Foot drop due to the progressive force decline of tibialis anterior muscle is one of the most significant factors for the increased risk of falls in Myotonic Dystrophy type I (DM1). Tibialis anterior is the most affected muscle with a 12% mean force decrease in 5 years vs 5-8% in the other muscle groups. So far, DM1 is missing restorative interventions able to counteract ankle dorsiflexion weakness, especially in cases of severe involvement. Functional Electrical Stimulation (FES) is a new rehabilitative approach and refers to the process of pairing the electrical stimulation with a functional task in persons unable to perform movements actively.4

AIM OF THE STUDY

To assess the efficacy of FES in improving tibialis anterior muscle strength, endurance and gait speed in DM1.

PATIENTS AND METHODS

DMS regimens were divided in two groups according to the rehabilitation training carried out:

FE5 Training Group

FES induced cycling training was performed for 30 minutes each day, for 3 weeks.

Resistance and Aerobic Training Group

Moderate isometric strength (30 minutes each day for six weeks) associated with aerobic training on a cycle ergometer (30 minutes daily sessions, speed 60% of the maximum heart rate).

Muscle MRI

Muscle MRI was performed in the lower limbs at the baseline (T0) and at the end of the treatment (T1), using a 1.5 T MRI scanner (1.5 T Philips Achieva). T1-weighted sequences and T2 images with fat saturation (SIPR) were acquired with the following parameters: field of view = 220x220 mm; voxel size: 0.8x1.31x5 mm; slices: 40; thickness = 5 mm; reconstruction matrix = 528x528 voxels. The extent of fatty replacement was scored on T1w images using the scale published by Mercuri et al.4

ROD based MRI voxel-wise quantification of tibialis anterior percentage of fatty infiltration. Some baseline and post treatment sections of acquired axial T2-SPIR on tibialis anterior were visually-based selected. In both sections, only left leg was then included in quantification process by cropping images using MRIcron tool. ROD were drawn outlining a) the cross sectional area of the whole leg section b) the cross-sectional area of whole the tibialis anterior muscle. In order to avoid bias of field size disomogenity on fat suppression quantification, the tibialis anterior muscle ROD was masked, thresholding low gray values at the minimum level that preserve leg section inclusion from foreground air noise. In order to avoid field of View change and voxels partial volume effect bias between assessment on volume quantification, post-treatment volumes expressed in cc were normalized using cross sectional area of the whole leg section rate between post-treatment and baseline. Percentage of change between post-treatment and baseline was then calculated.

RESULTS

Muscle strength

Table shows MRC scores at baseline (T0) and at the end of rehabilitation (T1). A significant improvement of global muscle strength as well as of tibialis anterior muscle strength was found only in the FE5 training group.

Muscle MRI

Fig. a-d show T1 weighted - TSE and T2-TE SPGR images of the left leg of subjects 1 and 4, acquired at baseline and after 3 weeks of FES training.

CONCLUSIONS

FES can be considered a valid tool to improve endurance and muscle weakness in DM1, also in muscles more severely compromised in which no other rehabilitative options are otherwise available.

The increment of the distance walked in six minutes without significant changes in the 10mWt might suggest a predominant effect of FES on type I slow twitch muscle fibers, which are known to be selectively atrophic in DM1.

FES is safe and well tolerated. DM1 patients could maintain a good muscle function for longer time reducing therefore the risk of serious adverse events.

More extensive controlled trials are needed.