SYSTEMATIC REVIEW

Effects of task oriented rehabilitation of upper extremity after stroke: A systematic review

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Abstract

Objective: To explore the current scientific evidence on the effects of task-oriented rehabilitation programme of upper extremity post-stroke.

Method: The systematic review comprised studies from 2012 to August 2020 which were both Hand-searched and explored on Cochrane, PubMed, PEDro and MEDLINE databases with authentic search techniques using population-intervention-control-outcomes format and Boolean operator. Randomised controlled trials on the use of task-oriented training for the improvement of upper extremity functional outcomes in subjects with stroke were shortlisted and reviewed. The risk bias tool was used to evaluate the biasness in the studies and the PEDro scale was used to evaluate the methodological quality of the studies.

Results: Of the 28 articles assessed, 16(%) were included for detailed review. All studies varied significantly with PEDro scores between 6 and 10. There were 12(75%) high-quality studies and 4(25%) fell in fair category. All the studies showed significant results in the improvement of upper extremity after stroke through task-oriented training rehabilitation ($p<0.05$).

Conclusion: Evidence supports the beneficial effects of task-oriented rehabilitation for the improvement of upper extremity functions post-stroke.

Keywords: Conventional therapy, Stroke, Stroke rehabilitation, Task-oriented rehabilitation, Upper extremity paresis.

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Introduction

Cerebrovascular accident (CVA), also known as stroke, is the sudden cessation of neurological system of body due to impairment in blood flow towards brain. It can be haemorrhagic or ischaemic.[1] Stroke is the world's second leading cause of disability and death.[2,3] Stroke is an acute cerebrovascular disorder that triggers the obstruction or bursting of blood vessels in the brain to develop neurological dysfunction, which include sudden clouded consciousness and paralysis.[4] The most frequent abnormalities that occur following stroke are spasticity (20-30%), lack of bladder function (28-79%), trouble swallowing (30-67%) and cognitive dysfunction (60%).[5]

Stroke is a leading cause of serious and long-term disability in the United States.[6] The expected percentage of stroke occurrences in Europe would rise by more than 30% between 2015 and 2035.[7] The impact of Stroke in the United States is more than 800,000 persons per year. In the United States, 80 % survived the early symptom.[8]

Upper extremity paralysis occurs in almost two-thirds of patients with stroke.[9,10]

Up to 85% of stroke patients suffer arm paralysis and, within 3 months, only 20%-56% recover complete muscle strength. The post-stroke functional improvement of the upper extremity (UE) is often slow as compared to the lower extremity.[11]

In patients with post-stroke hemiparesis, UE function is dependent on multiple factors, including the severity of paresis, the intensity of spasticity, and the level of motor and sensory loss. Post-stroke severe UE paresis, is a leading cause of significant long-term hand dysfunction. Cirstea & Levin[12] proposed that loss of motor function post-stroke in UE can lead to agony, joint contracture, and distress that can also progress to limb atrophy and prevent long-term rehabilitation. Consequently, the impaired UE activity affects the ability to complete daily life tasks, effectively reduces the patient's autonomy and decreases the anxiety on caregivers.[13] More research is essential to explore the best techniques for people that are unable to retrieve their hemiplegic UE functional capabilities.[14] Motor rehabilitation is usually completed within 10 weeks of stroke, and stroke rehabilitation mostly reaches a functioning condition at 3 to 6 months. Therefore, to facilitate maximum functional improvement during the sub-acute stroke phase, it is important to analyze post-acute stroke interventions.[9,10]

Therefore, the development and implementation of post-stroke treatment techniques has been improving an individual's performance and significantly reduce the tax

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liability on clinicians and the healthcare system.[3]

To determine the most effective therapeutic interventions for patients who are unable to accomplish their functional hemiplegic UE strength, more studies need to be done.[14] At one year following a stroke, the degree of improvement in motor function has the largest influence on subjective well-being.[11]

There are a large number of exercises for muscle strengthening that are used in the rehabilitation of stroke patients.[15] (i) Task-oriented rehabilitation[16] (ii) Constraint-induced movement therapy (CIMT)[17] (iii) Robotic-assisted therapy and Web-based telemedicine[18] (iv) Kinesio-taping[19] (v) Motor imagery[20] (vi) eccentric strength training[21] (vii) Whole-body vibration (WBV).[9]

