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The Efficacy of Upright Standing with Supportive Standing Frame Compared to No Standing Frame When Combined with Traditional Physical Therapy Intervention on Postural Control in Sub-Acute CVA with Significant Hemiplegia

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Clinical Scenario: The patient who led me to pursue this question was an 89-year-old female with a right side acute cerebrovascular accident (CVA) leading to significant left side hemiplegia, flat affect, and very poor sitting posture. Unfortunately she has since passed away, but prior to her passing significant medical interventions included custom seating and positioning system, standing and transfer training with two person assist, and static sitting balance training with one person assist. Problems identified were poor sitting balance, poor standing balance, decreased postural control, decreased proprioceptive awareness, decreased sensation, and decreased strength.

For the purposes of my clinical question I want to know what research says about the use of a supportive standing frame on patients with the diagnosis of CVA with significant unilateral hemiparesis or hemiplegia. The patients that are admitted to rehabilitation at skilled nursing facilities for a CVA often display hemiparesis, and are not able to stand without the assistance of two people. For these patients, they often also have a hard time sitting in a wheelchair due to poor sitting posture and inability to detect postural position in relation to midline. When I arrived at the skilled nursing facility there was a supportive standing frame that was gathering dust in the corner of the gym. After large amounts of WD-40 I was able to get it apart and figure out how it worked. I started to use it with my 89-year-old patient, but was wondering why it had gone so unused for so long; was it because nobody knew how to figure out all the levers and pulleys, or because nobody had seen a successful change in their patients with it? This was the inspiration for the critically apprised topic; to figure out why the dust had gathered.

My Clinical question: Does the use of a supportive standing frame in conjunction with traditional physical therapy interventions improve postural control in patients with significant hemiparesis following an acute CVA when compared to traditional physical therapy interventions alone?

Clinical Question PICO:
Population: Patients over the age of 65 that have undergone a CVA resulting in significant hemiparesis and impaired seated postural control
Intervention: The use of supported standing frame in conjunction with traditional physical therapy interventions
Comparison: Traditional physical therapy interventions alone

Outcome: Seated postural control

Overall Clinical Bottom Line: Based on the outcomes from Bagley *et al*. and Allison *et al*., there is fair evidence to suggest that providing supported standing frame treatment in conjunction with traditional physical therapy for patients with acute stroke does not improve outcomes compared to traditional physical therapy alone. Subjects in both studies had poor/very poor trunk control compared to age matched norms on ratings including the Trunk Control Test and the Rivermead Mobility Index, and were receiving sub-acute rehabilitation that required the assistance of 1-2 therapists for standing practice. In both studies there were subjects who were not able to complete the full standing frame protocol due to fatigue. This factor contributed to the high study loss rate (26% and 17%). Allison *et al.* did not perform a full intention to treat analysis and therefore was at risk for a Type II error revealing no significant difference between groups when one in fact could have existed. Bagley *et al.* did perform an intention to treat analysis and therefore more weight is placed on the outcomes of this study. Neither study revealed any significant harmful effects from treatment, however there was no evidence that supported the decision for a clinic to purchase a standing frame. If a clinic were to already have one available, it may be beneficial to use in conjunction with traditional acute CVA rehabilitation.

Search Terms: CVA, stroke, hemiparesis, standing frame, supportive standing frame, hemiplegia, physical therapy, interventions, peer reviewed, supported standing,

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Rationale for your chosen articles:
I began the article search process with the PEDro database, but quickly found that was limiting the topics I could choose from; none of the available research seemed to fit my clinical question. I then did a Google search just to make sure there was research about standing frames available in the physical therapy literature. Through this I found a citation for an article by Bagley *et al.* I next utilized the database Web of Science to try and expand the citation web. It was through Web of Science that I found citations for the articles by Wong *et al.* and Allison *et al*., among many others. I also searched through CINAHL with the keywords physical therapy, standing frame, stroke, hemiparesis, hemiplegia, randomized controlled trial, Oswestry standing frame, and postural control. I again found all three articles when sifting through the different combinations of keywords, and they seemed to be the three that best fit my clinical PICO for comparability.

