Effect of botulinum toxin injection in rectus femoris in stroke patients with stiff knee gait: Analytical effect and in gait re-organization

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Objective.– Over the past few years, several studies have shown that a botulinum toxin (BTX-A) injection in the rectus femoris muscle (RF) could enhance stroke patients’ walking capacity (Robertson et al., 2009). However, the mechanisms behind these benefits are still unknown. The aim of this study was to compare the analytical effect of BTX-A in the RF muscle (passive stretch and voluntary strength assessed by an isokinetic dynamometer) and functional repercussions on gait (assessed by three-dimensional motion analysis) in spastic hemiparetic patients with stiff knee gait (SKG) caused by RF spasticity.

Methods.– Ten stroke patients with SKG caused by RF spasticity were included and evaluated before and after a BTX-A injection in RF. Analytical evaluations consisted of: (i) a clinical examination; (ii) an assessment using an isokinetic dynamometer with surface electromyography (in order to quantify passive stretch and knee flexor and extensor voluntary strength); (iii) a three-dimensional motion analysis gait assessment (in order to quantify spatiotemporal and kinematic gait parameters).

Results.– One month after BTX-A injection in RF, the following results were found: (i) a decrease in knee extensor strength and an increase in knee flexor strength; (ii) no change in the intensity of extensor activity during passive stretch; (iii) an increase in the angle at which the stretch reflex occurred. 3D analyses showed an increase in gait speed, which was related to an increase in cadence and an increase in peak knee flexion during swing phase.

Discussion.– The improvement in knee flexion following BTX-A injection in RF seems to be related to an increase in the angle at which the stretch reflex occurs with no change in intensity of the contraction. This change in the threshold of the sensitivity of neuromuscular spindles infers that BTX-A affects the motoneuron γ-neuromuscular spindle synapse (Tronquet et al., 2006).

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Biomechanical, clinical and gait analysis’ effects of BoNTA injection in the rectus femoris muscle of incomplete SCI patients

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Background.– An understanding of the mechanical effects of botulinum toxin types A (BoNTA) on spastic and voluntary muscle contraction may help predict functional responders.

Objective.– To compare the effect of BoNTA on voluntary and stretch reflex-related torque (and angle at peak torque) produced by activation of the rectus femoris (RF) muscle.

Methods.– A prospective open pilot study. n = 15 incomplete SCI patients, impaired by a specific RF spasticity (n = 20), with RF hyperactivity in mid-swing and a stiff-knee-gait quantified by formal Gait Analysis (GA), were assessed before and after BoNTA injection (Botox, 200 UI). Main outcome data on spasticity were obtained by a pure tapping test on the RF muscle and knee extensors. Biofeedback or MTx targets were set to normalize spasticity (0 = normal, 10 = maximal spasticity). Individualized BoNTA (Botox) was injected during a 4-week period. The patients were examined twice weekly with a pure tapping test and a 3D motion analysis system. MTx data were recorded before and after BoNTA.

Results.– Four patients received 300 UI BoNTA and were excluded due to lack of MR access. The other 11 patients received 200 UI BoNTA and were assessed twice weekly. Ten patients were reassessed at the end of the 4-week period. Before BoNTA, the mean spasticity of the affected RF muscle was 7 ± 0.5 (SD). After BoNTA, the spasticity of the affected RF muscle was 2.5 ± 0.5, which is a significant improvement (p ≤ 0.05).

Conclusion.– BoNTA injection in the RF muscle caused a 60% decrease in spasticity and a gain of passive joint movement of 8.5° on average.

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