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A randomized trial of specialized versus standard neck physiotherapy in cervical dystonia

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ABSTRACT

Background: Anecdotal reports suggested that a specialized physiotherapy technique developed in France (the Bleton technique) improved primary cervical dystonia. We evaluated the technique in a randomized trial.
Methods: A parallel-group, single-blind, two-centre randomized trial compared the specialized outpatient physiotherapy programme given by trained physiotherapists up to once a week for 24 weeks with standard physiotherapy advice for neck problems. Randomization was by a central telephone service. The primary outcome was the change in the total Toronto Western Spasmodic Torticollis Rating (TWSTR) scale, measured before any botulinum injections that were due, between baseline and 24 weeks evaluated by a clinician masked to treatment. Analysis was by intention-to-treat.
Results: 110 patients were randomized (55 in each group) with 24 week outcomes available for 84. Most (92%) were receiving botulinum toxin injections. Physiotherapy adherence was good. There was no difference between the groups in the change in TWSTR score over 24 weeks (mean adjusted difference 1.44 [95% CI -3.63, 6.51]) or 52 weeks (mean adjusted difference 2.47 [-2.72, 7.65]) nor in any of the secondary outcome measures (Cervical Dystonia Impact Profile-58, clinician and patient-rated global impression of change, mean botulinum toxin dose). Both groups showed large sustained improvements compared to baseline in the TWSTR, most of which occurred in the first four weeks. There were no major adverse events. Subgroup analysis suggested a centre effect.
Conclusion: There was no statistically or clinically significant benefit from the specialized physiotherapy compared to standard neck physiotherapy advice but further trials are warranted.

1. Background

Cervical dystonia is the commonest type of dystonia with a prevalence of at least six per 100,000 [1,2]. Botulinum toxin injections are the main treatment, which improve neck position and pain [3,4] but often provide inadequate relief [5]. Therefore, alternative treatments are required. Oral medication is usually ineffective [6]. Physiotherapy is used but has a limited evidence-base. Recent systematic reviews of physiotherapy for cervical dystonia [7,8] found only four small (n = 12–40) randomized trials [9–12], testing several combinations of techniques including biofeedback, relaxation therapy, stretching, active exercises and transcutaneous nerve stimulation and concluded no firm recommendations on efficacy could be made.

A well-described, personalized intensive physiotherapy programme (called the Bleton technique after the physiotherapist who developed it) has been used to treat some people with cervical dystonia for several years [13] but has only been evaluated in one small inconclusive trial [12]. We, therefore, did a larger trial to assess whether this technique improved patient outcomes compared to standard physiotherapy advice.

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2. Methods

2.1. Trial design

This was a two-centre, randomized, parallel-group trial, which compared the Bleton physiotherapy technique with standard neck physiotherapy in adults with primary cervical dystonia. Both groups received standard best treatment, which for most included botulinum toxin injections every three months. The trial was registered with ClinicalTrials.gov (NCT00703287), approved by West Glasgow Ethics Committee and all participants gave written informed consent.

2.2. Trial participants

Eligible adult patients were recruited from two Scottish dystonia clinics provided they had a primary, non-psychogenic, focal cervical dystonia with an abnormal neck position (Toronto Western Spasmodic Torticollis Rating Scale (TWSTR) [14] Part 1A > 0) and were able to give informed consent. Patients being treated with botulinum toxin (type A or B) injections had to be on a stable regimen (same dose and injection pattern over the previous two injections) but those not receiving injections were also eligible providing they were happy to remain off injections for the duration of the trial. Exclusion criteria were secondary cervical dystonia, radicular/myelopathic features where cervical manipulation may be dangerous, fused cervical vertebrae shown on previous x-rays, previous use of the Bleton technique or deep brain stimulation.

2.3. Trial interventions

2.3.1. Individualized specialized physiotherapy regimen

Each centre had an experienced study physiotherapist (4–10 years post-qualification) with broad experience in neurological and musculoskeletal rehabilitation, who was trained for six weeks by Monsieur Bleton in his technique. After initial assessment the physiotherapist developed a personalized regimen for each patient according to the Bleton protocol, which has been described in detail (see appendix and ref [13]). Patients were treated in an outpatient physiotherapy department up to once a week for 45 min per session for 24 weeks.