Task-oriented training (TOT) is a strongly individualized intervention correlated with functional-based rehabilitation, such as aggressive motor activity, variable practice and daily guidance, client-centered, occupational therapy, motor learning and motor coordination.[14]

Task-oriented rehabilitation contains different therapy interactions, such as field walking, treadmill running, bicycle fitness programmes, round exercise, gripping exercises, functional arms training tasks, and CIMT. Multiple clinical studies have demonstrated about the improvement of the paretic upper limb in post-stroke patients with different task-oriented approach as treatment protocols.[16]

Task-oriented practice helps to improve the method of control by resolving problems through different tasks. Stroke survivors assume various movement patterns through the task-oriented practice and learn to reduce unnecessary activities which increase their potential for adaptation. To promote functional rehabilitation of the musculoskeletal and neuromuscular systems, task-oriented practice has also been used.[22] In comparison to eccentric strength training, researches on task-oriented training have showed promising outcomes. They concluded that strength increases due to the fact that reinforcement task-oriented training could leads to quality enhancement in performance. It will be the most effective resistance training for patients with stroke.[21]

Many physicians use manual therapy in the clinical setting, such as neurodevelopmental exercises or an extra tilt table, to improve UE mobility and to carry out assisted weight-load training in patients. The tilt table, when used under the guidance of physical therapists, has been a beneficial tool in mobilizing patients with acute and chronic stroke.[13] The systematic review of functional activities (self-care, work and recreation) aims to provide the patient with resources to identify the best treatment options that can enhance the functional performance.[14]

At present there are many different training programmes to improve the motor function in the patients recovering from stroke but there are no specific recommendations for the use of task oriented training in motor functions of upper extremity improvement after stroke. The purpose of this review is to collect all information about task oriented rehabilitation to improve the motor functioning of UE after stroke. Then, evaluate the evidence of TOT for clinical use to inform clinical practice training on motor strength of upper extremity after stroke.

Methods

The systematic review comprised studies from 2012 to August 2020 related to TOT rehabilitation. The initial detailed literature research was performed by 2 researchers independently, using search strategy designed for different databases, including Cochrane central register of control trials, PubMed, PEDro and MEDLINE. Hand-search was also done to prevent loss of relevant literature. For each database, the search strategy was built by adding the key terms and Boolean operators, i.e. AND, OR, and NOT aligned to the research objectives. Encoding words, synonyms and terms in the population-intervention-control-outcomes PICO format[23] were used and filtered by including full text, randomised controlled trial (RCT), human and English.

Study eligibility criterion was based on the PICO method.[23] Related information was extracted and analyzed from the included studies. Studies included were trials/studies of patients with acute, sub-acute and chronic stroke and having UE dysfunction; participants having age 30-85 years and able to do little active range of motion (ROM) of UE; peer reviewed; published in the English-language professional and scientific journals; contained any standardised assessment tool of the intervention's outcome; and the study designs were RCTs or controlled clinical trials. The studies excluded were those having patients suffering from any other traumatic brain injury or health condition affecting the rehabilitation programme; any form of editorials, commentaries, and case series; and studies written in a language other than English.

Search records were saved in EndNote X8 software. Duplicate records were removed after that different screening of articles were conducted on the basis of abstract and full text articles. In the end, full text articles included from different databases were used to create tables describing different variables, like methodology, sample size, demographic data etc. Studies were assessed thoroughly to calculate standard mean difference and effect between intervention and control groups. A table was created to describe the differences between these groups to divide these outcomes measures and the studies were managed according to quality scores. Analytical quality of the studies was assessed using the PEDro scale.[24] The overall quality of each study was assessed by 11 close-ended questions. Total score ranged from 1 to 10. Each question was marked 1 or 0.1 for totally fulfilling the criteria and 0 for not fulfilling the criteria. Total scores were added for each question for all the included studies. A score of 10 indicated excellent methodological quality of a study.

