Early Mobilization within 24 Hours in Adults Post-Stroke vs Standard Stroke Unit Care: Strong Evidence Suggests No Significant Differences in ADL Performance and More Rapid Recovery of Ambulation in Early Mobilization Group

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Clinical Scenario:

Condition/Problem

According to Bartels, M.N., Beland, H.E., & Duffy, C.A. (2011), a cerebrovascular accident (CVA), or stroke, is a disease of the cerebral vasculature in which a failure to supply oxygen to brain cells, which are most susceptible to ischemic damage, leading to their death. There are two types of CVAs: Ischemic and Hemorrhagic. Ischemic strokes are the most common and occur due to clots or the build up of fatty plaques in the blood vessels supplying the brain. Hemorrhagic strokes occur due to a rupture in the blood vessel in the brain, causing blood to leak into brain tissue and cause tissue death. Hemorrhagic strokes are caused by chronic high blood pressure or an aneurysm (Woodson, A., 2008). The amount and severity of tissue damage is dependent on the location and size of the stroke. Some residual problems following a stroke include cognitive deficits (memory, attention, orientation, language), hemiparesis/weakness, depression, visual/perceptual deficits, sensory disturbances, abnormal tone, balance deficits, and speech difficulties, resulting in decreases in ADL function (Gillen, G., 2013).

Incidence/Prevalence

According to the Stroke Association (2014), approximately 795,000 people in the U.S. have a stroke each year, with 87% of these being ischemic. Stroke is the leading cause of long-term disability and the fourth leading cause of death in the United States; 1 out of every 18 deaths is due to a stroke. It is reported that 55,000 more women than men have a stroke each year. There are 7,000,000 stroke survivors in the US over the age of 20 that may be experiencing limitations in ADL function (Stroke Association, 2014).

Impact of the Problem on Occupational Performance

Dressing- Most dressing tasks require UE use and bilateral integration. Clients with a weak or flaccid UE may have difficulty with dressing. Cognitive deficits secondary to a CVA may cause confusion and difficulties with sequencing and problem solving. Clients may experience left neglect, which causes inattention to the left side, creating frustration and difficulty during dressing tasks. Clients with apraxia may have difficulty developing a motor plan for dressing.

Bathing- Bathing requires bilateral use of the UE's. A stroke may impact a client's ability to sequence the task and understand the social expectations of hygiene. Clients with decreased balance may need to complete bathing tasks in a seated position with assistance. Clients with visual/perceptual deficits may have difficulty attending to the left side, which could impact his or her ability to thoroughly complete the task. Dependence on another person for bathing tasks can be frustrating for clients, leading to depression, learned helplessness, and loss of interest in the task.

Toileting- Clients with CVA typically do not have difficulty with bladder/bowel control. However, toileting requires balance and functional ambulation. Clients with cognitive deficits due to CVA in addition to decreased balance

and weakness may have difficulty with this activity. The need for assistance during toileting may cause embarrassment; this may motivate some individuals to work towards independence.

Grooming- Clients with UE flaccidity or weakness may have difficulty with grooming tasks, as many require bilateral integration of the UE's. Clients with decreased cognition may also experience difficulty with sequencing and attention. Clients with visual/perceptual deficits may have increased difficulty with grooming tasks.

Feeding-Clients with dominant UE flaccidity or weakness may exhibit difficulty with feeding, and may have to use their non-dominant UE to eat. Clients with visual/perceptual deficits, such as left neglect, may have difficulty locating all of the food on their plate, or noticing differences in contrasts between food and plate. Clients with apraxia may experience difficulty developing motor plans to bring food to the mouth, or to initiate motions such as cutting.

Cooking/Meal Prep- Clients with cognitive deficits may experience difficulty with sequencing cooking tasks, as well as remembering recipes or how long to cook food. They may be unaware of the freshness of food, which can be a safety risk. Clients with weakness, flaccidity, or abnormal tone in a LE, may have difficulty ambulating in the kitchen to complete cooking tasks effectively. Clients experiencing depression may not have the motivation to eat or prepare food for themselves, which can be detrimental to their health. Clients with visual/perceptual deficits may not notice that a burner is on due to visual neglect, or may have difficulty distinguishing differences in contrast of kitchen items. Clients with decreased sensation pose safety concerns when discerning the temperature of items. Clients with apraxia may experience difficulty developing motor plans in relation to cutting and stirring and may lack the ability to coordinate movements bilaterally, causing frustration.