2.3.2. Standard physiotherapy advice

The control group received standard physiotherapy advice for neck problems (see appendix). Although most patients with cervical dystonia in the UK do not get physiotherapy as standard care, we opted for this as a type of “placebo” to reduce potential bias from simply attending the physiotherapist. Patients were offered sessions every two to four weeks for 24 weeks.

For both groups the physiotherapist recorded attendance, duration and type of treatment per session and frequency of home exercises from their diaries. At the end of the intervention period the physiotherapist rated compliance with the exercise programme as poor, moderate or good, and encouraged patients in both groups to continue with the exercises they had been taught. No other neck physiotherapy was permitted for their dystonia during the one-year trial period. Both groups continued to receive standard care for their dystonia throughout the trial including any botulinum toxin injections according their normal schedule. The dose and site of injections could be adjusted according to clinical need.

2.4. Trial outcomes

The primary outcome was the change from baseline to 24 weeks (end of supervised physiotherapy) in the total TWSTR score. This widely used scale assesses neck position and dystonia-related disability and pain and has a teaching video [14], which the study outcome assessors watched to ensure standardization across the two centres. Secondary outcomes were: (i) change in total TWSTR and its subscores (severity of neck position, disability, pain) at 52 weeks (six months post-treatment to assess whether there was a prolonged benefit especially as patients were encouraged to continue with home exercises after the supervised period); (ii) change in Cervical Dystonia Impact Profile-58 (CDIP-58) score at 24 and 52 weeks, a rigorously developed and validated patient-completed 58 item health impact measure for cervical dystonia, which covers eight dimensions of health (head and neck symptoms, pain, upper limb activities, walking, sleep, annoyance, mood, psychosocial function) [15,16]; (iii) patient and clinician-based global impression of change on a seven point Likert scale (marked/moderate/minimal improvement, no change, minimal/moderate/marked deterioration) at 24 and 52 weeks; (iv) change in a generic quality-of-life measure, the EQ-5D, at 52 weeks; (v) adverse events defined as any unfavourable sign, symptom or illness that developed or worsened during the study, regardless of whether it was considered to be related to study treatment.

2.5. Randomization and masking

Consent and baseline assessments were done by the clinician/nurse involved in the patient's routine care before randomization, who then informed the physiotherapist who randomized each patient by telephoning a central randomization service at the Centre for Healthcare Randomised Trials, University of Aberdeen. Randomization was by a minimization algorithm using centre, the use of botulinum toxin and type of dystonia (predominantly tonic/static head deviation versus marked jerky/tremulous component). Only the treating physiotherapist was informed of the treatment allocation: the clinician/nurse who performed the outcome assessments remained masked throughout. Patients were unmasked but to minimize bias with the self-completed questionnaires the written and verbal information about the trial highlighted that no form of physiotherapy had been shown to be effective in cervical dystonia and that both groups would receive individualized physiotherapy requiring visits between one and four weekly. The Bleton technique was not specifically mentioned. Patients were told not to discuss their physiotherapy with their clinician/nurse.

2.6. Study visits

The baseline visit was performed just before the next botulinum injection in those having injections when their previous botulinum injection would be wearing off. Baseline data collection included demographic data, co-morbidities, current medication, duration of dystonia, details of previous botulinum toxin treatment and baseline assessment of the TWSTR scale, CDIP-58 and EQ-5D. The neck position was recorded on video using a standard protocol. After randomization, the physiotherapist, who was unaware of the baseline scores, arranged their first appointment as soon as possible. Patients were seen by the nurse four, 24 and 52 weeks after the baseline visit to record subsequent botulinum injections (dose and sites), the TWSTR score (with repeat videos), CDIP-58, patient- and nurse-rated global impression of change and any adverse events. In those receiving botulinum injections the four week visit was timed flexibly so that it occurred about four weeks after their last injection (i.e. the time of maximal benefit), whilst the 24 and 52 week visits took place just before their next injection as the toxin was wearing off, matching the baseline visit, to minimize confounding by the botulinum toxin.

2.7. Sample size and analysis

A worthwhile benefit was felt to be similar to that of botulinum toxin, namely a seven point (standard deviation [SD] 12) improvement in the TWSTR [3] i.e. that specialized physiotherapy sustained the maximum expected benefit of botulinum toxin over the injection cycle in those having injections. Forty-eight patients per group were required to show this difference at 5% significance with 80% power. We aimed to recruit 108 patients allowing 10% loss to follow-up.

