Incidence and severity of shoulder pain does not increase with the use of circuit class therapy during inpatient stroke rehabilitation: a controlled trial

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Questions: Does circuit class therapy result in a greater incidence or severity of shoulder pain compared with individual therapy? Is the incidence influenced by the degree of active shoulder control? **Design**: Controlled trial with intention-to-treat analysis. **Participants**: Sixty-eight people (6 drop-outs) undergoing inpatient rehabilitation after stroke. **Intervention**: Participants received either individual therapy or group circuit class therapy. **Outcome measures**: Incidence of shoulder pain over the previous 24 hours was measured as a yes/no response while severity of shoulder pain was measured using a visual analogue scale at admission, Week 4, and discharge. **Results**: There was no greater chance of participants receiving circuit class therapy having shoulder pain at Week 4 (OR 0.95, 95% CI 0.32 to 2.80) or discharge (OR 0.38, 95% CI 0.11 to 1.45) than participants receiving individual therapy. Of those participants who reported pain, there was no difference between groups in the severity of pain at Week 4 (mean difference –0.2 cm, 95% CI –3.2 to 2.7) or discharge (mean difference –2.1 cm, 95% CI –4.8 to 0.6). There was a greater chance of participants who had no active shoulder control having shoulder pain at Week 4 (OR 5.8, 95% CI 1.6 to 20.4) and at discharge (OR 3.8, 95% CI 1.0 to 13.9) than participants who had active shoulder control. **Conclusion**: The incidence and severity of shoulder pain was influenced by degree of active shoulder control but not by type of physiotherapy service delivery. Concerns regarding shoulder pain should not be a barrier to the implementation of circuit class therapy during inpatient stroke rehabilitation. **[English C, Hillier S, Stiller K (2008) Incidence and severity of shoulder pain does not increase with the use of circuit class therapy during inpatient stroke rehabilitation: a controlled trial. *Australian Journal of Physiotherapy* 54: 41–46]**

Key words: Cerebrovascular Accident, Shoulder Pain, Physical Therapy Modalities

Introduction

Shoulder pain is a common and potentially disabling condition affecting stroke survivors. The incidence of shoulder pain after stroke varies considerably, but the most recent data suggest almost one-third of people experience shoulder pain within the first four months after stroke (Lindgren et al 2007). While the aetiology of shoulder pain after stroke remains unclear, it appears related to the severity of motor impairments in the upper limb, loss of external rotation range of movement, and development of soft tissue damage within the shoulder joint complex (Turner-Stokes and Jackson 2002, Lo et al 2003). Shoulder pain after stroke has been associated with poor recovery of upper limb activity (Roy et al 1994), increased length of hospital stay (Roy et al 1994), disturbed sleep (Küçükdeveci et al 1996), and depression (Wanklyn et al 1996, Gamble et al 2000). It is therefore important that any investigation of new physiotherapy interventions or models of service delivery after stroke consider its impact on shoulder pain.

Circuit class therapy is emerging as an alternative method of physiotherapy service delivery for inpatient stroke rehabilitation (Blennerhassett and Dite 2004, English et al 2007). English et al (2007) found that circuit class therapy, as the sole method of physiotherapy service provision during inpatient rehabilitation after stroke, was an effective alternative to individual physiotherapy sessions. However, due to the semi-supervised nature of the circuit class therapy (ie, it involved a maximum of one physiotherapist to every four participants) the opportunity for specific 'hands-on' intervention to prevent or reduce shoulder pain was limited. Therefore, data regarding incidence and severity of shoulder pain were prospectively collected during the trial, in response to clinicians' concerns that a lack of individual therapy may have a negative impact on shoulder pain. The aim of this arm of the study was to monitor adverse events (incidence and severity of shoulder pain) associated with a new model of physiotherapy service delivery (circuit class therapy). The specific research questions were:

1. Does circuit class therapy during inpatient stroke rehabilitation result in a greater incidence or severity of shoulder pain compared with individual therapy?
2. Is the incidence influenced by the degree of active shoulder control (ie, the ability to raise the arm against gravity)?