Money Management- Clients with CVA may experience difficulty with money management tasks due to decreased cognition, aphasia, or visual/perceptual deficits.

Child care- Clients experiencing UE weakness or flaccidity, sensory, balance, visual/perceptual, or cognitive deficits may experience difficulty with childcare tasks.

Pet care- Clients experiencing UE weakness or flaccidity, sensory, balance, visual/perceptual, or cognitive deficits may experience difficulty with pet care tasks.

Medication Management- Clients experiencing decreased cognition may experience difficulty managing medications due to deficits in memory, orientation, and sequencing. They may not understand the need for medication and dosing requirements.

Shopping- Clients with decreased cognition may have difficulty creating a grocery list, planning money requirements, and transportation. Clients with UE weakness or flaccidity may experience difficulty ambulating throughout the store or using the affected UE functionally.

Intervention

In the studies reviewed, Very Early Mobilization (VEM), is defined as starting mobilization within 24 hours after onset of stroke symptoms, and continuing at frequent intervals. VEM involves getting out of bed, standing, walking, and performing ADL tasks such as bathing, grooming, and toileting. VEM protocols differ according to patient capability, and delivery can be difficult due to variations in care between stroke units (Craig, Bernhardt, Langhorne, & Wu, 2010).

Variations in VEM intervention schedules are typical due to differences in stroke unit protocol, and client's health status. If clients cannot be mobilized within 24 hours due to health concerns, they are monitored

and mobilized as soon as possible. Typically, VEM protocol is individualized and adjusted to fit the client's needs and abilities. There is no standard protocol or intervention schedule to follow. However, clients were mobilized several times per day, but usually time out of bed was not measured due to differences in client's abilities (Craig et al., 2010).

Why is this intervention appropriate for occupational therapy?

This intervention is appropriate for occupational therapy because it addresses areas of occupation such as ADL's, client factors involving body functions and body structures, and performance skills such as sensory perceptual, motor and praxis, and cognitive skills. VEM is a preparatory method. This intervention is preparing the client for faster recovery, so that they can fully participate in ADLs and other activities sooner.

Occupational Therapy Theoretical Basis

The biomechanical model supports VEM, where remediation of strength, range of motion, and function is the main focus. The goal is for the client to begin using his or her body sooner with the hope of regaining strength and function more quickly.

Science Behind the Intervention

Deaths that occur early in recovery post stroke are often related to complications of immobilization (Sundseth, Thommessen, & Ronning, 2012). It is hypothesized that having the client engage in mobilization earlier may reduce the number of deaths due to complications of immobilization such as blood clots or pneumonia. Another theory is that early mobilization utilizes brain plasticity for quicker recovery (Sundseth, Thommessen, & Ronning, 2012).

Focused Clinical Question:

Does very early mobilization (VEM) within 24 hours of admittance to a hospital stroke unit for clients over the age of 18 who have had a stroke, improve function compared to standard stroke unit care alone?

SUMMARY:

Research conducted was aimed at determining whether VEM within 24 hours of admittance to a hospital stroke unit for clients who have had a stroke was effective in improving function when compared to standard stroke unit care. Five databases were searched, and eight articles were located matching all search terms and inclusion/exclusion criteria. Three articles were critiqued; one was a meta-analysis of two RCT's at a level 1a, and two RCT's at a level 1b. These articles were chosen based on population, outcome measures, and time to mobilization. There was no difference found between VEM and SC groups on ADL performance. However, one study reported that clients in the VEM group were able to walk at FIM 5 for 50 m sooner than those in SC group.

Clinical Bottom Line: Early mobilization within 24 hours in adults post-stroke vs. standard stroke unit care: strong evidence suggests no significant differences in ADL performance between groups and more rapid recovery of ambulation in early mobilization group.

Limitation of this CAT: This critically appraised paper has been reviewed by occupational therapy graduate students and the course instructor.