1. Wong AM, Lee MY, Kuo JK, Tang FT. The development and clinical evaluation of a standing biofeedback trainer. *Journal of Rehabilitation Research and Development* 1997;34(3): 322-327.

Population: 43 male and 17 female participants (age 51.3 +/- 13.9 years) with unilateral hemiparesis or hemiplegia from their first acute stroke (CVA) or traumatic brain injury (TBI)
Intervention: Standing frame with biofeedback provided to bilateral force plates under the lower extremities; referred to as the Standing Biofeedback Trainer (SBT)
Comparison: Standing frame from a conventional standing table; referred to as Standing Training Table (STT)
Outcomes: Postural symmetry calculated via the force plates during upright stance, measured daily

2. Bagley P, Hudson M, Forster A, Smith J, Young J. A randomized trial evaluation of the Oswestry Standing Frame for patients after stroke. *Journal of Clinical Rehabilitation* 2005;19(3): 354-364.

Population: 140 patients that had sustained a new stroke with no concurrent medical condition likely to need palliative care and were medically stable and alert enough to participate in the study
Intervention: 14 consecutive days of treatment on the Oswestry Standing Frame in addition to traditional stroke care at the unit
Comparison: Usual stroke care without the addition of the Oswestry Standing Frame
Outcomes: Rivermead Mobility Index (RMI), Barthel Index, Rivermead Motor Assessment, Balanced sitting and sitting to standing components of the Motor Assessment Scale, Trunk Control Test, and Hospital Anxiety and Depression Scale. Measures were taken at baseline, six weeks, 12 weeks, and six months post stroke.

3. Allison R, Dennett R. Pilot randomized controlled trial to assess the impact of additional supported standing practice on functional ability post stroke. *Journal of Clinical Rehabilitation* 2007;21(6): 614-619.

Population: 17 participants (age 50-92) that were 6-58 days post stroke
Intervention: 45 minutes standing practice in a standing frame, tilt table, standing table or progressing to free standing/ambulation as able in addition to 45 minutes of conventional physical therapy treatment

Comparison: 45 minutes of conventional physical therapy treatment only including strengthening, improving mobility, and improving upper limb function
Outcomes: Gross Function Tool of the Rivermead Motor Assessment, Trunk Control Test, and the Berg Balance Scale

Table 1. Comparison of PEDro Scores

	Wong *et al.*	Bagley *et al.*	Allison *et al.*
Random	X	X	X
Concealed allocation	-	-	-
Baseline comparability	X	X	-
Blind Subjects	-	-	-
Blind Therapists	-	-	-
Blind Assessors	-	X	X
Adequate Follow-up	-	X	X
Intention-to-Treat	-	X	X
Between Group	X	X	X
Point Estimates & Variability	X	X	X
Total Score	4/10	7/10	6/10

The study by Wong *et al*., while very interesting, did not have an adequate control group for my purposes, as both groups received some sort of standing practice and neither received conventional physical therapy treatment. This difference in intervention combined with the lower PEDro score of 4/10, persuaded me to exclude this article from the research.

Both of the other two studies by Bagley *et al.* and Allison *et al.* included subject pools that were similar to my patient and a control group that received conventional physical therapy treatment. While I would have liked to find a study that used a standing frame in the place of traditional physical therapy treatment I realize this would not be an ethical study and therefore does not exist in the literature. The intervention subjects in both of these studies received extra minutes

of therapy during the week compared to their control group counterparts. This is not ideal and I will need to keep this in mind as I critique the internal validity of the study designs. Based on the above comparisons, I have chosen to write this critically appraised paper on the articles by Allison *et al.* and Bagley *et al.*