Method

Design

The current study was part of a larger assessor-blinded, non-randomised, controlled clinical trial which investigated the effectiveness of circuit class therapy compared with individual therapy during inpatient stroke rehabilitation

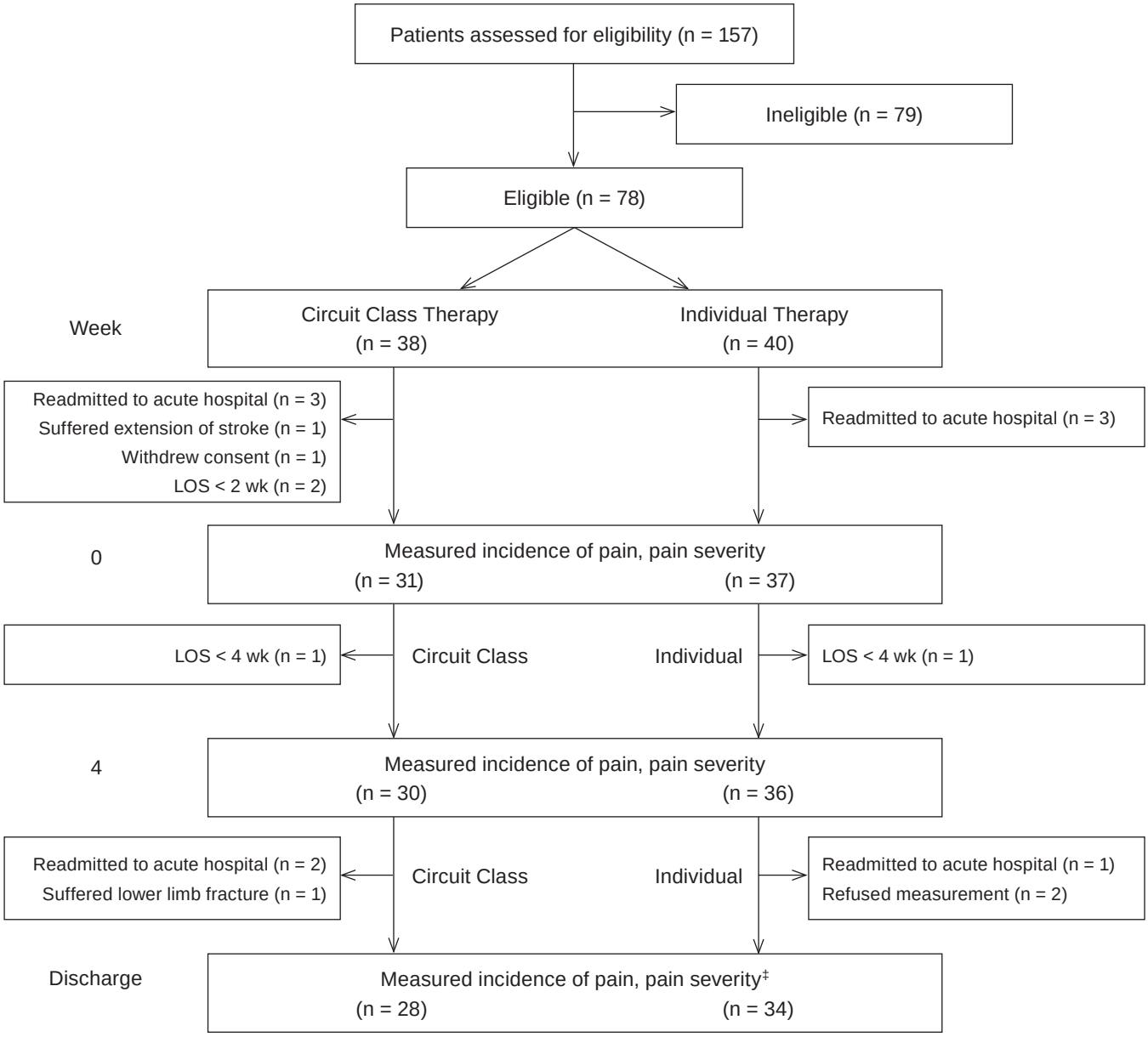

Figure 1. Design of and flow of participants through the trial, modified from English et al (2007). LOS = length of hospital stay. ‡Includes 1 participant in each group with length of stay of less than 4 weeks, who did not complete a Week 4 measurement.