Analyses were according to the intention-to-treat principle. The primary analysis was the difference between the two physiotherapy arms in the change in TWSTR score from baseline to 24 weeks adjusted for the baseline TWSTR score, the minimisation factors (centre, type of dystonia [static/jerky], use of botulinum toxin) and age, sex, and duration of dystonia using a normal theory linear model. Similar models adjusting for the same covariates were used to analyse the difference in TWSTR at 52 weeks, the eight domains of the CDIP-58 at 24 and 52 weeks and the EQ-5D at 52 weeks. Higher scores on either TWSTR or CDIP-58 indicate worse health. Patient and clinician-rated global impression scores (grouped as better [marked/moderate improvement], no change including minimal improvement or deterioration, or worse [marked/moderate deterioration]) were compared using Fisher exact tests, and a binary odds ratio for these data grouped as 'Better vs. Not Better' calculated by logistic regression adjusting for the same covariates used to analyse the difference in TWSTR. Predefined subgroup analyses assessed whether the effect of physiotherapy for the primary outcome varied by age, gender, centre, the use of botulinum toxin, the type of dystonia, the duration of the dystonia, the severity of the dystonia (as measured by baseline TWSTR).

No interim analyses were planned. The primary analyses used all the available data at each time point and excluded patients with missing data. We conducted sensitivity analyses assuming the data were missing at random using Rubin's multiple imputation approach to check the findings were robust to missing data. The amount of missing data was insufficient to attempt modelling the missing data under the assumption of a non-ignorable mechanism. No adjustment has been made for multiple comparisons. All analyses were carried out in SAS 9.1.3 (Service Pack 4) for Windows, SAS Institute, Cary, NC, USA.

3. Results

One hundred and ten patients were randomized between January 2008 and November 2008 (92 Glasgow, 18 Aberdeen). The baseline characteristics of the randomized patients were well matched in each group (Table 1). Glasgow patients were slightly older, more likely to be female and more severely affected than Aberdeen patients (Supplementary data Table S1).

Six of the 110 patients (1 specialized, 5 standard) withdrew immediately after randomisation (some before completion of their baseline assessments) and did not receive either intervention. Of the remaining 104, 20 (11 specialized, 9 standard) withdrew from the trial and had no outcome assessed at 24 weeks (Fig. 1). Six other participants either did not complete or missed data from the CDIP-58 at six months. 60% of patients in each group attended ≥80% of

Table 1
Baseline characteristics of randomized patients.

	Specialized physiotherapy (n = 55)	Standard physiotherapy (n = 55)
Mean age (yrs) [SD]	55.3 (13.5)	57.0 (12.9)
Number of women (%)	38 (69%)	42 (76%)
Centre:		
Aberdeen	9 (16%)	9 (16%)
Glasgow	46 (84%)	46 (84%)
Mean duration dystonia in yrs (SD)	13.7 (9.3)	13.4 (7.4)
Dystonia type:		
Static	34 (62%)	33 (60%)
Jerky	21 (38%)	22 (40%)
On botulinum toxin	49 (91%)	51 (93%)
Median dose of botulinum in units[a]:		
abobotulinumtoxin A (Dysport®)	500 (n = 39)	400 (n = 45)
[interquartile range]	[320, 640]	[300, 600]
onabotulinumtoxin A (Botox®)	150 (n = 1)	130 (n = 4)
rimabotulinumtoxin B (Neurobloc®)	1200 (n = 5)	- (n = 0)
Other medication:		
Analgesics	16 (29%)	15 (27%)
Antidepressants	6 (11%)	8 (14%)
Antispasmodics/anti-tremor	12 (22%)	15 (27%)
Mean TWSTR (SD)	n = 54	n = 52
Severity	19.9 (4.4)	20.0 (3.2)
Disability	12.9 (5.8)	13.6 (6.4)
Pain	8.9 (5.6)	9.4 (5.4)
Total	41.7 (12.3)	42.9 (12.1)
Mean CDIP-58 (SD)	n = 54	n = 52
Head & neck	68.1 (20.1)	63.5 (22.8)
Pain	59.9 (24.8)	56.3 (27.0)
Upper limb activities	45.4 (30.0)	46.4 (27.6)
Walking	39.0 (33.1)	44.6 (33.5)
Sleep	42.2 (34.7)	42.8 (33.0)
Annoyance	46.8 (27.3)	43.9 (27.7)
Mood	36.3 (29.2)	33.2 (26.1)
Psychosocial	55.8 (30.0)	53.3 (29.3)
EQ-5D (SD)		
Thermometer	62.6 (21.6) (n = 51)	61.4 (19.0) (n = 48)
Utility	0.51 (0.30) (n = 53)	0.55 (0.27) (n = 49)

[a] Unknown in 6 patients on botulinum toxin.