ARTICLE: Bagley *et al.*

Clinical Bottom Line: Based on the study by Bagley and colleagues, treatment that incorporated a standing frame with conventional physical therapy resulted in outcomes that were no different to treatment with just conventional physical therapy. The patients had sustained a new stroke, scored a zero on the Trunk Control Test at baseline, and were medically stable. The outcomes were the Rivermead Mobility Index and the Trunk Control Test. Both groups had 14 days of physical therapy treatment; however, the treatment group used the Oswestry Standing Frame as part of their treatment. The authors did not report if any within group improvements were made. Providing the addition of standing frame treatment did not have any adverse effects. The standing frame itself is an expensive investment, but the treatment does not have an additional cost if the clinic already owns one. The minor threats to internal validity (PEDro score 7/10) were the lack of evidence of baseline similarity, the inability to maintain assessor blinding, and a study loss rate of 26%; however, these did not compromise overall validity. There were no significant threats to external validity and therefore results can be extrapolated to a similar population subset. Future research should include outcome measures addressing alertness, bone density, and ability to utilize upper extremities during the treatment. These may provide insight into other benefits from standing frame practice. Additionally the use of standing frame treatments could be studied when combined with the treatment session of a speech language pathologist or during a cognitive assessment by an occupational therapist to allow more time in the standing frame in addition to conventional physical therapy.

Article PICO:
Population: 140 patients that had sustained a new stroke with no concurrent medical condition likely to need palliative care and were medically stable and alert enough to participate in the study.
Intervention: 14 consecutive days of treatment on the Oswestry Standing Frame in addition to traditional stroke care at the unit.
Comparison: Usual stroke care (as described above) without the addition of the Oswestry Standing Frame
Outcomes: Rivermead Mobility Index (RMI), Barthel Index, Rivermead Motor Assessment, Balanced sitting and sitting to standing components of the Motor Assessment Scale, Trunk Control Test, and Hospital Anxiety and Depression Scale. Measures were taken at baseline, six weeks, 12 weeks, and six months post stroke.

Blinding: There was no blinding of subjects or therapists in this study. I do not think this poses a significant threat. It is possible that therapists providing care to those not using the standing frame might be influenced to provide more standing treatment. For the patients, it would be their natural inclination to have their own best interest at heart and to participate to

the best of their ability during the study and throughout the rehabilitation process. The assessments were conducted in a separate rehabilitation facility that was remote to the stroke unit. This was done as a way to be confident in the blinding of the assessors. The assessor was, however, unblinded to one patient at the six-week assessment, two patients at the 12-week assessment and one patient at the six-month assessment. The assessor was asked to guess group allocation for the patients and the authors performed a kappa analysis at each time point, the results of the analysis indicated that the assessor otherwise remained blinded throughout treatment.

Controls: There was no placebo group in this study to act as a true control. However, the group that received only conventional physical therapy interventions serves as an adequate comparison, as the only difference between groups was the addition of the standing frame practice. Both groups received similar length therapy sessions.

Randomization: Patients were stratified by two factors: the presence or absence of urinary incontinence or catheter use within the first two weeks post stroke, as well as stroke type as determined by the Oxford Stroke Classification. Randomization was concealed using opaque allocation envelopes. The authors stated that randomization was successful between groups and provided baseline assessment scores for all outcome measures.

Study: The study was a randomized, controlled, single-blind trial. A total of 140 patients that had sustained a new stroke with no concurrent medical condition likely to need palliative care and were medically stable and alert enough to participate in the study were recruited. To be considered 'fit enough' for the study patients had to be able to sit in a chair for more than half an hour, and score at least 11 on the Glasgow Coma Scale. Patients also needed to score a zero on the Trunk Control Test, and require the use of two therapists to stand with an erect trunk.

The treatment group (n=71) received conventional physical therapy in line with what is typically provided for patients who had survived a stroke. In addition, they utilized the Oswestry Standing Frame during the first 14 treatment sessions. The goal was for use of the frame over 14 consecutive days, but when this was not possible, they attempted to achieve 14 sessions total. The control group (n=69) received only conventional physical therapy. The conventional care varied, and was flexible to allow the therapists to use clinical judgment to adjust treatments to the needs of each specific patient. One patient in the control group received a session with the standing frame by accident.