(English et al 2007). All persons admitted to Hampstead Rehabilitation Centre, Adelaide, South Australia for rehabilitation after stroke between March 2002 and October 2003 were considered for inclusion. Within three days of admission to rehabilitation, consenting participants were allocated to the individual therapy group or circuit class therapy group. Participants were allocated to groups according to their date of admission to rehabilitation in pre-determined blocks of time. For this reason, allocation to groups could not be concealed from the recruiter and it was not possible to blind the participants or treating therapists to group allocation. Participants received the allocated type of physiotherapy rehabilitation (individual therapy or circuit class therapy) for the duration of their inpatient stay and the non-physiotherapy components of multidisciplinary rehabilitation were provided to both groups as per usual practice. Participants were measured at admission to inpatient rehabilitation, Week 4 of rehabilitation, and at discharge from inpatient rehabilitation by an examiner who was unaware of the design and aim of the study and blinded to participants' group allocation. Ethical approval was obtained from the University of South Australia and Royal Adelaide Hospital Research Ethics Committees.

Participants

Persons receiving inpatient rehabilitation post-stroke were eligible for inclusion if they: were diagnosed with a stroke resulting in unilateral motor deficits, had sufficient ability to participate in circuit class therapy (ie, ability to follow 3-part commands, sit unsupported, and stand with one person assisting), and had the ability to give informed consent. They were excluded if they had: a cerebellar lesion, a past history of any neurological disorder (excluding previous stroke), used a walking aid (excluding single-point cane) or required assistance for activities of daily living prior to their stroke. The participants' degree of active

Table 1. Mean (SD) or number (%) of the groups and mean (95% CI) or odds ratio (95% CI) of the differences between groups in the characteristics of the participants.

Characteristic	Group			Difference between groups
	All participants n = 68	Circuit class therapy n = 31	Individual therapy n = 37	Circuit class therapy minus individual therapy
Age *(yr)*, mean (SD)	66 (13)	62 (12)	69 (12)	–7 (–13 to–1)
Female, n (%)	27 (40)	12 (32)	15 (48)	2.0 (0.7 to 5.2)
Left hemiparesis, n (%)	42 (62)	20 (65)	22 (59.5)	1.2 (0.5 to 3.3)
Infarcts, n (%)	58 (85)	24 (77)	34 (92)	0.3 (0.1 to 1.3)
Time between stroke and admission to rehabilitation *(days)*, mean (SD)	27 (14)	28 (16)	24 (12)	5.2 (–1.5 to 12.0)
Length of hospital stay *(days)*, mean (SD)	65 (39)	56 (31)	71 (44)	–15.2 (–34.7 to 4.5)
MAS Item 6 *(0-6)* median (IQR)	4.0 (1.0 to 5.0)	4.0 (1.0 to 5.0)	4.0 (1.0 to 5.0)	$p = 0.70$ †
Unilateral spatial neglect, n (%)	11 (16)	5 (16)	6 (16)	1.0 (0.3 to 3.7)

MAS = Motor Assessment Scale, †Mann-Whitney U test

shoulder control was measured using Item 6 (upper arm function) of the Motor Assessment Scale for stroke (Carr et al 1985) since it is thought to influence the incidence of shoulder pain. Participants were classified as active (ie, able to raise their affected arm against gravity) if they scored 5 or 6, or non-active (ie, could not raise their affected arm against gravity) if they scored < 5. All participants were assessed for the presence of unilateral spatial neglect as this may impact on the ability to reliably use a horizontally-aligned visual analogue scale using the star cancellation test (Freidman 1992). Participants were considered to have unilateral spatial neglect if they failed to cross out three or more stars on one side of the paper (Freidman 1992).

