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Telerehabilitation in MS: Gait, Balance, and Patient-Reported outcomes

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Introduction and Purpose

- MS commonly results in physical and cognitive disability. Functional improvement of established physical deficits can be achieved through rehabilitation methods to include physical therapy (PT).
- Access to specialized rehabilitation services is limited due to a variety of factors including availability, geographical distance, mobility limitations, transportation difficulties, and financial constraints.
- Telecommunication technology offers the capacity to supervise and direct a PT program remotely through audio and visual real-time communication.

Purpose:
Demonstrate the feasibility and evaluate the efficacy of a telecommunication Physical Therapy (T-PT) program for gait/balance and patient-reported outcomes (PRO) for fatigue, confidence, and self-efficacy in individuals with ambulatory deficits secondary to MS .

Methods

Design:
Single-center, prospective, randomized, three-arm, evaluator blinded, 8-week study.

Subjects:
Thirty individuals were included (female 69%, mean age 54.7 years, RMS 60%. SPMS 23%, PPMS 17%, mean EDSS 4.3) and randomized in a 1:1:1 fashion.

Intervention:
A customized home-based exercise program (HEP) was performed unsupervised 5 days a week for 8 weeks by all subjects.
Group 1 (control)- HEP unsupervised;
Group 2 (T-PT)- HEP plus remote PT supervised via audio and visual real-time telecommunication 2-3 times per week;
Group 3 (PT)- HEP plus on-site PT at the medical facility 2-3 times per week.
Outcomes were measurements of gait, balance and patient reported outcomes (PROs). Selected outcomes were performed with a computerized system (NeuroCom SmartBalance).

Outcomes (performed at baseline and week 8):
Gait measures: EDSS, T25FW, Functional gait assessment (FGA), NeuroCom Smart Balance Master walk tests.
Balance measures: Berg balance scale, NeuroCom Smart Balance tests.
Quality of life questionnaires (PRO): Short form-36 (SF36), Fatigue impact scale (MFIS), functional activities balance confidence scale (ABC), and self-efficacy questionnaire (MSSE).

Statistical Analyses
T-tests (two-tailed) were performed on the mean of the (after-before) differences for each variable grouped by treatment type to test for significant differences from 0. This was to test if each treatment has a statistically significant effect on the considered variable.
False discovery rate corrected pair-wise t tests (two-tailed) were performed to test for significant differences amongst the considered variable across treatments. This was to test if a particular treatment had a statistically significantly different effect on a variable than the other two treatments.
Between these two analyses one can assess if a) a particular treatment makes a significant impact on the considered variable, and b) is one treatment significantly more impactful on a variable than the other treatments.
Statistical significance was defined as a p value <0.05.
Program used was R Core Team (2016, Vienna Austria) .

Results

All 3 groups exhibited benefit on some of the outcomes when compared to baseline (Table). T-PT had statistical improvement in FGA and SF36m and a strong trend for MFIS. PT showed benefit in those outcomes and on the SP36p. The control group showed improvement on ABC, FGA and MSSE but not on the SF36m or SF36p.
Comparison of the mean difference scores pairwise between treatment groups found that SF36m was significantly more improved in the PT group than in control (p=0.0047 FDR corrected). SF36p in the PT group was significantly more improved than in the T-PT and control groups (p=0.0090 FDR corrected).
In order to put an overlay of the "average" of all gait/balance/self reported variables, the directionality of the variables needs to be the same (Graph). In order to achieve this, all variables z-scores whose desired directions were "low" (lower values representing a better outcome) were multiplied by negative 1.
One participant dropped out due to an MS relapse.

Table 1

Gait Variable	Control-mean	T-PT-mean	PT-mean	Control.diff.zero	T-PT.diff.zero	PT.diff.zero	p.T-PTvsPT	p.T-PTvsControl	p.PTvsControl
FGA	2.9000	4.0000	3.5556	0.0002	0.0006	0.0095	0.7308	0.7308	0.7308
T25FT	-0.5540	-1.2960	-1.3478	0.0708	0.0933	0.0255	0.9566	0.6391	0.6391
WA.length	0.1400	3.1680	-0.2167	0.4841	0.0855	0.5362	0.6430	0.6430	0.9273

-For Table 1 and Table 2:
-First three columns are the difference between the mean after-treatment scores minus the mean before-treatment scores
-Next three columns are the p-values for the t-tests to determine if the first three columns of values are significantly different than 0
-Last three columns are the p-values (FDR corrected) for the two sample paired t-tests comparing the mean differences between each pairing of groups.