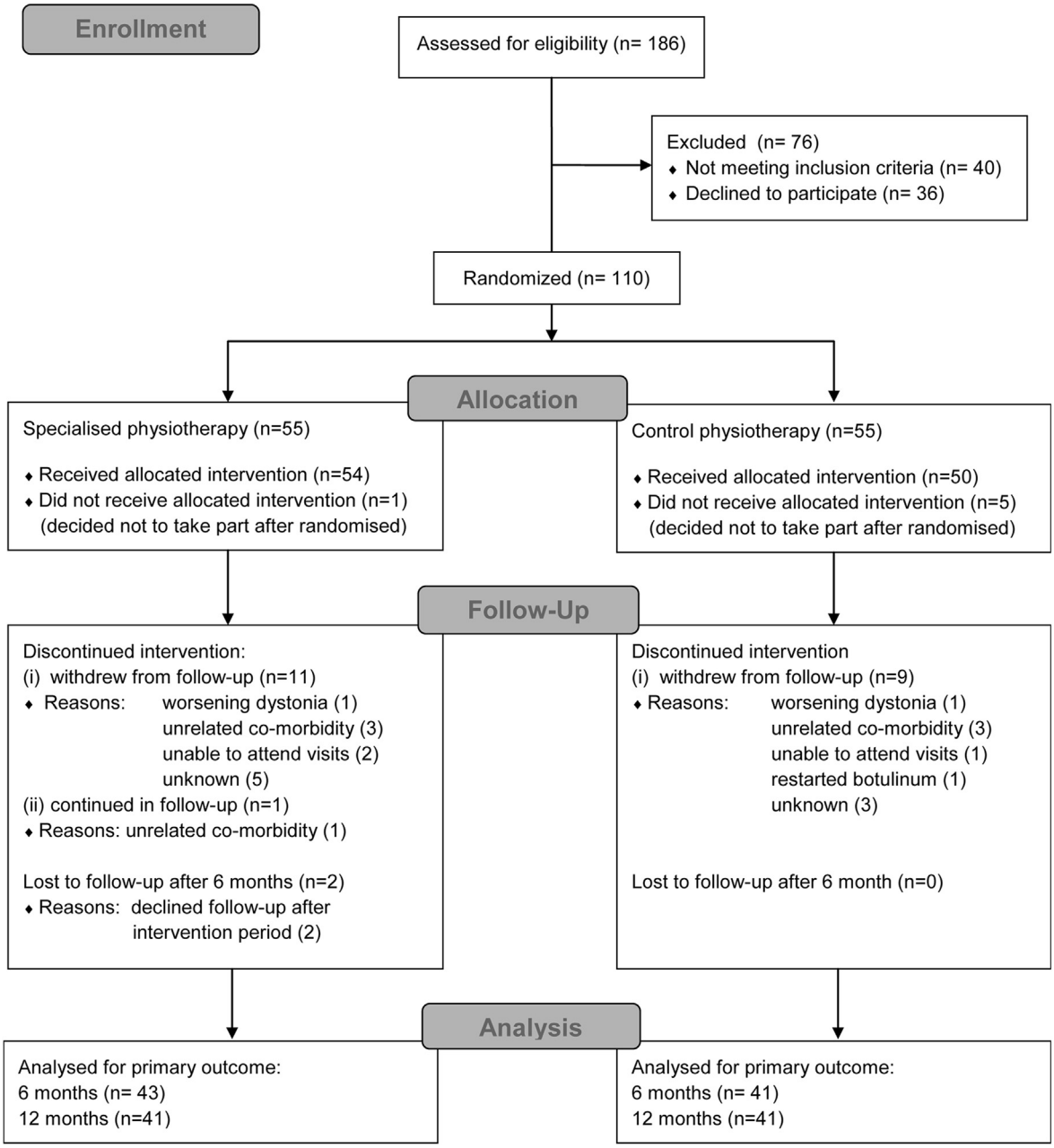

Fig. 1. CONSORT study flow diagram.

the physiotherapy sessions (mean number 14 and 8 in specialized and standard groups respectively) and physiotherapist-rated adherence with each programme was rated good in about 60% of both groups with no differences between the centres (Supplementary data Table S2).