Outcome measures: For the purpose of my clinical question I chose to include the outcome measures that deal with gross motor function of the trunk. I therefore excluded the *upper extremity* score of the Rivermead Motor Assessment, the Barthel Index, the Hospital Anxiety and Depression Score, as well as the Nottingham Extended ADL Scale. The Rivermead

Mobility Index (RMI), *gross function* and *leg and trunk* scores from the Rivermead Motor Assessment, the balanced sitting and sitting to standing scores of the Motor Assessment Scale, as well as the score on the Trunk Control Test are all relevant to my clinical question as they assess postural control. All of the relevant outcome measures were assessed at baseline, six weeks, 12 weeks, and six months post stroke.

The authors did not establish reliability of their raters. Upon further investigation of the relevant outcome measures, only two were confirmed to have good reliability and validity. The primary outcome measure for the study, the RMI, was stated to be both valid and reliable by the authors. An article by Chen *et al.,* that was found in an independent Medline search, also reported the RMI to have a minimal detectable change of 2.2 points. An MCID has not yet been established.[1] For the Trunk Control Test, a literature search revealed no established MDC or MCID. Inter-rater reliability has, however, been established ($r=0.76$, $p<0.001$).[2] Upon searching the literature I was unable to find established reliability or validity for the Rivermead Motor Assessment and the Motor Assessment scale. They were also not used in their entirety in this study, thereby negating potential MDC or MCID values. Therefore I chose to exclude the latter assessments and only use the RMI and Trunk Control Test as relevant outcome measures.

Study losses: Of the total 140 patients that were randomized into groups for the study, 30 of them passed away prior to the final assessment at 6 months post stroke, 13 in the control group and 17 in the intervention group. One patient was withdrawn from the study due to a misdiagnosis. Excluding the patients that died, 21 patients (including patients from each the treatment and control groups) did not receive all 14 treatments as per the protocol of the study during the 'early treatment' phase. It appears that this was due to the intervention in part as 11 patients were too unwell to receive rehabilitation and 4 refused treatment. Visual inspection of the data presented does not reveal any missing information not stated by the authors. An intention to treat analysis was performed, as well as a primary analysis for RMI change scores including all patients, and a secondary analysis using only patients that completed all 14 treatments as outlined in the study protocol.

Summary of internal validity: There were several strengths to the study design. It was a randomized controlled trial, which allowed participants to achieve the maximum benefit from their physical therapy treatment sessions with or without standing practice. Both groups received the same amount of treatment, and each treatment was tailored to the specific patient that allowed clinical judgment to achieve maximum benefit. The internal validity of this study was rated as fair due to the presence of three minor threats. The failure to keep the assessors blind to all participants in the study was a minor threat. The subject's group was correctly guessed by the assessor about 50% of the time in the three separate testing occasions (48%, 54%, and 52%), indicating the guessing was no better than chance. Overall the assessors were blinded to group allocation throughout the study. The significant number of study losses

(26% of recruited subjects) was also a minor threat due to the authors performing an intention to treat analysis. While the authors state baseline similarity between subjects, they do not provide any relevant statistics to support this statement. Without relevant information proving baseline similarity one cannot be completely sure that the differences between groups at any time-point was due to the intervention itself or due to differences between the two groups. The lack of evidence of baseline similarity is the third minor threat.

Evidence: The authors found no significant difference between groups for any of the relevant outcome measures stated above at any time-point during the study. No within group analysis was done.

Applicability of study results:
Benefits vs. Costs: According to this study the costs far outweigh the benefits of using an Oswestry Standing Frame to increase postural control for patients post stroke with hemiparesis. The financial cost of the Oswestry Standing Frame is around $800.00 (estimated from a for sale frame in the UK for £495), which is a large investment for a clinic to make. Patients were also stated to have declined treatment more in the standing frame group than the control group (9 standing frame, 6 control). While it is not clear why patients declined in the standing frame group more often it could be attributed to something inherent to the standing frame treatment itself. It should be noted that there may be other potential benefits from the treatment that were not addressed in this study such as increased alertness with upright posture, or the positive effects of weight bearing on the skeleton and other body systems. And while incorporating the standing frame into treatment did not change outcomes in the study, it was also not harmful to patients. If a clinic already owns a standing frame there are no negative consequences to choosing to include it as part of the skilled intervention program.