Risk of bias for every included study was assessed by two independent researchers using the risk of bias tool in accordance with Cochrane handbook for systematic review of interventions.[25] Selection bias was assessed by allocation concealment and random sequence generation, as well as detection bias by blinding of outcome assessment marked as unclear, low risk and high risk in each study.

Outcomes of Interest: These included all valid and reliable tools or scales used to appraise the strength and activities of the upper limb. Some of them were primary outcome measures, like Hand Grip Strength (HGS), Wolf Motor Function Test (WMFT), Box and Block Test (BBT), Jebsen Talory Test (JJT), Action Research Arm Test (ARMT) and Fugl Meyer Assessment Test (FMAT). Secondary outcome measures included Modifed Ashword Scale (MAS), minimal assessment level measured before and between treatment and after follow-up by clinical examination, patient's quality of life (QOL) related to activities of daily living (ADLs).

Results

Of the 2109 studies, 28(1.3%) full text articles were shortlisted for assessment, and, of them, 16(0.75%) were included for analysis and synthesis (Figure). Data was not extractable from 12(0.47%) of the studies out of 28 studies (incomplete\ missing data, full article not available, only abstracts were there).

All the included studies scored 6-9 on the PEDro scale; 12(75%) in the high-quality category and 4(25%) in the fair category (Table-1).[4,5,13,14,21,26-35] Demographics and basic data of the studies were noted separately (Table-2). The included studies showed positive and negative effects which were compared with the objective of the review, indicating that the studies showed improvement in term of UE functions after stroke with TOT rehabilitation (Table-3).

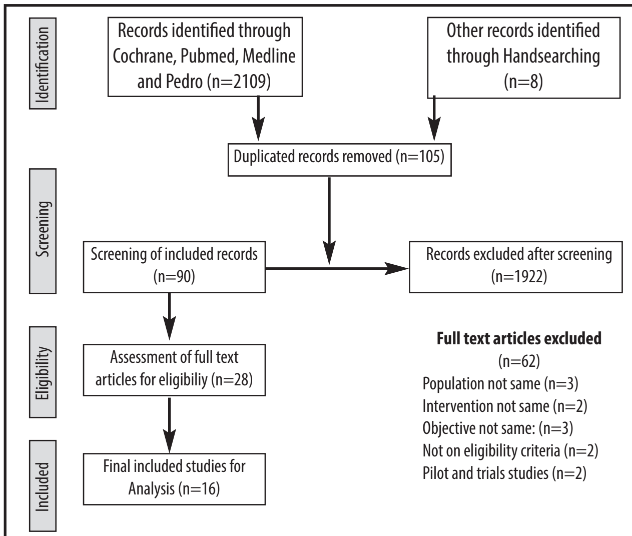

Figure: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart.

Table-1: Quality assessment of the included studies through PEDro scale.[24]

No	Author name	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score
1	Carolee J.Winstein et al.[28]	Yes	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	6
2	Kim, Chang-Yong Kim, Hyeong-Dong[13]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	9
3	Mireille A.Folkerts et al.[21]	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
4	Misbah marryam[5]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
5	Kim, Jinhong, Yim,Jongeun[29]	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7
6	Sun-Ho Kim[4]	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	7
7	Aye Aye Thant et al.[30]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
8	Khader A. Almhdawi et al.[14]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
9	Mohamed E. Khallaf[31]	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	8
10	Cheryl Carrico et al.[32]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
11	Sandy McCombe Waller et al.[33]	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	8
12	So-Young Han et al.[34]	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
13	Kamal Narayan Arya et al.[35]	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	8
14	Gui Bin Song[36]	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
15	Paulo Bazile da Silva et al.[26]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
16	Hye-Sun Lee[37]	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	8

Table-2: Demographic data of the included studies.