Baseline, 24 week and 52 week assessments were made at a mean of 83 (SD 13.9), 78 (SD 13.5) and 79 (SD 13.6) days after last botulinum toxin injection with no difference between the two treatment groups. Both physiotherapy groups showed large improvements in the TWSTR score (about 10 points) and CDIP-58 subscores at 24 weeks, which were sustained at 52 weeks. However, there was no significant difference between the two groups at either time period (Table 2). The results for the TWSTR scale did not differ when missing data were accounted for using Rubin's approach: at 24 weeks, the difference between the treatment groups was 0.11 (95% confidence interval of −4.75 to 4.97) and at 52 weeks it was 1.74 (95%CI -3.77 to 7.26).

There was no evidence of bias from unmasking of the outcome assessor: there were no reported cases where the patient told the assessor what type of physiotherapy they were receiving; at the end of the trial the outcome assessor was asked to guess each patient's treatment group and the agreement with the actual group was no better than chance (kappa 0.07). One centre (Aberdeen) assessed the TWSTR severity score for all its patients' videos blind to both treatment allocation and visit number and found no change in its scoring.

Most of the improvement occurred during the first month of the trial (Supplementary data Fig. S1). There was no evidence that the treatment effect on the primary outcome varied by age, gender, type of dystonia, disease severity or duration but there was

Table 2
Results of primary and secondary outcome measures at six and 12 months.

	Specialized physiotherapy (SD)	Standard physiotherapy (SD)	Difference[a] (specialized − standard) (95% CI)	P Value
(a) At six months				
Mean change in TWSTR[b]	N = 43	N = 41		
Total Score	−9.60 (10.2)	−11.8 (11.9)	1.44 (−3.63, 6.51)	0.57
Severity	−4.23 (4.64)	−5.22 (5.63)	0.74 (−1.54, 3.03)	0.52
Disability	−2.91 (4.34)	−3.49 (4.94)	0.15 (−1.91, 2.22)	0.88
Pain	−2.46 (4.77)	−3.07 (6.02)	0.38 (−1.86, 2.62)	0.74
Mean change CDIP-58[b]	N = 38	N = 40		
Head & neck	−19.6 (23.7)	−15.0 (23.5)	−3.59 (−14.0, 6.77)	0.49
Pain	−11.8 (22.6)	−12.1 (28.4)	−0.42 (−11.7, 10.9)	0.94
Upper limb activities	−5.4 (20.7)	−10.0 (21.3)	2.43 (−6.94, 11.8)	0.61
Walking	−5.3 (25.3)	−13.7 (21.5)	4.32 (−5.49, 14.1)	0.38
Sleep	−11.5 (20.4)	−16.3 (26.4)	5.04 (−5.50, 15.6)	0.34
Annoyance	−13.8 (21.6)	−8.9 (22.7)	−4.74 (−14.8, 5.33)	0.35
Mood	−8.1 (16.5)	−7.9 (24.3)	−1.35 (−10.6, 7.92)	0.77
Psychosocial	−15.6 (23.9)	−16.9 (24.7)	1.28 (−9.97, 12.5)	0.82
Patient-rated outcome:	N = 39	N = 40	Odds ratio[d]	
Number better/much better	18 (46%)	18 (45%)	1.07 (0.40, 2.84)	0.62[e]
Number mild change/neutral	18 (46%)	21 (53%)		
Number worse/much worse	3 (8%)	1 (3%)		
Clinician rated outcome:	N = 39	N = 39	Odds ratio[d]	
Number better/much better	11 (28%)	11 (28%)	1.17 (0.39, 3.47)	1.00[e]
Number mild change/neutral	27 (69%)	26 (67%)		
Number worse/much worse	1 (3%)	2 (5%)		
(b) At 12 months				
Mean change in TWSTR[b]	N = 41	N = 41		
Total score	−12.2 (10.8)	−14.9 (14.7)	2.47 (−2.72, 7.65)	0.35
Severity	−5.17 (4.63)	−5.34 (6.07)	0.26 (−1.98, 2.50)	0.82
Disability	−5.07 (4.98)	−6.85 (5.98)	1.44 (−0.74, 3.61)	0.19
Pain	−1.99 (4.02)	−2.72 (5.91)	0.43 (−1.67, 2.53)	0.69
Mean change CDIP-58[b]	N = 38	N = 38		
Head & neck	−18.1 (23.1)	−15.2 (24.2)	−1.81 (−12.6, 9.01)	0.74
Pain	−10.8 (26.6)	−13.3 (25.6)	1.64 (−10.0, 13.3)	0.78
Upper limb activities	−6.7 (18.3)	−10.2 (21.2)	2.16 (−6.49, 10.8)	0.62
Walking	−4.8 (21.1)	−8.6 (22.2)	1.39 (−8.25, 11.0)	0.77
Sleep	−7.7 (24.9)	−14.3 (25.2)	7.58 (−3.06, 18.3)	0.16
Annoyance	−13.2 (16.3)	−11.6 (20.7)	−2.00 (−10.2, 6.20)	0.63
Mood	−5.9 (14.8)	−10.6 (21.8)	3.70 (−4.60, 12.0)	0.37
Psychosocial	−13.3 (20.0)	−19.3 (22.9)	5.27 (−4.82, 15.4)	0.30
Patient-rated outcome:	N = 38	N = 37	Odds ratio[d]	
Number better/much better	16 (42%)	15 (40%)		
Number mild change/neutral	20 (53%)	21 (57%)	1.09 (0.42, 2.84)	1.00[e]
Number worse/much worse	2 (5%)	1 (3%)		
Clinician rated outcome:	N = 40	N = 39	Odds ratio[d]	
Number better/much better	17 (43%)	18 (46%)		
Number mild change/neutral	23 (58%)	20 (51%)	0.77 (0.28, 2.11)	0.73[e]
Number worse/much worse	0 (0%)	1 (3%)		
EQ-5D[c]	N = 37	N = 39		
Thermometer	2.0 (24.1)	7.8 (21.0)	−1.2 (−10.7, 8.4)	0.81
Utility	0.07 (0.25)	0.06 (0.24)	0.01 (−0.10, 0.22)	0.88