Feasibility of treatment: The study procedure is not specifically reproducible. Experienced clinicians were using their own clinical decision making to tailor the conventional physical therapy treatment. In addition, the amount of time spent in the standing frame was not standardized between patients and was dependent on the activity tolerance of each specific person. The length of the treatment sessions and number of sessions received is within the scope of physical therapy interventions within a skilled nursing facility.

Summary of external validity: The external validity of the study is good for a subset of the patients treated at skilled nursing facilities. The internal validity of the study, rated as fair, does not compromise the ability to generalize the results to a broader patient population. The subject sample is similar to a subset patients treated in the skilled nursing setting, and can therefore be extrapolated to patients who have undergone a recent stroke, are able to sit upright for greater than a half an hour, and cannot achieve a score greater than zero on the trunk control test. Future research should include outcome measures addressing alertness,

bone density, and ability to utilize upper extremities during the treatment. These may provide other evidence of benefits from standing frame practice. Additionally, the use of standing frame treatments could be studied when combined with the treatment session of a speech language pathologist or during a cognitive assessment by an occupational therapist to allow more time in the standing frame in addition to conventional physical therapy.

ARTICLE: Allison *et al.*

Clinical Bottom Line: Based on the study by Allison and colleagues, an extra daily session of standing practice added to conventional physical therapy results in limited to no differences in outcomes compared to conventional physical therapy. No differences were found at any time points for scores on Berg Balance Scale and the Trunk Control Test in patients with a recent diagnosis of a new stroke. However, the authors did report a significant difference between groups in change scores from weeks one to 12 on the Berg Balance Scale. Because of the small sample size, the clinical meaningfulness of this difference is not clear. Both groups underwent a 45-minute conventional physical therapy treatment session each day, and the treatment group also performed a 45-minute standing practice session in a standing frame, tilt table, or free standing. Participating in additional standing treatment proved exhausting for three participants who withdrew during the first week, citing fatigue as the primary reason. The treatment was not cost effective as there was no additional benefit shown by using the extra time and resources for the treatment group. Threats to internal validity (PEDro score 6/10) included the lack of a statement of baseline similarity and a small sample size with no performed power analysis. Given the small sample size, extrapolation of results to a larger subset of the population of older adults that have undergone a new stroke should be made with caution. Future studies should include combining the standing frame treatment with upper extremity range of motion or strength exercises to have a more efficient use of the patient and therapist time.

Article PICO:
Population: 17 participants (age 50-92) that were 6-58 days post stroke
Intervention: 45 minutes standing practice in a standing frame, tilt table, standing table or progressing to free standing/ambulation as able in addition to 45 minutes of conventional physical therapy treatment
Comparison: 45 minutes of conventional physical therapy treatment only including strengthening, improving mobility, and improving upper limb function
Outcomes: Gross Function Tool of the Rivermead Motor Assessment, Trunk Control Test, and the Berg Balance Scale

Blinding: There was no blinding of subjects or therapists in this study. I do not think this poses a significant threat. It is possible that therapists providing care to those not using the standing frame might be influenced to provide more standing treatment. There is very minimal threat to a lack of subject blinding; as it would be their natural inclination to have their own best interest at heart and to participate to the best of their ability during the study and throughout the rehabilitation process. A therapist who was blind to treatment allocation and did not work on the unit where the patients underwent their therapies conducted the assessments.

Controls: There was no placebo or true control group in this study as all subjects received standard physical therapy interventions. Daily treatment times were not, however, equivalent as the treatment group received the standing practice in addition to the standard physical therapy. The additional hours of therapy in the treatment group may be the cause for any significant differences between groups, and not necessarily the standing practice alone.

Randomization: A staff member blinded to the study achieved randomization via random group allocation through sealed envelopes. While randomization appears successful at baseline, the authors did not report whether or not there was a statistically significant difference in baseline characteristics. This lack of established post week-1 baseline similarity is a significant threat to the study.