Intervention

Circuit class therapy was provided to groups of up to six participants to one therapist for up to 90 minutes twice daily, 5 days a week. With regard to the upper limb, participants with some active control of the hemiplegic arm performed task-specific exercises which were individually tailored and progressed in dosage and complexity during circuit class therapy. Participants with no active control of the upper limb spent approximately 20 minutes per day with their affected arm positioned at end of range shoulder abduction and maximal comfortable shoulder external rotation. A full description of the circuit class therapy sessions is provided in English et al (2007) and in Appendix 1 (see eAddenda for Appendix 1). If participants complained of shoulder pain during circuit class therapy sessions, any aggravating activities or exercises were modified or ceased. Hydrotherapy was not offered to the circuit class therapy group.

Individual therapy occurred under the direct and constant supervision of a physiotherapist or physiotherapy assistant, on a ratio of one therapist to one participant, for up to 60 minutes daily, 5 days a week. These sessions were not based on any one particular treatment philosophy and were tailored to the individual according to the physiotherapist's assessment. Hydrotherapy was offered at the therapist's discretion.

Outcome measures

Incidence of shoulder pain was measured by asking participants if they had experienced any shoulder pain during the previous 24 hours (yes/no response). If participants answered yes, they were asked to rate the severity of pain using a horizontally aligned 10-cm visual analogue scale. The left end of the visual analogue scale was labelled 'no pain at all' and the right end was labelled 'worst pain imaginable'.

Data analysis

Differences in the incidence of shoulder pain between circuit class therapy and individual therapy, as well as between participants with active shoulder control and non-active shoulder control were analysed using a χ^2 statistic. In addition, OR (95% CI) were calculated. A Mann-Whitney U test (significance level $\alpha = 0.05$) was used to analyse differences in severity of pain between circuit class therapy and individual therapy and differences between groups at baseline in Item 6 Motor Assessment Scale scores. Analysis was by intention-to-treat.

Table 2. Number (%) of participants in each group (circuit class therapy versus individual therapy) with pain, and odds ratio (95% CI) of pain between groups.

Outcome	Groups						Odds ratios between groups		
	Week 0		Week 4		On discharge		Week 0	Week 4	On discharge
	CCT (n = 31)	IT (n = 37)	CCT (n = 30)	IT (n = 36)	CCT (n = 28)	IT (n = 34)	CCT relative to IT	CCT relative to IT	CCT relative to IT
Pain	5 (16)	7 (19)	8 (27)	10 (28)	4 (14)	10 (29)	0.82 (0.23 to 2.91)	0.95 (0.32 to 2.81)	0.38 (0.11 to 1.45)

CCT = circuit class therapy, IT = individual therapy

Table 3. Mean (SD) of groups and mean (95% CI) difference between groups for severity of pain in those participants with pain.

Outcome	Groups						Difference between groups		
	Week 0		Week 4		On discharge		Week 0	Week 4	On discharge
	CCT (n = 5)	IT (n = 7)	CCT (n = 8)	IT (n = 10)	CCT (n = 4)	IT (n = 10)	CCT minus IT	CCT minus IT	CCT minus IT
Pain VAS *(cm)*	3.9 (3.8)	5.6 (3.0)	3.8 (3.5)	3.6 (2.4)	5.8 (1.7)	3.7 (2.2)	1.7 (–2.6 to 6.1)	–0.2 (–3.2 to 2.7)	–2.1 (–4.8 to 0.6)

CCT = circuit class therapy, IT = individual therapy, VAS = visual analogue scale

Results

Flow of participants through the trial

Flow of participants through the trial is shown in Figure 1. Seventy-eight people consented to participate and were allocated to groups. Ten withdrew before the baseline measurement so that a total of 68 participants, 41 male, 27 female, with a mean age of 66 years (SD 13) began the intervention. Two participants withdrew before the Week 4 measurement and a further six before discharge. The majority of participants who withdrew from the trial were either readmitted to an acute hospital or refused assessment (Figure 1). None of the participants who withdrew after intervention began reported shoulder pain at baseline. The discharge measurement occurred a mean of 65 (39) days after admission. Table 1 presents baseline characteristics of the participants. Groups were similar at baseline in terms of active shoulder control, the number of participants with unilateral spatial neglect and the amount of time between onset of stroke and admission to rehabilitation. (Table 1.)