[a] Adjusted for centre, age, gender, use of toxin, type of dystonia, and baseline score.
[b] Negative value implies improvement from baseline and for the difference between treatment groups that specialized physiotherapy is better than standard.
[c] Positive value implies improvement from baseline and for the difference between treatment groups that specialized physiotherapy is better than standard.
[d] Odds ratio for binary outcome "Better" vs. "Not Better" for specialized vs. standard physiotherapy, adjusted for the covariates above plus baseline TWSTR score.
[e] Fisher exact test.

evidence of a centre-effect: specialized physiotherapy was significantly better than standard in Aberdeen but not in Glasgow (Fig. 2). Post-hoc analyses showed that this centre effect was mostly due to a difference in the severity subscore of the TWSTR and that a marginally statistically significant centre-effect (in favour of specialized physiotherapy in Aberdeen) also existed for the TWSTR disability score and the 'head & neck', 'pain' and 'upper limb' components of the CDIP-58 at 24 weeks (Supplementary data Table S3) but not for any of the other outcomes.

At 24 and 52 weeks patients rated their improvement greater than clinicians with 40–50% in both physiotherapy groups rating themselves as better or much better compared to about 30% by clinician rating. However, there was no significant difference between the groups in either patient or clinician rating (Table 2). Botulinum toxin doses were standardized to the equivalent dose of onabotulinumtoxin A, assuming conversion factors of 1:1:4:50 for onabotulinumtoxin A/incobotulinum toxin A/abobotulinumtoxin A)/rimabotulinumtoxin B respectively [17]. Post-hoc analysis showed that the botulinum doses did not change significantly during the trial: the specialized physiotherapy group used 1.3 units less toxin per visit versus 1.2 units less in the standard group at 24 weeks (mean difference 0.1, 95%CI -11.3, 11.5) and 8.8 units more toxin than baseline versus 1.0 unit more in the standard group at 52 weeks (mean difference 7.8, 95%CI -32.4, 34.3). The physiotherapy interventions were safe with no major adverse events in either group (Supplementary data Table S4).