No	Study author (latest to old)	Country	Age mean SD	Gender M/F	Drop out	Participants	Side L/R
1	So-Young Han et al. 2021[34]	Korea	NM	NM	0	25 EG:13 CG:12	NM
2	Hye-Sun Lee 2020[37]	Korea	EG: 72.1 ± 5.0 CG: 73.2 ± 6.1	M:27 F:9	0	36 EG:18 CG:18	L:18 R:18
3	Aye Aye Thant et al. 2019[30]	Thailand	EG: 55 ± 8.43 CG: 55.14 ± 10.44	M:14 F:14	0	28 EG:14 CG:14	L:14 R:14
4	Mohamed E. Khallaf 2018[31]	Egypt	G 1: 50.17±2.76 G 2: 49.5±3.85	M:16 F:8	0	26 G1:13 G2:13	L:9 R:17
5	Kim, Chang-Yong Kim, Hyeong-Dong 2018[13]	Korea	CG: 60.41 (5.84) EG1: 59.47 (6.24) EG2: 58.44 (9.01)	M:24 F:21	9	45 EG1:15 EG2:15 CG:15	L:24 R:21
6	Kim, Jinhong Yim,Jongeun 2018[29]	Korea	EG: 51±2.98 CG: 74.11±2.88	M:8 F:12	4	24 EG:12 CG:12	L:7 R:12
7	Misbah Marryam 2017[5]	Pakistan	EG:56.06±8.94 CG: 56.06±8.94	M:21 F:17	5	43 EG:22 CG:21	NM
8	Mireille A. Folkerts et al. 2017[21]	Netherland	56.06±8.94	M:9 F:2	0	11 EST-TOSTG:5 TOST-ESTG:6	L:6 R:5
9	Carolee J. Winstein et al. 2016[28]	California	ASAPG: 60.9(13.7) DEUCCG: 59.9 (10.5) UCCG: 61.1(13.1)	M:203 F:158	46	361 ASAPG:119 DEUCCG:120 UCCG:122	L:154 R:173
10	Sun-Ho Kim 2016[4]	Korea	EG: 48.90 ± 10.12 CG: 47.50 ± 14.43	M:11 F:9	0	20 EG:10 CG:10	L:8 R:12
11	Khader A. Almhdawi 2016[14]	USA	ITG: 61.1 ± 9.56 DTG: 62.5 ± 8.54	M:13 F:7	0	20 ITG:10 DTG:10	L:15 R:5
12	Cheryl Carrico et al. 2016[32]	USA	EG: 58.7±12.1 (18 CG: 65.4±10.8 (18)	M:18 F:18	5	36 EG:18 CG:18	L:12 R:23
13	Paulo Bazile da Silva 2015[26]	Brazil	TOTG: 70.4 (7.83) TOT-STG: 70.3 (7.83)	M:7 F:13	0	20 TOTG:10 TOT-STG:10	L:15 R:5
14	Song Gui Bin 2015[36]	Korea	TBG: 51.15±14.81 RBG: 48.65±12.81	M:21 F:19	0	40 TBG:20 RBG:20	L:21 R:19
15	Sandy McCombe Waller et al. 2014[33]	Switzerland	SAEBOG:57 COMBOG:56	M:16 F:11	0	27 SAEBOG:14 COMBOG:13	L:13 R:14
16	Kamal Narayan Arya et al.2012[35]	India	EG: 51.67 ± 7.96 CG: 50.21 ± 7.60	M:62 F:41	1	103 EG:51 CG:52	L:45 R:58

EG; Experimental group; CG: Control group; TOTG: Task-oriented training group; TOTSTG: Task-oriented training strength training group; TBG: Task-oriented bilateral group; RBG: Repetitive bilateral group; ITG: Initial task group; DTG: Delayed task group; ASAP: Accelerated skill acquisition programme; DEUCC: Dose-equivalent usual and customary care; UCC: Usual and customary care; COMBO: Combination bilateral arm training and task oriented training; SAEBO: Task-oriented training alone.

There were 6 studies that fell in the high-risk category in terms of the three parameters on which the risk of biasness was assessed (Table-4).[13,26,29,31,33,35]

Discussion

The current systematic review was planned to explore the current evidence for the effectiveness of TOT in combination or separately to improve UE function and

Table-3: Characteristics of the included studies.

