; STP: Structured Task Practice; ASS: Ashworth Spasticity Scale; FMSS: Fugl Meyer Stroke Scale; MI: Motoricity Index; TMS: Toulouse Motor Scale; MFAC: Modified- Functional Ambulation Category; RMI: Rivermead Mobility Index; BI: Barthel Index; TU&G: Timed Up and Go; 6MST: 6 minutes step test; FMS: Fugl Meyer Scale; MAS1: Modified Ashworth score; ROM: Range of Motion; FIM: Functional Independence Measure; RMA: Rivermead Motor Assessment; BBS: Berg Balance Scale; NHP: Nottingham Health Profile; MES: Motor Evaluation Scale; MAS: Motor Assessment scale; BMT: Brunnstrom Movement Therapy; 6MWT: 6 Minute Walk Test; MAL-28: Motor Activity Log-28; WMFT: Wolf Motor Function Test; FMA: Fugl Meyer Assessment; ARAT: Action Research Arm Test; GWMT: Graded Wolf Motor Function Test; MAL: Motor Activity Log; STREAM: The Stroke Rehabilitation Assessment Scale; TIS: Trunk Impairment Scale; SRAM: Stroke Rehabilitation Assessment of Movement; FRT: Functional Reach Test; MMSE: Mini-Mental Status Examination; N/A=Data not available

M. H. That *et al.*<sup>[26]</sup> did one randomized trial and found the significant improvement in the Rhythmic Auditory Stimulation (RAS) group (n = 43). RAS involved using rhythmic sensory cues, for velocity ( $P = .006$ ), stride length ( $P = .0001$ ), cadence ( $P = .0001$ ), and symmetry ( $P = .0049$ ). Bobath group (n = 35) patients did not show improvement in all treatment measures.

Burcu Ersoz Huseyinsino *et al.*<sup>[30]</sup> reported improvement in the constraint-induced movement therapy group (n = 13) over the Bobath Concept group (n = 11) ( $P = 0.003$ ;  $P = 0.01$ , respectively) in their randomized trial, after 10 days of treatment.

K N Arya *et al.*<sup>[31]</sup> in 2012 compared Meaningful Task-Specific Training (MTST) (n = 51) with the Bobath group (n = 52) and showed improvement ( $P < .001$ ) in motor activities in the MTST group compared to the Bobath group after 4 weeks of treatment.

### Bobath more effective than other techniques (n = 5)

One randomized trial done by Wang RY *et al.*<sup>[24]</sup> reducing spasticity in stroke patients showed improvement in tone control ( $P = 0.006$ ) after Bobath treatment (n = 21) than with orthopedic treatment (n = 23). The orthopedic treatment technique included passive, assistive, active, and progressive resistive exercises.

Kim Brock *et al.*<sup>[29]</sup> concluded that following the intervention, there was more considerable improvement in gait velocity for those in the Bobath intervention compared to the Task Practice (TP) response. There were no significant differences

between the groups for balance. As the study was conducted at two different sites, the mean improvement was slightly more in the Bobath group than the TP group.

Muhammad Kilinc *et al.*<sup>[32]</sup> did a comparison between Bobath therapy and Proprioceptive Neuromuscular Facilitation (PNF) for poststroke trunk control, upper and lower extremity function, and walking and balance. They reported improvement in both groups (n = 22), but the both group had a significant ( $P < 0.05$ ) benefit.

In one randomized trial done by Jolanta Krukowska *et al.*<sup>[33]</sup> 72 patients were divided into four groups. The criteria for this division were the body side (right or left) paralyzed and the applied rehabilitation methods. They reported more significant improvement in the NDT-Bobath therapy group in comparison with the PNF method ( $P < 0.05$ ).

Gelber *et al.*<sup>[17]</sup> conducted one study to find the superiority of any one of the techniques over one another in the rehabilitation of stroke patients. These techniques were NDT and Traditional Functional Retraining Approach (TFR). TFR stresses practicing functional tasks as early as possible. They found an improvement in gait velocity that too only in the Bobath group ( $P = 0.04$ ) and no significant difference in other outcome variables between the two treatment groups.

### Both techniques: Equally effective (n = 4)

Van Vliet PM *et al.*<sup>[23]</sup> compared Bobath technique with Movement Science-Based Therapy (MSBT) in 120 patients, and reported

no significant difference in movement and functional abilities between the two techniques. According to them, no technique is superior to other techniques.

Ruth Dickstein *et al.*<sup>[15]</sup> did one trial to compare the therapeutic efficacy of three approaches: conventional treatment with traditional exercises, PNF, and the Bobath approach. They found improvement in functional activities, muscle tone, and ambulation in each patient (n = 131) in all groups after 6 weeks of treatment. No advantage of one approach over others could be detected.

Basmajian *et al.*<sup>[16]</sup> revealed in their randomized trial that both forms of therapy (Bobath and Integrated Behavioral Physical Therapy) on 29 stroke patients, obtained little improvement, maintained at 9-month follow-ups, but there was no superiority of one therapy over the other.

Alain P Yelnik *et al.*<sup>[27]</sup> found significant improvement in balance and walking parameters in all subjects of both groups (n = 68). One group was given multisensorial training (MST), which uses manipulation of sensory information for balance. Other groups received conventional neuro-developmental theory (NDT)-based training for 5 weeks. Small differences were found in favor of the Bobath group, but clinically insignificant.

