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JOINT FUNCTION CHANGES IN HEMIPARETIC GAIT AFTER VISUAL EMG BIOFEEDBACK TRAINING

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AIMS: Post-stroke patients often show gait abnormalities related to inappropriate dynamic voluntary activation of the ankle plantar/dorsi-flexors [1]. Retraining of these muscles and related ankle function should be incorporated into a gait-retraining program. The use of dynamic EMG biofeedback procedures to overcome limitations of retraining muscles in isolation has been proposed [2]. Results demonstrated improvements in specific quantitative gait parameters. However, the experimental setup, including overground walking, limited its scope of clinical application. Treadmill walking is often used as a substitute to overground walking and it is especially convenient when used by less functional patients. We hypothesized that treadmill gait retraining with visual EMG biofeedback could be beneficial to hemi-paretic subjects.

METHODS: Eight adults (7M, 1F; age range: 47-59) more than 2 years post-stroke with residual ankle plantar-dorsiflexion strength (MRC≥3), limited spasticity (Ashworth <2), not receiving physical therapy, able to walk at a speed between 0.5 and 0.9 m/s participated in the study. During the training sessions, subjects walked on a treadmill at a comfortable speed and EMG from the gastrocnemius lateralis and tibialis anterior muscles in addition to footswitch signals were collected (five trials of 4 min each). The target EMG (normal activation intervals) and the real-time rectified EMG patterns were shown on a screen display positioned in front of the subject. Before and after the 12-session treadmill training, gait data were recorded (Vicon512). Statistical analysis of the gait data was performed on a subject-by-subject basis. Gait and joint parameters before and after treatment were compared using a two-tailed Mann-Whitney U test (significance $p<.05$, trend $.05<p<.1$).

RESULTS: The p-values for the pre- and post-training comparison of selected gait and joint parameters are shown in Table. Walking speed increased significantly in 5 subjects, decreased in 1, and showed a decrease trend in 1 subject. Affected side single support increased in 5 subjects and showed an increase trend in 2 other subjects. Significant increase in stride length was shown by 4 subjects and 1 subject showed an increase trend. All but 1 subject showed an increase in ankle power generation at push off (significantly in 5 subjects). Changes in knee extensor moment were found in 5 subjects.

n	walking speed	affected side single support	affected side stride length	max plantar, stance	max plantar, push-off	peak ankle power	max flex. mom., stance	max ext. mom., stance
1	**0.016**	NS	NS	NS	**0.032**↓	NS	NS	NS
2	**0.008**↓	**0.008**	NS	**0.008**↓	0.095	NS	NS	**0.008**
3	NS	0.056	0.095	**0.008**	0.056	NS	0.095	**0.008**
4	**0.008**	**0.008**	**0.008**	0.056	0.056	**0.008**	NS	**0.008**
5	0.056↓	**0.008**	NS	**0.008**	NS	**0.008**	**0.008**	**0.008**
6	**0.008**	0.056	**0.008**	**0.008**	0.095	**0.008**	0.095	NS
7	**0.008**	**0.032**	**0.008**	NS	**0.008**	**0.016**	NS	**0.008**
8	**0.008**	**0.032**	**0.008**	0.095	**0.008**	**0.008**	**0.008**	0.095

P-values for changes in selected gait parameters for each of the 8 subjects. Statistically significant (bold) and trend (plain) changes

CONCLUSIONS: An overall positive response to the intervention can be inferred by the significant changes seen in most subjects. By training the gastrocnemious lateralis, subjects achieved timing and magnitude of muscle activity that led to an increase in ankle power at push off. The training of the tibilias anterior enabled subjects to dorsiflex the ankle during swing and attain heelstrike at ground contact aiding foot clearance and reducing circumduction.

[1] Kerrigan et al, J Head Trauma Rehabil, 1999. 14:136-45.
[2] Colborne et al, Arch Phys Med Rehabil, 1993. 74:1100-6.