Compliance with trial method

Participants in the circuit class therapy group received 129 minutes (SD 23) of physiotherapy rehabilitation per day which was 93 minutes (95% CI 84 to 101) more than participants in the individual therapy group who received 37 minutes (SD 9) per day. The content of therapy sessions was recorded by the treating therapist directly after each session. Intervention specifically aimed at reducing shoulder pain was recorded for 12 (32%) participants in the individual therapy group. Various 'hands-on' interventions were delivered including soft tissue massage, mobilization of the glenohumeral joint/scapula, facilitation, active assisted and/or passive range of movement, stretching and re-education of movement patterns. In addition, hydrotherapy was specifically recorded as having being aimed at shoulder pain reduction for two individual therapy participants, and the use of a hot pack and ultrasound was recorded on two separate occasions. In contrast, 'hands-on' interventions were not included in any circuit class therapy session with one exception. One circuit class therapy group participant received transcutaneous electrical stimulation to the affected shoulder joint complex during circuit class therapy sessions as a method of pain relief. Practice of upper limb activities was included in approximately a quarter of all individual therapy sessions and circuit class therapy sessions. Questioning of the blinded assessor at the end of the trial indicated that she remained unaware of the trial design and therefore of participants' group allocation.

Effect of therapy on incidence and severity of shoulder pain

Group data are presented in Tables 2 and 3 while individual data are presented in Table 4 (see eAddenda for Table 4). Twelve participants (18%) reported shoulder pain at admission to rehabilitation, 7 (18%) in the individual therapy group and 5 (16%) in the circuit class therapy group and this incidence rose slightly at Week 4 and discharge (Table 2). At Week 4, there was no greater chance of participants receiving circuit class therapy having shoulder pain (OR 0.95, 95% CI 0.32 to 2.81, p = 0.92) than participants receiving individual therapy. At discharge, there was still

Table 5. Number (%) of participants in each group (active versus non-active shoulder control) with pain and odds ratio (95% CI) of pain between groups.

Outcome	Groups						Odds ratios between groups		
	Week 0		Week 4		On discharge		Week 0	Week 4	On discharge
	Active (n = 38)	Non-active (n = 30)	Active (n = 34)	Non-active (n = 32)	Active (n = 33)	Non-active (n = 29)	Non-active relative to Active	Non-active relative to Active	Non-active relative to Active
Pain	4 (11)	8 (27)	4 (12)	14 (44)	4 (12)	10 (34)	1.7 (0.5 to 6.4)	5.8 (1.6 to 20.4)	3.8 (1.0 to 13.9)

Active = antigravity shoulder control (Item 6 MAS score ≥ 5), Non-active = less than antigravity shoulder control (Item 6 MAS score < 5).

no greater chance of participants receiving circuit class therapy having shoulder pain (OR 0.38, 95% CI 0.11 to 1.45, $p = 0.16$) than participants receiving individual therapy. However, there is uncertainty about the size of the OR as indicated by the wide 95% confidence intervals. Within the sub-group of participants who reported shoulder pain, there were no significant difference between groups in the severity of pain at admission (mean difference 1.7 cm, 95% CI –2.6 to 6.1), Week 4 (mean difference –0.2 cm, 95% CI –3.2 to 2.7) or discharge (mean difference 2.1 cm, 95% CI –4.8 to 0.6) (Table 3). Although the mean difference of 2.1 cm in severity of pain at discharge was arguably of clinical importance, there is uncertainty about the size of this estimate as indicated by the wide confidence intervals.