## Discussion

The present systematic review was based on the evaluation of the qualitative effects of the Bobath Concept compared with other stroke rehabilitation approaches. Nineteen RCTs conducted till July 2021, studying 1,086 stroke patients, were selected and analyzed. According to the previous reviews,<sup>[4,9,10,34,35]</sup> the evidence confirming the efficacy of this therapy over other advanced neuro-physiotherapy techniques as the preferred type of treatment is not present. One systematic review was published in 2019,<sup>[35]</sup> and they confirmed that overall the Bobath concept is not as beneficial as other therapies. We have more up-to-date search with seven more studies<sup>[16,26-29,31,33]</sup> reviewed in our paper. Moreover, this review did not mention their registration identity. They described three additional studies that were not suitable according to the eligibility criteria for inclusion in our review. Another systematic review<sup>[36]</sup> conducted in 2020, described that Bobath therapy is inferior to task-specific training and not superior to other interventions in improving lower limb activities after stroke, with the exception of PNF technique. One major difference we have from this review is they targeted only lower limb performance, and we included whole-body motor recovery which adds to the quality of our review. Our study adds to the perspective of results of these systematic reviews that there is no evidence related to the superiority of Bobath therapy except to the PNF technique and orthopedic approach as results came out to be similar in terms of improvement.

There is inconclusive evidence for the efficacy of Bobath over other treatment approaches in improving motor activity, gait, spasticity, and daily living activities after stroke. Only three

studies demonstrated that the Bobath technique is useful in all outcome variables used in those studies with excellent significant value.<sup>[24,32,33]</sup> One comparing Bobath with orthopedic approach on different motor stages, found good improvement in the tone control, motor assessment, stroke-related impairment, and balance in Bobath treated patients.<sup>[24]</sup> The other two studies had PNF as the comparison approach and showed improvement in both groups, still Bobath treated group had higher and significant gains in balance, posture, gait parameters, and trunk control.<sup>[32,33]</sup> Though there was no superiority of Bobath over multisensorial treatment and conventional exercise program. One study found a small difference in favor of Bobath, but clinically insignificant.<sup>[27]</sup> The other two studies reported improvement in Bobath-treated patients but only in balance and gait velocity.<sup>[17,29]</sup>

Three studies<sup>[15,16,23]</sup> stated that Bobath is equally useful to Movement Science-Based Therapy, PNF technique, and Integrated Behavioral Physical Therapy in improving movement abilities and functional independence.

The other ten studies had reported that Bobath was not effective when compared to other therapeutic techniques. These treatment techniques are MRP,<sup>[18,28]</sup> forced use therapy,<sup>[19]</sup> Robot therapy,<sup>[20]</sup> POWM,<sup>[21]</sup> Arm BASIS augmented exercise therapy,<sup>[22]</sup> gait training,<sup>[23]</sup> RAS,<sup>[26]</sup> Constraint-Induced Movement Therapy,<sup>[30]</sup> meaningful task-specific training.<sup>[31]</sup> Hence, its superiority in improving upper extremity, and hand motor power, lower limb motor control, and gait, daily living functional activities, and spasticity could not be proved. The studies had uniform outcome measures and unequal follow-up duration. Seven out of 19 studies had study participants less than 30, which makes them relatively weak studies.

There were several limitations observed in this review. First, the lack of additional databases such as EMBASE, the Latin American and Caribbean Health Science Literature Database (LILACS), and additional Chinese databases could not be searched. Second, only the databases published in English were selected. The treatment duration was less than 1 month in three of the nineteen reviewed studies. One-month therapy is necessary to see the noticeable difference or improvement when giving any therapeutic approach in stroke.

Meta-analysis of these studies could not be done due to quantitative differences in patients' properties, duration of intervention, outcome measures, and treatment therapies. Hence, this systemic review cannot advocate the Bobath therapy method, with a specific advantage over the other. However, a well-planned RCT with a more significant number of participants is required to draw any further conclusion.

## Future Directions and Conclusions

Evidence supporting the efficacy of Bobath as compared to alternative rehabilitation approaches is presently lacking. We

tend to suggest that future studies shall be conducted to analyze Bobath therapy for stroke by doing quantitative analysis on acceptably stable trials with equal dose and duration of therapy, initiation time of therapy, variety of therapy, a larger sample size, adequate follow-up, and coverage of standard items.

The shortage of consistent coverage and, therefore, the heterogeneousness discovered within the enclosed trials are making it troublesome to come to a quality conclusion on the effectiveness of the Bobath therapy protocol.

### Key points

1. This is a systematic review conducted to evaluate the effectiveness of the Bobath approach on rehabilitation of stroke patients, based on RCTs, and to compare it with other rehabilitative techniques.
2. This review is registered in PROSPERO with registration number "CRD42019125400." A total of 425 articles (up to July 2021) with Bobath as intervention along with another control group or comparison group were found, and 19 RCTs were included as per eligibility.
3. As per the PEDro scoring for methodological quality assessment, three high quality, nine good quality, and three moderate quality studies were identified.
4. Ten studies had reported no improvement with the Bobath concept, four studies reported Bobath as equally useful to other techniques, and five studies reported Bobath more effective than other techniques.
5. Meta-analysis of these studies could not be done due to quantitative differences in patients' properties, duration of intervention, outcome measures, and treatment therapies.

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### Conflicts of interest

There are no conflicts of interest.

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