4. Discussion

This trial showed no difference in the change in TWSTR scores,

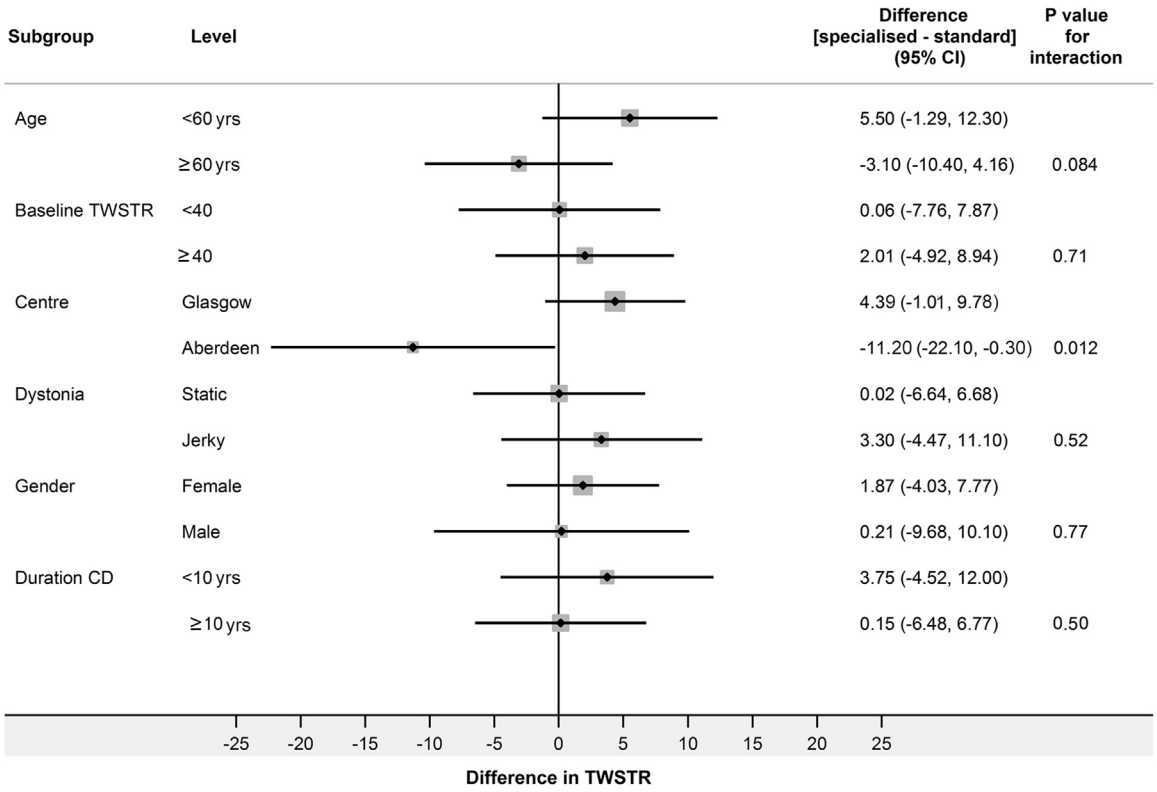

Fig. 2. Pre-specified subgroup analyses on primary outcome (change in TWSTR from baseline to 24 weeks). Footnotes to Fig. 2: Abbreviations: CD cervical dystonia. P value is for interaction between given subgroup and treatment effect. The use of botulinum toxin was not analysed because too few patients who were not using toxin completed the trial.

patient-rated measures of impact on lifestyle and patient/clinician-rated measures of global improvement outcomes between the two physiotherapy groups although some confidence intervals were wide and could not exclude clinically important benefits for either group. Although the majority of patients were receiving botulinum toxin, we do not believe the results were confounded by this because the assessments were made at the end of the injection cycle when the effect of botulinum toxin was wearing off and at similar times in both treatment groups. Randomization ensured that any variability in the effective duration of the botulinum toxin affected both groups equally.

There were a number of potential sources of bias that could have affected these results. Firstly, there were significant numbers of withdrawals. However, at 24 weeks withdrawals were similar in both groups. Given the similarity of the results in both groups, it is unlikely that the missing data would have significantly altered the results and the multiple imputation sensitivity analyses using Rubin's approach confirmed this.

Secondly, the patients were unmasked. However, the impact of this was minimized by highlighting that there was no evidence for any type of physiotherapy in cervical dystonia and that both groups were getting active and individualized treatment. However, if some patients were aware of the potential benefit of the specialized technique, any bias from patient unmasking would probably have inflated any apparent benefit (especially in patient-reported outcomes) in the specialized arm, rather than work to produce a negative result.