Table 1: Search Strategy

Databases Searched	Search Terms	Limits Used	Inclusion and Exclusion Criteria
OT seeker	Early Mobilization	None used	Stroke within 24 hours Adults over 18 ADL Functioning as outcome measures
Cochrane	Early Mobilization Early Movement Early Mobilization in Stroke Early Mobilization after Heart Attack	None used	Stroke within 24 hours Adults over 18 ADL Functioning as outcome measures
A comprehensive search of the UW System Data Bases	Early Mobilization after stroke	None used	Stroke within 24 hours Adults over 18 ADL Functioning as outcome measures
StrokEngine	Early Mobilization	None used	Stroke within 24 hours Adults over 18 ADL Functioning as outcome measures
Google Scholar	Telemetry stroke	None used	Stroke within 24 hours Adults over 18 ADL Functioning as outcome measures

Table 2: Summary of Study Designs of Articles Retrieved

Level	Study Design/Methodology of Articles Retrieved	Total Number Located	Data Base Source	Citation (Name, Year)
Level 1a	Systematic Reviews or Meta-analysis of RCTs	2	UW System Data Bases UW System Data Bases	Bernhardt, J., Thuy, M. N. T., Collier, J. M., & Legg, L. A. (2009). Craig, L. E., Bernhardt, J., Langhorne, P., Wu, O. (2010).
Level 1b	Individualized RCTs	6	OT Seeker	Bernhardt, J., Dewey, H., Thrift, A., Collier, J., Donnan, G. (2008)

			UW System Data Bases	Cumming, T.B, Collier, J., Thrift, A.G., Bernhardt, J. (2008) Cumming, T.B, Thrift, A.G., Collier, J.M, Churilov, L., Dewey, H.M., Donnan, G.A, Bernhardt, J. (2010) Sundseth, A., Thommessen, B., Ronning, O.M. (2012) Wijk, R.V., Cumming, T., Churilov, L., Donnan, G., Bernhardt, J. (2011) Diserens, K., Moreira, T., Hirt, L., Faouzi, M., Grujic, J., Bieler, G., Vuadens, P., & Michel, P. (2011).
Level 2a	Systematic Reviews of Cohort Studies			
Level 2b	Individualized Cohort Studies and Low Quality RCTs (PEDro <6)			
Level 3a	Systematic Review of Case-Control Studies			
Level 3b	Case-Control Studies and Non-Randomized Control Trials			
Level 4	Case-Series and Poor Quality Cohort and Case-Control Studies			
Level 5	Expert Opinion			

Table 3: Summary of Included Studies

	Study 1 Craig, Bernhardt, & Langhorne (2010).	Study 2 Cumming, Thrift, Collier, Churilov, Dewey, Donnan, Bernhardt (2010).	Study 3 Sundseth, Thommessen,& Ronning (2012).

Design	Meta-analysis	Randomized Control Trial	Randomized Control Trial
Level of Evidence	1a	1b	1b
PEDro score (only for RCT)	6	10	7
Population	This meta-analysis included 2 studies. • N=103 • 18+ with new or recurrent stroke • Excluded those with severe pre-stroke disability or co-morbidity • 1 study excluded participants with modified Rankin score >2. • Average age VEM group: 71.6(14.2) • Average age SC: 72.0 (11.6)	• N=71 • 18 years of age • Average age 74.7 years with a standard deviation of 12.5 years. • Randomized within 24 hours of symptom onset of first or recurrent stroke • Systolic BP 120-220 mmHg • HR 40-100bpm • O2 Saturation >90% • Temperature <38.5 <u>Excluded</u>: • Premorbid modified Rankin Scale (mRS) score >3 • Deterioration within first hour • Direct admission to intensive care • Concurrent progressive neurological disorder, acute coronary syndrome, severe heart failure, LE fracture preventing mobilization • Required palliative care	• N=56 • 18+ admitted to stroke unit within 24 hours of stroke onset (cerebral infarction, intracerebral hemorrhage, first ever or recurrent stroke) • Average age VEM group: 76.5(9.7) • Average age control group CG group: 77.3(9.3)
Intervention Investigated	• N=54 • Mobilization within 24-36 hours after onset of stroke symptoms • VEM was then delivered for 7 or 14 days	Very Early Mobilization (VEM): • N=38 • Began mobilization as soon as practical after randomization (goal within 24hrs)	Very early mobilization (VEM): • N=27 • Mobilized within 24 hours of admittance to hospital o Mobilization is defined as all out of bed activities. • Mobilization was performed by PT,