Figure 1-6

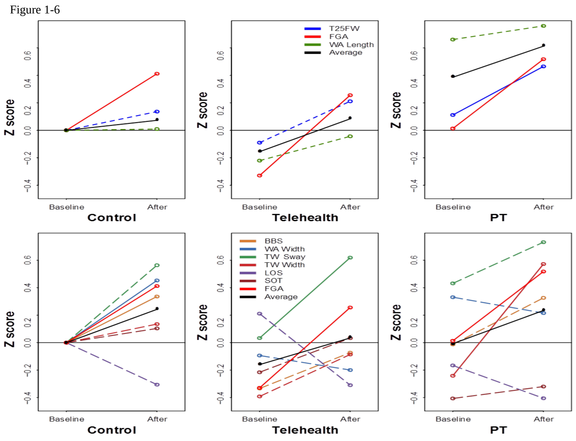
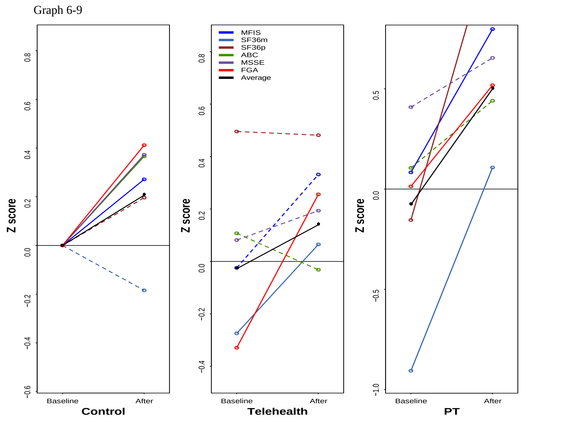


Table 2

Self Report Vars	Control mean	T-PT mean	PT mean	Cont.diff.zero	T-PT.diff.zero	PT.diff.zero	p val.T-PT/PT	p val.T-PT/Con	p val.PT/Cont
ABC	9.2000	-2.9000	9.0000	**0.0279**	0.6004	0.1351	0.4757	0.4757	0.9865
FGA	2.9000	4.0000	3.5556	**0.0002**	**0.0006**	**0.0095**	0.7308	0.7308	0.7308
MFIS	-5.0000	-6.5000	-13.3333	0.0835	0.0530	**0.0175**	0.3762	0.7932	0.3762
MSSE	5.2000	1.7000	4.1111	**0.0372**	0.3223	0.0618	0.7965	0.7965	0.7965
SF.36.m	-2.0500	2.9667	11.8333	0.8389	**0.0438**	**0.0118**	0.0546	0.2112	**0.0047**
SF.36.p	3.2000	4.1556	21.7875	0.0849	0.0762	**0.0073**	**0.0090**	0.8643	**0.0090**

Graph 6-9



Discussion

For gait measures, (Table 1, Figures 1-6) FGA was found to improve in all three treatment groups, while T25FT only showed significant improvement in PT group.
For balance measures, (Table 1, Figures 1-6) the control group improved for BBS and WA-width. In the T-PT group TW-sway was found to be significantly improved. In the PT group TW-width was found to be significantly improved.
Intervention with a physical activity program results in improvement of quality of life as measured by different PROs.
T-PT showed benefit equivalent to that of on-site PT, except for a specific outcome measure, the SP36p. No significant improvement in treatment effectiveness was identified when compared to the control group. However, PT was also not found to yield significant improvement in treatment effectiveness in any variable other than SF36p when compared to the control group, (Table 2, Figures 6-9). Thus, while there is no evidence that T-PT is a significantly better treatment than the control group of customized self-directed home exercise program, there is also little evidence that PT is a significantly better treatment than control or T-PT.

Conclusions

T-PT is a convenient, practical and effective method to perform PT in MS individuals. It is overall equivalent to conventional on-site PT as measured by patient reported outcomes of fatigue, confidence and self-efficacy, and objective measures of gait and balance.
There is evidence that each treatment strategy is effective in regard to at least two self-reported measures. There may be opportunity for clinicians to assess which measures an individual needs addressed the most and prescribe a treatment protocol accordingly. It may also be possible to give more freedom of choice to each patient depending on the level of treatment involvement (s)he feels most comfortable with. Additional research with larger sample sizes is needed to better assess the comparative treatment effectiveness.
T-PT should be researched further and used more extensively as a mean to improve functional independence and quality of life in MS patients.

Disclosures

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Disclosure: Dr. C. Fjeldstad, Ms. A. Thiessen and Dr. Pardo have no conflicts of interest to report.

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