The same physiotherapist in each centre provided the specialized physiotherapy and the control intervention, which could have resulted in the physiotherapist applying some specialized techniques in the standard arm. However, we do not believe this happened as we identified this issue in the planning phase and the physiotherapists worked closely together to ensure that the standard physiotherapy arm involved none of the specialized techniques (see appendix for description of interventions). This was confirmed in the treatment logs. It would have been possible to have a control group that did not see a physiotherapist at all (which would reflect normal practice in the UK) but we felt that this would not control for an attentional effect of physiotherapy i.e. a non-specific benefit from regularly seeing a physiotherapist who took an interest in their dystonia. Importantly, the outcome assessors were masked to treatment allocation.

Finally, although the therapists were trained and accredited in the specialized technique by the person who developed it, they might not have applied it adequately. However, both physiotherapists were experienced and felt they had a good grasp of the technique and applied it properly. The intensity of specialized physiotherapy in the trial was, if anything, greater than recommended.

There was evidence that the effectiveness of specialized physiotherapy varied by centre so that it was better than standard physiotherapy in Aberdeen but not Glasgow. It would be unwise to overemphasize this subgroup analysis, which may be a chance finding. The Aberdeen subgroup was very small and the size of the benefit in Aberdeen seems implausibly large (an 11 point improvement in total TWSTR is larger than the effect of botulinum toxin). There was no evidence that the physiotherapy was performed better in one centre than the other (Table S2) and the small differences in the patients recruited in each centre would not explain the differential effect.

It was striking that in both groups large improvements were seen in the TWSTR score and CDIP-58 sub-scores at one month (time of peak effect of botulinum toxin in those being injected) and maintained at six and 12 months. It may be that both physiotherapy

interventions were highly effective so that the toxin effect seen at one month did not wear off, although the improvement was not accompanied by reduction in botulinum toxin doses. However, it is also possible that the sustained benefit is a non-specific effect of the attention patients received in the trial similar to a placebo effect. The patients in the standard physiotherapy arm were seen more frequently than would have been the case in routine practice to try to partially control for an attentional effect and, therefore, it is possible that the large improvement over baseline seen in the standard arm would not be replicated in clinical practice. A further trial of standard physiotherapy versus no physiotherapy would be required to assess this further although, in the absence of sham physiotherapy, controlling for attention bias would be difficult.

This is the largest trial of physiotherapy in cervical dystonia to date. Given the results, the specialized physiotherapy programme cannot currently be recommended for widespread use, especially given its costs in terms of training and delivery. The limited generalizability (only two physiotherapists applied the technique), broad confidence intervals and possible centre-effect suggests further large trials of specialized physiotherapy are merited and one is underway [18].

Conflict of interest

The Dystonia Society and other funders had no role in the design, conduct, analysis or writing of the report. Peter Meager was part of the authorship to recognize his efforts in identifying the need for a trial in response to the Society's interest in this physiotherapy technique, bringing together the principal investigators, commenting on the protocol from a patient perspective, liaising with Mr Bleton with regards to training the therapists and identifying funding. None of the other authors have any conflict of interest.

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Appendix: Summary of interventions

Specialized physiotherapy intervention

This combined re-education of posture and awareness of the body's midline position, relaxation of overactive muscles and strengthening of underactive muscles. The first step was to increase the patient's awareness of their midline position and then progress their range of neck movement away from the natural directional pull of the dystonic muscles. Initially this was achieved with proprioceptive and sensory feedback on the cheek/face in the direction in which the patient was being encouraged to turn. Over time the range of movement was increased, adding holds at the end of the range, varying the speed of movement and applying resistance to movement in different postural sets. Exercises also focused on strengthening the underactive muscles in the neck. Physiotherapy conventionally started with the patient lying on his/her back, followed by a sitting position, then standing, walking and finally with their main functional activities. Patients were encouraged to adapt their environment at work and home in order to work their head and neck in the opposite direction to the pull from dystonic muscles. They were given individualized exercises to practice at home at least twice a day with a diary to return at each session to record adherence. Controlled immobility was encouraged several times a day in front of a mirror to allow self-monitoring.

Standard physiotherapy intervention

The control intervention was standardized between the two centres and included advice about posture, sleeping position, relaxation, standard neck exercises to increase the range of neck movement, as well as shoulder, thoracic/lumbar spine and core stability exercises. The emphasis was on self-management with home exercises (5–10 repetitions for each) twice a day recorded with a diary. Information sheets and diagrams (taken from http://www.physiotools.com) were provided. None of the techniques from the specialized arm were used.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.parkreldis.2015.12.010.

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