		• Also received standard care from ward therapists and nursing staff • Additional interventions aimed to sit upright and out of bed 2x/day • Therapy delivered by trained nurse and PT for 1st 14 days or until discharge from acute stroke unit	nursing staff, & OT • No detailed protocol defining type or amount of exercise was used
Comparison Intervention	N=49; Standard Care	N= 33; Standard care from ward therapists and nursing staff	N=29; Began mobilization between 24-48 hours
Dependent Variables	• Independence at 3 months • Early complications of immobility 5-7 days post stroke • Activities of daily living at 3 months after stroke	• Independence in ADLs • Recovery of walking	• Neurological impairment • Death • Independence • Complications
Outcome Measures	Primary: Whether participants had modified Rankin scale (mRS) ≤ 2 and Barthel Index (BI) ≥ 18 at 3 months, designating independence. Secondary: • Early complications of immobility (assessed on day 5 & day 7): falls, pneumonia, chest infection, deep vein thrombosis, and pulmonary embolism. • ADL scores on Barthel Index at 3 months	Primary: • Number of days from stroke onset until patient could first walk 50 meters without human assistance Secondary: • Barthel Index • Rivermead Motor Assessment-Gross function subtest	All taken on admission, discharge and 3 months poststroke: Primary: • Number of participants with Modified Rankin scale (mRS) score of 3-6 Secondary: • Death • National Institute of Health Stroke Scale (NIHSS) • Barthel Activities of Daily Living Index • Type and number of complications
Results	• Proportion of very early mobilization (VEM) participants who were independent at 3 months was higher than standard care (SC) group	• Days to walking: o VEM walked sooner p=0.032 • Barthel Index: o No difference between groups at 3 months	• Clients scoring 3-6 on mRS: o No difference between groups (Odds ratio: 2.70, 95% CI: 0.78-9.34, p=0.12) • Death o No difference between groups (Odds ratio: 5.26, 95% CI: 0.84-32.88, p=.08) • Neurological imairment (NIHSS):

	(pooled absolute risk difference: 15.3%, 95% CI: -4.0%-38.0%) • VEM group was more likely to be independent at 3 months than SC according to mRS (adjusted odds ratio: 3.11, 95% CI: 1.03-9.33). • VEM group was more likely to be independent at 3 months than SC group according to BI (adjusted odds ratio: 4.41, 95% CI: 1.36-14.32) • Risk of experiencing early immobility-related complications was significantly lower in VEM group than SC group (adjusted odds ratio: 0.20, 95% CI: 0.10-0.70) • VEM group had higher ADL score on BI at 3 months than SC. o VEM: median=20, IQR: 16.5-20 o SC median=17, IQR:12-20	(p=0.713) • Rivermead Motor Assessment: o No difference between groups at 3 months (p=0.883)	o Improved for both groups from baseline to follow-up stat sig (p=<.001) o Changes in the CG were greater than VEM group with d= 1.24; p=0.02) • Barthel Index: o No difference between groups (p=0.73) • Complications: o No difference between groups (p=0.08)
Effect Size	Not specified & unable to calculate with given data	Not specified & unable to calculate with given data	d=1.23 (Neurological Impairment, in favor of CG)
Conclusion	VEM has a favourable effect on independence in participants with acute stroke at 3 months. More studies using the same protocol should be completed to contribute to a more valid pooled analysis.	Clients who received VEM in addition to standard stroke unit care walked sooner than those with standard care only. Providing VEM can accelerate recovery of functional activities. Early mobilization may decrease length of hospital stay and increase likelihood of	A nonsignificant trend was found in the VEM group toward poorer outcome, death rate, and dependency. Improvement in neurological function was found in the CG. Limitations of the study cause the inability to draw reliable conclusions regarding VEM within 24 hours of stroke.

		being discharged home.	

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

Overall Conclusions:

Function was defined as ability to walk 50 meters at a FIM level 5 or independence in ADLs. Independence in ADLs was defined as a score of 18 or higher on the Barthel Index and/or a 2 or lower on the modified Rankin scale. Cumming, et al. (2010) and Sundseth, Thommessen, & Ronning (2012) found no statistically significant difference in independence in ADL performance between subjects mobilized within 24 hours and those who received standard stroke unit care in two studies. However, Craig et al. (2010) found that the VEM group was three to four times more likely to be independent in ADLs as measured by the Barthel Index and the mRs scale at 3 months post stroke than standard care as reported by adjusted odds ratios. One study found that subjects mobilized within 24 hours were able to walk without human assistance after a median of 3.5 days compared to a median of 7 days in the standard care group (Cumming et al., 2010). This difference was statistically significant.

