Mini-Review Article • DOI: http://dx.doi.org/10.2478/medu-2020-0004 Medical University • 3(1) • 2020

Medical University

EFFICACY OF CURRENT METHODS FOR CORRECTION OF TALIPES EQUINOVARUS IN PATIENTS WITH CENTRAL HEMIPARESIS

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Abstract

The problem of physiological gait stereotype restoration in patients with post-stroke central hemiparesis remains relevant to this day. This is primarily associated with high risk of falls in this category of patients. At this point, there is a wide variety of methods related to exercise treatment and robotised correction or restoration of impaired gait against the background of post-stroke hemiparesis. At the same time, the problem of management of talipes equinovarus associated with this syndrome remains quite complex and not completely solved. We have analysed existing methods of talipes equinovarus correction with different levels of evidentiality.

Keywords

talipes equinovarus • hemiparesis • risk of falls

Main Text

Both the problem of cerebrovascular accident (CA) and the process of rehabilitation after CA remain relevant in all states around the globe [1]. The objective of verticalization with subsequent gait restoration is top priority for post-CA patients with the syndrome of central hemiparesis. Each stage of recovery involves application of walkers, quad canes. Walking without support has a risk of falls. According to existing research, the risk of falls after stroke for the inpatient varies from 14% to 65% [2, 3].

After discharge, falls occurred in 73% of the cases [2]. Such high possibility of falls for central hemiparesis patients is determined by several factors. These are, firstly, reduction of muscle strength and loss of the capability of leaning on the paretic extremity. Oftentimes, patients develop incorrect centre-of-gravity shifting (CoG). In particular, the shift occurs in direction of the intact extremity. This makes the patient less stable and the risk of falls during gait increases. Also, of large importance in occurrence of falls in central hemiparesis patients is the formation of talipes equinovarus. At the current stage of neurorehabilitation technology development, there are different methods for correction of muscle strength deterioration and CoG shifting which in turn leads to decreased risk of falls during gait. However, methods that effectively correct talipes equinovarus are quite restricted and insufficient.

Let us investigate into the reasons determining this. Hypertonia occurs in the following muscles in equinovarus deformity: tibialis anterior, tibialis posterior, peroneus longus, soleus, gastrocnemius, extensor hallucis longus, flexor hallucis longus [4]. This changes gait biomechanics. Talipes equinovarus prevents natural maximum ankle-joint dorsiflexion at the third stage of the gait cycle, restricts foot lifting from the supporting surface at the beginning of the fourth stage [5]. Additionally, there is a decrease in the support surface area and compensatory knee-joint hyperextension [6].

Means and methods exerting influence on talipes equinovarus could be conveniently classified into methods removing the defect and methods correcting it. The methods completely removing talipes equinovarus are the following: proprioceptive correction suits, spasticity-decreasing methods, central muscle relaxants, biological feedback with electromyography, vibration therapy and percutaneous electric neurostimulation. The methods that only temporarily correct talipes equinovarus are orthoses.

Let us give a more detailed description of each method. The proprioceptive correction suit consists of supporting and load parts. This system works as a muscle support structure. Elements of the system are located in close approximation

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to extensors, flexors and rotation muscles. Thus, it is possible to achieve reflective response of the organism to external stimulation. Analogical elements are located on the foot for correction of its positioning. The evidentiality level of this method is D [7, 8].

One of the options for paretic extremity spasticity decrease and thus elimination of talipes equinovarus is vibration treatment (Vibromatic, "Grizzly"). However, application of this method has a number of restrictions: epilepsy, common infectious diseases, third-degree cardiovascular insufficiency, severe angina, malignant tumours, thrombophlebitis, trophic ulcers, severe neuroses and significant endocrine system dysfunction. The average course of treatment totals 10 procedures [9, 10].

The method of EMG with biological feedback is recommended for correction of spasticity with the C-level central hemiparesis syndrome. The method implies the following: application of electrodes on active muscles leads to appearance of an electromyographic signal which is in accordance with the real activity of the muscle. Therefore, the patient and the attending physician may assess objectively real physical activity and the response of the muscle to the load [11].

Also, on the purpose of spasticity decrease and alleviation of the pain syndrome, the patients are recommended to undergo percutaneous electric neurostimulation. It evokes the "blockade" of the pain impulse, increase in local blood flow, decrease of the perineural oedema, destruction of algogenic substances (bradykinin) and inflammation mediators (acetylcholine, histamine). The method uses impulse current 2-400Hz with short impulse duration (20-50ms) [12, 13].

Application of physiotherapy as means reducing spasticity in the paretic foot is also relevant in the modern neurorehabilitation practice. These may include thermal procedures, as well as electric stimulation of certain muscle groups, e.g. tibialis anterior [14].

Therapeutic massage of paretic limbs exerts positive influence on decrease of the muscle tone. It is recommended to use light stroking of affected muscles. The antagonist muscles, oppositely, can be rubbed or massaged with superficial kneading in a faster pace [15].

Additionally, there are medical treatment methods for spasticity decrease in the paretic foot of patients with central hemiparesis syndrome. These include: local antispasmodic therapy using A-type botulinum toxin that leads to development of chemodenervation. A-type botulinum toxin affects neuromuscular transmission directly due to release of acetylcholine at the presynaptic level and further long-term muscle relaxation. This determines its antispasmodic action. Botulinum toxin injection must be performed directly into spasmodic muscles in an optimally selected dose, which provides for a positive and safe effect [16]. This method is recommended for muscle tone lowering, increase of movement volume in the impaired extremity, contracture development prevention, gait improvement and pain alleviation in spastic patients [17, 18]. It is most effective to combine botulinum toxin therapy and rehabilitation methods [19]. This provides for improvements in gait pace acceleration, step length increase, static and dynamic balance improvement and, consequently, reduction of the risk of falls. Dosage: it is recommended to adhere to intervals of at least 12 weeks between injections in order to prevent development of resistance to the preparation. The evidentiality level for this method is A [20, 21].

Usage of central muscle relaxants is recommended for treatment of generalised spasticity that significantly restricts mobility and working capacity in patients with central hemiparesis [22]. Muscle-relaxing action is determined by affecting α2-adrenergic receptors located at the spinal cord level. Another possible mechanism is facilitation of inhibitive influence of GABA and decrease of neural transmission activity, which lowers motor cortex excitability [23]. However, action of central muscle relaxants is not targeted in relation to separate muscle groups. This may lead to the development of undesired general muscle weakness [24]. This type of therapy has the evidentiality level B.

Foot orthoses are technical means of rehabilitation used for foot load alleviation, its fixation and correction of talipes equinovarus. Despite temporariness of their effect (for the duration of wearing), this means of correction has evidentiality level A. It is recommended in the setting of need for immediate improvement of gait quality and velocity or weight distribution in legs during standing and walking [4]. Usage of orthoses may be temporary during rehabilitation exercises or constant in order to eliminate the risk of falls during the patient's independent walking [25].

Conclusion

It becomes obvious from studying accessible methods of talipes equinovarus correction for post-stroke patients with hemiparesis that there is no method that would eliminate the aforesaid defect completely. All described means and methods only partially solve the problem. Thus, the risk of falls remains high for this category of patients. As a consequence, search for a brand-new solution in correction of talipes equinovarus in the patient with central hemiparesis syndrome remains relevant.

Conflict of Interest Statement

We declare that there is no conflict of interest that would be associated with this paper.

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