Study: The study was a randomized controlled trial consisting of 23 subjects with new or recent diagnosis of stroke admitted to the rehabilitation unit of a hospital. They were excluded if they were terminally ill, were medically unstable, or were unable to participate safely due to another factor. 17 patients were admitted to the study; 10 men and seven women. The groups were then randomly allocated into a control group receiving a 45-minute conventional physical therapy treatment, and a treatment group receiving 45-minutes of standing practice in standing frame, tilt table, or free standing in addition to a 45-minute session of conventional physical therapy. This treatment was continued throughout the patient's stay at the unit, and discharged once the patient returned home where they were referred for outpatient services.

Outcome measures: The three outcome measures used in the study were the Gross Function Tool Section of the Rivermead Motor Assessment, the Trunk Control Test, and the Berg Balance Scale. The authors did not cite reliability or validity for any of the selected outcome measures, but after an independent literature search I found that for the Berg Balance Scale, specific to patients who have undergone a stroke, there is an MDC of 6.9 points,[6] an excellent test re-test reliability of ICC=0.98,[4] and excellent inter-rater reliability of ICC=0.95.[5] The Trunk Control Test was also found to have excellent inter-rater reliability ($r=0.76$, $p<0.001$).[2] There was no literature establishing the Rivermead Motor Assessment's reliability or validity, and it was therefore excluded as an outcome measure relevant to my clinical question. Measures were taken at week 1, week 2, and week 12 during the study.

Study losses: Three patients withdrew from the treatment group within the first week of the study, all citing fatigue as the reason for withdrawal. Only one of those three patients consented to allow future measures be taken and was included via an intention to treat analysis. Data from the other two subjects was not included. While three patients does not seem like a large number, the study had such a small n that these three equated to 17% of the sample size.

Summary of internal validity: The internal validity of this study is fair due to two major threats. There is no statement of baseline similarity for the participants in the study. However, participants were randomized, allocation was concealed, and valid outcome measures were used. The lack of evidence that baseline comparability exists is a major threat as it negates any statistical significance that may have been found throughout the duration of the study. Additionally, outcome measures were only assessed after the first week of treatment and at 12 weeks. While they do establish that participants had no statistically significant differences in the scores after week one of treatment, this cannot suffice for the lack of baseline similarity. The lack of a full power analysis to determine an appropriate sample size is the second major threat. Due to the small sample size in the study (n=17) and the loss of data for two of those subjects, it is possible that there is not enough power to detect a difference between groups. This leads to an increased likelihood of a type II error occurring which would lead the examiners to believe there was no difference between groups when one does, in fact, exist.

Evidence: The authors state that there was no significant difference between groups for any of the outcome measures at any of the time points during the study. The authors express that both groups show trends of improvement over time that was not statistically significant, and visual inspection of the data confirms this. They did, however, find a significant difference in change scores between the two groups from week one to week 12 for the Berg Balance Scale scores only (see Table 2). It is not clear if this should be accepted as an actual difference between groups. While there was no statistically significant difference found at baseline for BBS, it is possible the lack of difference found was due to the small sample size. If the treatment group started the study with lower scores than the control group, change scores cannot be directly compared. Both groups achieved the MDC of 6.9 with regards to the Berg Balance Scale.

Table 2. Berg Balance Scale Scores† at Weeks 1, 2, and 12

	Control Group	Intervention Group
Week 1	16.5 (2-26.5)	8 (2.5-21.75)
Week 2	28 (8-44)	24 (7.25-45)
Week 3	44 (11-52)	47 (11.25-51.5)
Difference week 1 to week 12	20.5* (1.5-31)	37* (6.5-42)

†scores expressed as median and interquartile ranges; *P<0.05

Applicability of study results:

Benefits vs. Costs: Both groups improved over time during the study, but there was no statistically significant additional benefit to the extra standing practice. Differences in amount of change on the BBS, while statistically significant, are questionable. The doubled treatment time for the treatment group was time consuming for both the patients and the therapists.

Additionally, there were adverse events with three participants withdrawing from the treatment group, citing fatigue as the primary reason. Given the limited benefits found with regards to the Rivermead Motor Assessment and the Berg Balance Scale change scores, the extra standing time may not be justified.