There was a difference in the amount of time after stroke onset to the time outcome measurements were taken. Craig et al. (2010) took measures of independence at 5 - 7 days to monitor progress and 3 months post stroke, Cumming et al. (2010) took post-intervention measures of independence at 3 months and 12 months post stroke while Sundseth, et al. (2012) took measures at 4 - 5 days post-stroke to monitor progress and 3 months post-stroke.

Total treatment time varied between studies, as did median time to first mobilization. Studies analyzed by Craig et al. (2010) used a total treatment time ranging from 61.3 - 167 minutes for the VEM group and 42.2 - 69 minutes for the standard care (SC) group. Sundseth et al. did not specify a protocol for total treatment time. Median time to first mobilization ranged from 13.1 - 27.3 hours for the VEM group and 30.8 - 33.3 hours for the SC group.

Sundseth et al. (2012) reported that more clients in the VEM group presented with more severe strokes than in the SC group. This difference did not reach significance, however, more clients in the VEM group were more likely to have passed away at the 3-month follow up than the SC group. This suggests that clients with more severe strokes may be more vulnerable to post-stroke complications. Caution should be taken when mobilizing clients with severe stroke. Craig et al. (2010) defined pre-stroke disability differently between protocols, which may have affected the post-treatment results. One protocol defined pre-stroke disability as an mRs score >3, while the other protocol defined it as an mRs score >2, resulting in a smaller number of clients in the mild-moderate disability category for the latter protocol.

The Barthel Index assesses the ability of a client to care for him or herself with respect to his or her ADLs. While this assessment is a valid and reliable measure of ADLs in stroke research, it is not sensitive to small changes in function due to the scoring process. The modified Rankin scale compares current to prior function in daily activities. It is also a valid and reliable measure of ADLs in stroke research. It is possible that there may have been more changes in function than those detected by the outcome measures used.

There was insufficient evidence supporting the effect of VEM within 24 hours of admittance to a hospital stroke unit for clients over the age of 18 who have had a stroke to improve function compared to standard stroke unit care alone. Craig et al. demonstrated serious methodological problems, such as using a pooled analysis of evidence from two studies, indicating clients were more likely to be independent at three months. With a higher level of rigor, Sundseth et al. (2012) and Cumming et al. (2010) did not demonstrate that VEM was any more or less effective than standard stroke unit care.

Boundaries:

One hundred and fifty-nine participants with average ages between 60.4 and 87.2 years, within 24-48 hours of new or recurrent stroke onset were included. Participants with deterioration within the first hour of admission, direct admittance to an intensive care unit, comorbidities such as progressive neurological disorders, acute coronary syndrome, severe heart failure, intravenous or intraarterial thrombosis, a lower limb fracture preventing mobilization, or impairments in ADL function with a pre-stroke mRs score above a 3 were excluded.

Implications for Practice:

There was no difference found between VEM and SC groups on ADL performance. However, one study reported that participants in the VEM group were able to walk at FIM 5 for 50 m sooner than those in SC group. It is important to consider the severity of the stroke when mobilizing clients before 24 hours. One study reported an increase in death in the VEM group, which contained participants with more severe strokes. VEM group got more treatment time than the SC group, but this did not make a difference in outcomes. More improvement in function may be seen clinically than measured by the Barthel Index and the modified Rankin Scale as these are not sensitive to small changes in function. While the inclusion criteria required participants be age 18 or older, the ages of the participants in these studies average between 71.6-77.3 years. This is important to consider when interpreting effectiveness of very early mobilization.

References

Gillen, G. (2013) Cerebrovascular accident/stroke. In Pendleton, H.M. & Schultz-Krohn, W. (Eds.). *Pedretti's occupational therapy: Practice skills for physical dysfunction. (845-880)* (7th ed.). St. Louis, MO. Elsevier.

