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Review Article

CONSTRAINT INDUCED MOVEMENT THERAPY AFTER STROKE: A REVIEW

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ABSTRACT

Constraint-induced movement therapy (CIMT) was developed to overcome upper limb impairments after stroke and is the most investigated intervention for treating stroke patients in the previous decades. This review describes the current evidence regarding original CIMT and modified versions of CIMT (mCIMT). For this literature review, the publications of last 6 years were searched and analyzed. Randomized control trial (RCS), literature review and meta-analysis that were published in the English language were selected and the reference list in all articles was checked for additional data sources. After analysis and evaluation of all the collected articles related to CIMT conclusion favoring CIMT was made as compared to the traditional and other treatment modalities for early improvement of motor function of upper limbs after acute stroke. CIMT was found to be more beneficial in improving the symptoms of hemineglect after stroke with more benefits than other conventional therapies in improving the quality of daily life in immediate basis.

Key words: Stroke, Constraint induced movement therapy (CIMT), Rehabilitation.

INTRODUCTION

Stroke is a common and frequently occurring disease, and its onset age tends to be younger. With the continuous improvement of medical diagnosis and treatment technology, although the mortality rate of acute stroke has decreased significantly, the disability rate however has increased [1].

It has complex etiology. Due to the different location, size and nature of brain injury, it is clinically manifested as motor, sensory, verbal, swallowing, cognitive and heart rate dysfunction. Among them, motor dysfunction sequelae is the most prominent, which causes limb paralysis on the affected side, long-term bedridden, difficult to take care of themselves, social status decline, and great psychological trauma to patients. These disabilities seriously affect the quality of life of patients and their families, and make the whole society bear a heavy medical burden [2].

85% [3] of stroke patients were accompanied by upper limb dysfunction, and 55-75% [4,5] of them still have upper limb dysfunction during the recovery period, and the recovery of upper limb dysfunction is more difficult than that of lower limb function [6,7]. Therefore, rehabilitation plays an important role in overcoming the disability caused by stroke. In this study, we discussed various rehabilitation techniques, especially with regard to constraint induced movement therapy. In this study, we did a strict evaluation and analysis on the randomized controlled trials of constraint induced movement therapy in the treatment of upper limb dysfunction of stroke patients with hemiplegia, so as to explore whether the constraint induced movement therapy is superior to the general rehabilitation therapy based on technology and motor relearning technology, so as to provide rehabilitation measures for clinical and provide rehabilitation measures for patients with hemiplegia after stroke to provide a strong basis for the selection of upper limb dysfunction.

The research status of constraint induced movement therapy:

Concept of constraint induced movement therapy:

In recent two years, scholars at home and abroad began to pay attention to a new treatment method, namely constraint induced exercise therapy (CIMT) [8]. This method of stroke rehabilitation includes intensive exercise of the affected arm and very limited use of the unaffected arm during the waking hours [8]. The main treatment strategy is to restrict the use of healthy upper limb, force patients to use the affected side upper limb in daily life, strengthen the affected side upper limb, repeatedly train the affected side upper limb, and transfer the training content to daily life to obtain the curative effect [9,10,11,12]. Therefore, constraint induced movement therapy has been gradually formed and has achieved the good therapeutic effect in the rehabilitation of stroke and traumatic brain injury. At present, the use of this method of treatment has been extended to patients with aphasia after brain injury, children with cerebral palsy or hemiplegia, patients with limb pain after amputation and Parkinson's disease, and achieved good results [16]. Neurodevelopmental therapy, represented by Bobath, Brunnstrom and Kabatt Knott Voss technology, is widely used in the rehabilitation of motor dysfunction after stroke. This technology is mainly focused in the recovery of the motor ability of such patients. At present, the rehabilitation methods used are traditional rehabilitation training and sports relearning technology based on

Technology [17]. Bobath technique, Brunnstrom technique and Kabatt Knott Voss technique have poor effect on upper limb function; while the modified constraint induced movement therapy based on plasticity theory of central nervous system has better rehabilitation effect on hemiplegia after stroke. Therefore, Physical therapists have been trying to find a more effective treatment technology than neurodevelopmental therapy or traditional treatment technology. This treatment method has been widely used in stroke rehabilitation, and achieved good results.

Development of constraint induced movement therapy:

CIMT is a training method developed by Professor Edward and Taub and their colleagues to treat upper motor neuron injury through animal (monkey) experiments developed by neuroscience researchers of Alabama University after several years of research. It was mainly used in laboratory from 1960s to 1970s. This treatment method originated from experiments done in animals and has a solid theoretical basis. In the process of clinical application, it has proved the change of cerebral cortex functional reorganization. It is a rehabilitation treatment technology developed based on the plasticity theory of central nervous system.

Mechanism of constraint induced movement therapy:

Constraint induced movement therapy is mainly used to restrict the use of healthy side upper limb and force patients to use the affected side upper limb in daily life, and focus on short-term intensive and high-dose repetitive training of the affected side, and pay attention to the training of movements in activities of daily life [18]. Its theoretical basis comes from the research results of behavioral psychology and neuroscience: the formation and correction process of "learned non-use". Learned disuse refers to the inhibition of motor function and sensory function after central nervous system injury. This kind of inhibition leads to the loss of motor function of the affected limb in the early stage of injury, and the contralateral limb is used compensable, thus making the affected limb useless. Because this kind of misuse comes from learning after injury, it is also known as learned, non-use. Constraint induced movement therapy is a rehabilitation technology based on the plasticity theory of central nervous system.

Indication of CIMT:

According to Taub and Wolf's experiment, there are three conditions for the use of exercise therapy for stroke patients, mainly by restricting the use of contralateral upper limbs by means of forced devices. There are three conditions for constraint induced movement therapy for stroke patients, and studies have shown that about 75% of patients after stroke meet these conditions [29].