Feasibility of treatment: Reproduction of the treatment is not entirely feasible. Clinical judgment and decision making of well-seasoned therapists was the driving force behind conventional physical therapy treatments, and the details were not outlined. The treatment consisted of two 45-minute sessions for the treatment group, which may not be possible in all settings. This time-management issue might be reduced by incorporating upper extremity range of motion and strengthening into the standing practice time. The treatment seemed feasible for some patients; however, three of the seven patients in the treatment group withdrew citing fatigue- nearly 50%. This study utilized PTAs to conduct the standing practice but that is not feasible in all settings. If a facility has the means to provide both conventional physical therapy in addition to standing practice, then they could have aides perform the standing components, using a standing frame or tilt table when necessary.

Summary of external validity: The fair internal validity does not compromise the ability to generalize the study results to similar populations; however, it should be generalized with caution due to the very small sample size. The subject sample is similar to patients treated in the clinic in that they underwent a new stroke and were of the age that is typically seen in a skilled nursing facility or inpatient rehabilitation center. The benefits of conventional therapy with or without the addition of standing practice can be extrapolated to individuals that have undergone a new stroke and are being treated at an inpatient facility.

Synthesis/Discussion: The purpose of this paper was to determine if the use of a supportive standing frame in conjunction with traditional physical therapy interventions improve postural control in patients with significant hemiparesis following an acute CVA when compared to traditional physical therapy interventions alone. I found two articles that addressed my clinical question.

While the methodological quality of the studies was similar, Bagley *et al.* had overall a higher internal validity due to clear baseline similarity, a relatively low withdrawal number of the subjects, a higher sample size, and an intention to treat analysis. Because of these factors the outcomes are more applicable than those in the study by Allison *et al.* Subjects in the Bagley *et al.* study were also more similar to my clinical question. Their inclusion criteria required that subjects must not be able to achieve any score on the Trunk Control Test, while Allison *et al.* did not exclude patients if they had slightly more trunk control at baseline.

Both studies allowed some flexibility in the treatment schedule, which is essential when providing care to this unique (and at times medically unstable) population. The intervention group in Bagley *et al.* received 'usual stroke care' in addition to 14 consecutive days of practice in a standing frame, while Allison *et al.* gave the intervention group 45 minutes of 'traditional physiotherapy' in addition to 45 minutes of 'standing practice' that included a standing frame and/or therapist assisted standing in the parallel bars or in the gym. Similar to my clinical question, both studies used the standing frame as an adjunct to their traditional physical therapy treatment. Both emphasized that while treating patients in the clinical setting you must remain flexible- and while it may be beneficial to provide standing practice in every treatment session on every single day, there are times when that is not possible. The comparison (or non-intervention) groups in each study performed traditional stroke rehabilitation including strengthening, mobility, and upper limb function- but did not receive standing practice.

Both studies used similar outcome measures but I chose only to include those that had established reliability and or validity. Bagley *et al.* used the Rivermead Motor Assessment and the Trunk Control Test, while Allison *et al.* used the Berg Balance Scale and the Trunk Control Test. The Trunk Control Test was most meaningful for my clinical question because it directly assesses postural control. Bagley *et al.* had the most adequate follow-up for this population; as they assessed outcomes at baseline, six weeks, 12 weeks, and six months post stroke, while Allison *et al.* only assessed outcome at week 1, week 2, and week 12 during the study. Standing frame treatment did not have a statistically significant effect in outcome measures in the two studies; however, it was not a harmful addition to treatment and may provide additional benefits to this population.

While these two articles addressed my clinical question, the process of reviewing the studies led to additional questions. These included: Would standing frame treatments be more

beneficial for arousal level and provide better outcomes for speech language pathologist treatment?; Would performing a cognitive assessment with the patient in a standing frame provide better overall score than with the patient in supine due to arousal level?; and For patients who are unable to sit upright independently after stroke, would upper extremity strengthening have better carryover effects if performed in a standing frame? Future research endeavors should be aimed at the arousal aspect of providing upright standing frame practice, as well as the benefit of antigravity training for the nervous and cardiovascular systems

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