Effect of active shoulder control on incidence and severity of shoulder pain

Group data are presented in Table 5 while individual data are presented in Table 4 (see eAddenda for Table 4). Twelve participants (18%) reported shoulder pain at admission to rehabilitation, with a higher incidence for those with no active shoulder control (8, 27%) than those with active shoulder control (4, 11%). This relationship strengthened at Week 4 and at discharge (Table 5). At Week 4, there was a significantly greater chance of participants who had no active shoulder control having shoulder pain (OR 5.8, 95% CI 1.6 to 20.4, $p = 0.004$) than participants who had active shoulder control. This chance persisted at discharge, albeit to a lesser extent (OR 3.8, 95% CI 1.0 to 13.9, $p = 0.04$). Although the confidence intervals were wide, at Week 4, both ends include effects of clinical significance, indicating that there is no uncertainty about the estimates.

Discussion

Provision of group circuit class therapy as the sole method of inpatient rehabilitation after stroke did not significantly affect the incidence or severity of shoulder pain. However, the 95% confidence intervals of incidence of shoulder pain were wide, suggesting that there was a slight chance that those subjects receiving circuit class therapy were either three times more likely or, conversely, one-third less likely to report shoulder pain at both baseline and four weeks later. One possible reason for the individual therapy group having a higher reported incidence of shoulder pain at discharge compared to the circuit class therapy group is length of hospital stay. Participants in the individual therapy group had, on average, a 15 day longer length of stay in rehabilitation (English et al 2007). This is consistent with a study that suggests that incidence of shoulder pain increases with time after stroke (Turner-Stokes and Jackson 2002). However, the individual therapy group had a slightly higher incidence and severity of shoulder pain at baseline which also may have influenced the results.

The overall incidence of shoulder pain in this study (18% at admission and 27% at week four) was comparable to the 22% reported within the first four months of stroke (Lindgren et al 2007) and is lower than the 54% reported in a previous study of inpatient rehabilitation after stroke (Turner-Stokes and Jackson 2002). The results of the current study suggest that the incidence of shoulder pain may be influenced by the degree of active shoulder control as those participants who were unable to raise their affected arm against gravity were significantly more likely to experience shoulder pain four weeks into rehabilitation compared with those participants who had antigravity shoulder control. While the 95% confidence intervals were wide, they still indicated a significant difference between groups. Participants with less than antigravity shoulder control were at least 1.5 times more likely to experience shoulder pain and could have been up to 20 times more likely to experience pain. This finding is in agreement with several previous studies which have reported a link between shoulder pain after stroke and poor motor control of the upper limb (Ratnasabathy et al 2003, Roy et al 1995, Wanklyn et al 1996). Therefore, the results of this study suggest that the degree of active shoulder control has a greater influence on the development of shoulder pain than the type of physiotherapy service delivery.

While some authors have suggested the use of a vertically-aligned VAS to minimise the effects of unilateral spatial neglect (Turner-Stokes and Jackson 2006), others have found the vertically-aligned VAS to be less reliable than the horizontally-aligned scale (Sriwatanakul et al 1983). As the incidence of unilateral spatial neglect was low and similar between participant groups (16% in each group), it is unlikely to have impacted on the results.

Analgesic use may have influenced the results and was not monitored in this study. However, as the incidence of shoulder pain was measured with a yes/no response over

the previous 24 hours, it is unlikely that the use of analgesia would have completely eradicated pain; hence the results should be valid. However, the severity of reported shoulder pain may have been influenced by analgesic use.

The evidence for effectiveness of circuit class therapy in promoting recovery of motor function early after stroke is increasing (Blennerhassett and Dite 2004, English et al 2007) and anecdotal reports suggest that this method of physiotherapy service delivery is being increasingly utilized throughout Australia. It is important that any new method of service delivery is investigated not only for effectiveness, but also for likely adverse events. This study found little evidence of increased risk of shoulder pain with the use of circuit class therapy, suggesting that concern regarding shoulder pain should not be a barrier to the implementation of circuit class therapy, however, further research is required.

eAddenda: Table 4 and Appendix 1 available at www.physiotherapy.asn.au

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