- 10 degrees active wrist extension on the affected hand
- 10 degrees active thumb abduction on the affected hand
- 10 degrees active extension of any other two digits on the affected hand

Limitations of CIMT:

The subjects were required to wear gloves on the side of upper limb with less injury during 90% awake time to limit their activities and carry out compulsory training for more than two weeks. At the same time, subjects were asked to do six hours of repetitive training (RTP) and adaptive training (ATP) [19,20] five days a

week. The repeated training with high intensity can easily fatigue patients. Therefore, there are still many patients and therapists who are not willing to use this treatment technology [21,22]. Constraint induced movement therapy ignores the bilateral synergy in daily activities, and overemphasizes the single movement of the affected upper limb [23]. Therefore, many researchers believed that this treatment is not feasible in clinical application. Therefore, some researchers further put forward the concept of modified constraint induced exercise therapy [24] and believe that the modified constraint induced movement therapy is a kind of constraint induced movement therapy. On the basis of guided exercise therapy [25], the intensity and repetition times were adjusted according to the patient's condition and tolerance, and only some movements suitable for the patient were selected for special training, 2 hours each time, 3 times a week, and each training also limited the healthy side's body activities, continuous training for 10 weeks, other training contents were carried out in daily life [26]. The therapeutic effect of mCIMT is superior to that of CIMT and its acceptance is also more extensive as it has overcome many problems of CIMT [27, 28]. Hence, the modified version of this movement therapy may be more suitable as compared to the older technique for patients after stroke.

Efficacy evaluation of constraint induced movement therapy:

Among them, the rehabilitation effect of CIMT therapy can be evaluated by the international authoritative evaluation forms, such as Motor activity log (MAL) [30], Fugl Meyer assessment (FMA) [31], Motor assessment scale (MAS) [32], Barthel Index (BI) and Wolf motor function test (WMFT) [33].

Application of constraint induced movement therapy in stroke patients:

Research on upper limb dysfunction:

A large number of studies have shown that "learned non-use" widely exists in patients with cerebral infarction hemiplegia [34]. After correct and systematic rehabilitation training, patients can effectively avoid the occurrence of "learned non-use" or correct the "learned non-use". Taub [35] et al. Found that this therapy can significantly improve the activities of daily living, quality of life and working ability of patients in real life, and through follow-up such treatment effect can last for more years after treatment. In addition, seven American rehabilitation institutions participated in the prospective study of constraint induced movement therapy in the treatment of upper limb motor dysfunction after sub-acute stroke. A randomized controlled trial [36] was conducted. 202 stroke patients were collected and the motor activity recording scale and motor function scale were used as evaluation tools. The results showed that two weeks of simultaneous therapy could significantly improve the motor function of the upper limbs after stroke compared with the traditional rehabilitation treatment group. From the perspective of evidence-based medicine, it has fully proved the effectiveness of constraint induced movement therapy in the rehabilitation of the affected upper limb. Wang Wen Qing and others through the rehabilitation research of cerebral infarction patients believe that constraint induced movement therapy can improve the upper limb movement mode and improve the fine movement and movement speed of hands in a short period of time, and its curative effect is obviously better than that of traditional treatment method. Wang Gang (37) and others believe that constraint induced movement therapy

can promote the recovery of upper limb function in patients with sub-acute stroke hemiplegia, and its curative effect is better than conventional treatment method. Wang Gang also concluded that constraint induced movement therapy is superior to traditional rehabilitation therapy in improving upper limb function of patients in sub-acute and chronic stage after stroke, and is also applicable to patients in acute stage, which can significantly improve the flexibility of upper limb of patients, and its curative effect is far better than that of traditional rehabilitation therapy (38). Henderson C A (39) et al. studied 13 patients with sub-acute or chronic stroke and two patients with sub-acute brain injury. The results showed that the modified constraint induced movement therapy could significantly improve the motor function of the upper limbs and improve the daily activities of the upper limbs, and these effects could last for more than 3 months. Zhang Zhi Chao (40) and others believe that the modified constraint induced movement therapy has a positive therapeutic effect on the recovery of affected upper limb function. This study showed considerable improvement in the motor function of affected upper limbs, the ability of daily life activities and also the quality of life. Moreover, its effect on improving upper limb function and daily living ability of stroke patients with hemiplegia is more significant than that of older technique of the movement therapy.

Research on lower limb dysfunction:

Numata (41) and others used constraint induced movement therapy to train a patient with right hemiplegia. It was observed that the right lower limb began to move autonomously after the contralateral limb was restricted. Wang Wen Qing (42) introduced constraint induced movement therapy into the rehabilitation of lower limb function of hemiplegic patients, and achieved good results. Using (improved) constraint induced movement therapy to train the lower limbs of hemiplegic patients can significantly improve the function of lower limbs; improve the balance ability and walking ability of patients.

CONCLUSION

Since the start of constraint induced movement therapy, there have been more and more researches on the rehabilitation of stroke patients with hemiplegia, and most of them believe that its curative effect is better than that of conventional rehabilitation therapy. Through the analysis and evaluation of the literature related to constraint induced movement therapy, it is concluded that constraint induced movement therapy can improve upper limb motor function after acute stroke more effectively than traditional treatment and other treatment methods. Constraint induced movement therapy is more beneficial to improve the symptoms of hemiplegia after stroke. Compared with other traditional therapies, constraint induced movement therapy also has greater benefits in improving the quality of daily life. However, the use of CIMT therapy and the impact of curative effect still need more research to play its greater value. Further studies are needed to assess its long-term benefits, and it can be said that there are few studies on the combination of therapies.

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