Stroke Association (2014). *Impact of stroke (stroke statistics).* Retrieved from http://www.strokeassociation.org/STROKEORG/AboutStroke/Impact-of-Stroke-Stroke-statistics_UCM_310728_Article.jsp

Articles Appraised:

Craig, L. E., Bernhardt, J., Langhorne, P., Wu, O. (2010). Early mobilization after stroke: An example of an individual patient data meta-analysis of a complex intervention. *Stroke, 41,* 2632-2636.

Cumming, T.B, Thrift, A.G., Collier, J.M, Churilov, L., Dewey, H.M., Donnan, G.A, Bernhardt, J. (2010). Very early mobilization after stroke fast-tracks return to walking: Further results from the phase II avert randomized controlled trial. *Journal of Rehabilitative Medicine, 42*, 153-158. doi: 10.1161/STROKEAHA.110.594598

Sundseth, A., Thommessen, B., & Ronning, O.M. (2012). Outcome after mobilization within 24 hours of acute stroke. *Journal of the American Heart Association, 43*, 2389-2394. doi: 10.1161/STROKEAHA.111.646687.

Related:

Bernhardt, J., Dewey, H., Thrift, A., Collier, J., & Donnan, G. (2008). A very early rehabilitation trial for stroke (avert): Phase II safety and feasibility. *Journal of the American Heart Association, 39*, 390-396. doi: 10.1161/STROKEAHA.107.492363

Bernhardt, J., Thuy, M. N. T., Collier, J. M., & Legg, L. A. (2009). Very early versus delayed mobilization after stroke. *Stroke, 40,* e489-e490.

Cumming, T.B, Collier, J., Thrift, A.G., & Bernhardt, J. (2008) The effect of very early mobilization after stroke on psychological well-being. *Journal of Rehabilitative Medicine, 40*, 609-614. doi: 10.2340/16501977-0226

Langhorne, P., Stott, D., Knight, A., Bernhardt, J., & Barer, D. (2010). Very early rehabilitation or intensive telemetry after stroke: A pilot randomised trial. *Cerebrovascular Disease, 29,* 352-360.

Wijk, R.V., Cumming, T., Churilov, L., Donnan, G., & Bernhardt, J. (2011). An early mobilization protocol successfully delivers more and earlier therapy to acute stroke patients: Further results from phase II of avert. *Neurorehabilitation and Neural Repair, 26*(1), 20-26. doi: 10.1177/1545968311407779

Non-Stroke Related:

Agorastides, I., Sinopidis, C., El Meligy, M., Yin, Q., Brown, P., & Frostick, S. (2007). Early versus late mobilization after hemiarthroplasty for proximal humeral fractures. *Journal of Shoulder and Elbow Surgery, 16*(3) S33-S38.

Diserens, K., Moreira, T., Hirt, L., Faouzi, M., Grujic, J., Bieler, G., Vuadens, P., & Michel, P. (2011). Early mobilization out of bed after ischaemic stroke reduces severe complications but not cerebral blood flow: A randomized controlled pilot trial. *Clinical Rehabilitation, 26*(5), 451-459.

Doiron KA, Hoffmann T, & Beller EM. (2013). Early intervention (mobilization or active exercise) for critically ill patients in the intensive care unit (protocol). Cochrane Database of Systematic Reviews 2013, Issue 10. Art. No.: CD010754. DOI: 10.1002/14651858.CD010754

Li, Z., Peng, X., Zhu, B., Zhang, Y., & Xi, X. (2013). Active mobilization for mechanically ventilated patients: A systematic review. *Archives of Physical Medicine & Rehabilitation, 94*(3), 551-561.

Nash, C. E., Mickan, Del Mar, C. B., & Glasziou, P. P. (2004). Resting injured limbs delays recovery: A systematic review. *Journal of Family Practice, 53*(9), 706-712.

Oldmeadow, L., Edwards, E., Kimmel, L., Kipen, E., Robertson, V., & Bailey, M. (2006). No rest for the wounded: Early ambulation after hip surgery accelerates recovery. *ANZ Journal of Surgery, 76*(7), 607-611.

Paschos, N. K., Mitsionis, G. I., Vasiliadis, H. S., & Georgoulis, A. D. (2013). Comparison of early mobilization protocols in radial head fractures. *Journal of Orthopaedic Trauma, 27*(3), 143-139.

Van Der Horst, C. M., Kanter, J. A., De Jong, M. T., & Keeman, J. N. (1985). Shoulder function following early mobilization of