No	Study author (latest to old)	Method	Drop out	Participants	Interventions	Outcomes	Conclusion	p-values of results	Vote counting
1	So-Young Han et al .2021[34]	RCT	0	25 EG:13 CG:12	EG:MTT CG:OT	MFT	MTT improve motor function of UE	P<0.05	Positive effect
2	Hye-Sun Lee 2020[37]	RCT	0	36 EG:18 CG:18	EG:RAPAEL CG: RACGA	BBT JTT WFMT GST TMT	RAPAEL show significant effects on UE	BBT<0.001 JTT=0.475 WMFT=0.032 GST=0.001 TMT=0.813	Negative effect
3	Aye Aye Thant et al. 2019[30]	RCT	0	28 EG:14 CG:14	EG:TOT CG:CET	WMFT FAS FMA SIS	TOT improves functional performance of UE	P>0.005 P<0.005	Positive effect
4	Mohamed E. Khallaf 2018[31]	RCT	0	26 G1:13 G2:13	EG: anti-gravity training+TST CG:CT+ROM	NHPT FM Goniometer	Anti-gravity and TST improves UE function	P≤ 0.05	Positive effect
5	Kim,Chang-Yong Kim, Hyeong-Dong2018[13]	RCT	9	45 EG1:15 EG2:15 CG:15	CE TOT CT	FMS WMFT HGS	CE improves Tilt table UE function with TOT	FMS<0.05 WMFT<0.01	Negative effect
6	Kim, Jinhong Yim,Jongeun 2018[29]	RCT	4	24 EG:12 CG:12	EG: HF-Rtms+TOMT CG: HF-rTMS	BBT HGS PG	HF-rTMS + TOMT show positive effect on hand function	P<0.05	Negative effect
7	Misbah Marryam 2017[5]	RCT	5	43 EG:22 CG:21	EG:TE+TOT CG:TE	MAS	TOT improves UE function	P<0.001	Positive effect
8	Mireille A.Folkerts et al. 2017[21]	RCT	0	11 EST-TOSTG:5	EST TOST	HHD IMI ARAT	EST with TOST increases function and strength	HHD<0.001 IMI<0.003 ARAT<0.05	Positive effect
9	Carolee J. Winstein et al. 2016[28]	RCT	46	361 ASAPG:119 DEUCCG:120 UCCG:122	STOT DEOT OT	SIS UEFM WFMT	STOT have no significant effect on UE function	P<0.05 P<0.001	Positive effect
10	Sun-Ho Kim 2016[4]	RCT	0	20 EG:10 CG:10	EG:EMG+TOT CG:TOT	FMA BBT RVC JTHFT	EMG is effective with TOT on UE function	BBT<0.05 FMA<0.05 RVCC<0.001	Negative effect
11	Khader A. Almhdawi et al. 2016[14]	RCT	0	20 ITG:10 DTG:10	TOT	COMP MAL WMFT	TOT effected for COMP and MAL	MAL<0.001 WMFT<0.009 COMP<0.001	Positive effect
12	Cheryl Carrico et al. 2016[32]	RCT	5	36 EG:18 CG:18	PNS ITOT	FMA WMFT ARAT	PNS improves UE function with ITOT	FMA<0.025 WMFT<0.020 ARAT<0.025	Negative effect
13	Paulo Bazile da Silva et al. 2015[26]	RCT	0	20 TOTG:10 TOT-STG:10	TOT TOT-ST	FMS MAS TEMPA	TOT-ST improves UE function	FMS<0.001 MAS<0.05 TEMPA<0.05	Positive effect
14	Gui Bin Song 2015[36]	RCT	0	40 TBG:20 RBG:20	RBAT TOBT	BBT JTT MBI	BAT is effective with TOT	P<0.05	Positive effect
15	Sandy McCombe Waller et al. 2014[33]	RCT	0	27 SAEBOG:14 COMBOG:13	BLTOT ULTOT TOT	FMS WMFT	BLTOT is more effective than TOT for UE function	P<0.018	Positive effect
16	Kamal Narayan Arya et al. 2012[35]	RCT	1	103 EG:51 CG:52	MTST CT	103 EG:51 CG:52	MTST increase UE function	P<0.001	Positive effect

RCT: Randomised control trial, WMFT: Wolf motor function test, BBT: Block and box test, JTT: Jebsen Taylor test, FMA: Fugl Meyer assessment, MAS: Modified Ashword scale, rTMS: Repetitive transcranial magnetic stimulation, FMS: Functional movement screen, ARAT: Action research arm test, MAL: Minimum acceptance level, ADL: Activities of daily life, EST: Eccentric strength training, HHD: Hand-held dynamometer, PG: Pinch grip, HG: Hand grip, STOT: Specific task-oriented .

Table-4: Risk of bias for each included study.

No	Study author (latest to old)	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (detection bias)
1	So-Young Han et al. 2021[34]	–	?	?
2	Hye-Sun Lee 2020[37]	+	+	+
3	Aye Aye Thant et al. 2019[30]	+	+	?
4	Mohamed E. Khallaf 2018[31]	+	+	+
5	Kim, Chang-Yong Kim, Hyeong-Dong 2018[13]	+	+	+
6	Kim, Jinhong Yim,Jongeun 2018[29]	+	–	?
7	Misbah Marryam 2017[5]	+	+	?
8	Mireille A.Folkerts et al. 2017[21]	–	–	?
9	Carolee J. Winstein et al. 2016[28]	+	+	+
10	Sun-Ho Kim 2016[4]	?	+	+
11	Khader A. Almhdawi et al. 2016[14]	+	–	?
12	Cheryl Carrico et al.2016[32]	+	–	+
13	Paulo Bazile da Silva et al. 2015[26]	+	+	–
14	Gui Bin Song 2015[36]	?	?	?
15	Sandy McCombe Waller et al. 2014[33]	+	+	+
16	Kamal Narayan Arya et al. 2012[35]	+	+	+

Unclear? Low Risk +, High Risk –

performance and ADLs post-stroke. There were 16 studies with 865 participants. Overall, the use of TOT with other therapeutic exercises enhanced the function and strength of UE post-stroke. More RCTs related to stroke patients are needed to determine the value of TOT in improving QOL. Because the topic was novel in the context of the therapeutic setting, there were few relevant publications in literature, but TOT result was evidently better.

There was a high degree of evidence for TOT as the review included only RCTs and trials of acceptable consistency.

The findings support the hypothesis that TOT exercise is more successful than TIT with strength training. For inducing neuromuscular adaptations alone, and in the persistent phase after stroke, energy consumption, motor functions and functional recovery are improved.[26]

The TOT approach is more client-centred, uses more meaningful strategies, and is more effective than CIMT for a broader spectrum of post-stroke patients.[14]

Current evidence indicates that TOT can lead to improved motor performance and may significantly contribute to post-stroke activity. To evaluate the impact of TOT and to maintain a minimum level of training at which motor rehabilitation occurs, extensive, well-controlled and conducted RCTs using structured procedures with relevant parameters that investigate the reaction to multiple doses of TOT are essential.[27] The post-stroke functional improvement of the UE is often slow compared to LE. For determining the most effective therapeutic interventions for patients unable to accomplish functional hemiplegic UE strength, more studies are needed.[14]

The current review revealed that although heterogeneity existed in the studies in terms of study designs, locations and outcome measures, there was a constant pattern encouraging the use of TOT. The TOT rehabilitation in combination with other physiotherapeutic techniques is used to enhance the strength and motor function of UE post-stroke. There should be more studies comparing the effect TOT with different techniques to improve UE motor function.

One of the important limitations of the current systematic review is the quality of the included studies. Few researches have been done to evaluate the effects of TOT on patients in acute and sub-acute phases of stroke because more focus has been on the chronic phase of stroke. This remains questionable that why more improvement could not be seen in studies dealing with the chronic phase of stroke. Further studies should be conducted with variation in parameters.

Further clinical trials should also be conducted to find the effect of TOT in improving QOL, functional activities, social role and emotional development after UE function improvement. TOT should be used in clinical and hospital setups to improve UE function in patients with stroke. Current evidence suggests TOT is better than all other physiotherapy interventions to improve UE function.

Conclusion

All the studies reviewed in the systematic review concluded that TOT rehabilitation was beneficial in the improvement of UE functions post-stroke.

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