Posture, How it Develops, and why Standing is Important

Posture

Human posture can be defined as, *“the position of one or many body segments in relation to one another and their orientation in space”* (Ham et al, p26). The head, trunk, pelvis, lower limbs and feet are known as body ‘segments’, while spinal joints, hips, knees, ankle and shoulder joints are considered the body ‘linkages’ (Pope 2002).

Human posture is influenced by a number of interconnected factors:

- muscle tone (i.e. high or low)
- body shape and size (i.e. height and weight)
- gravity
- the surface (e.g. uneven ground, slopes, sand, footwear)
- the task in hand
- length of time required to be in a particular posture
- level of health, well-being or emotional state

Therefore, posture can be seen as the inter-relation and inter-dependency between:

- comfort
- stability
- function (including movement)

In the absence of stability, function (for example, the ability to play, use communication devices or do schoolwork) is impaired. However, stability can only be achieved with some degree of comfort. Function may be achieved in the absence of comfort or with minimal stability, but it will be short-lived. The balance must be struck between comfort, stability and function, depending on the task in hand and the environment. Therefore posture is important because it supports a vast range of daily functions, in addition to supporting internal processes such as breathing, vision, digestion, circulation, temperature regulation.

Humans need to be able to operate in a variety of environments, for a variety of reasons and hold themselves upright against gravity. When considering posture it should be seen as an active and dynamic process which underpins movement and function (Hong, 2005). Howe and Oldham (2001) also highlight that posture and movement are inextricably linked, referring to posture as a temporary arrested movement, which is in a constant state of change.

How posture develops

Posture, How it Develops, and why Standing is Important

When babies are born they have a predominantly flexed (C-shaped) posture with two primary spinal curves known as the thoracic curve (mid back) and sacral curve (bottom) (see Image 1).

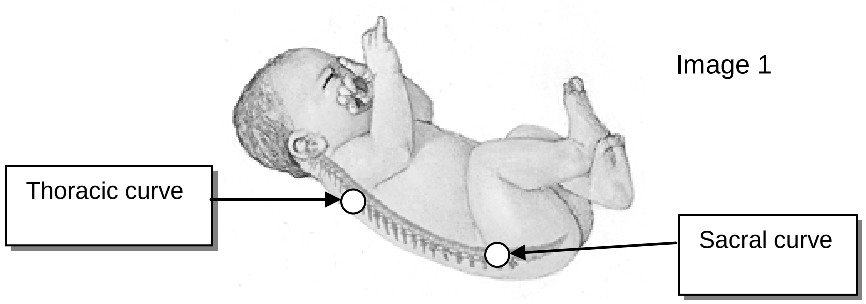


Image 1

In the usual sequence of events, babies move through developmental stages almost seamlessly (Image 2).

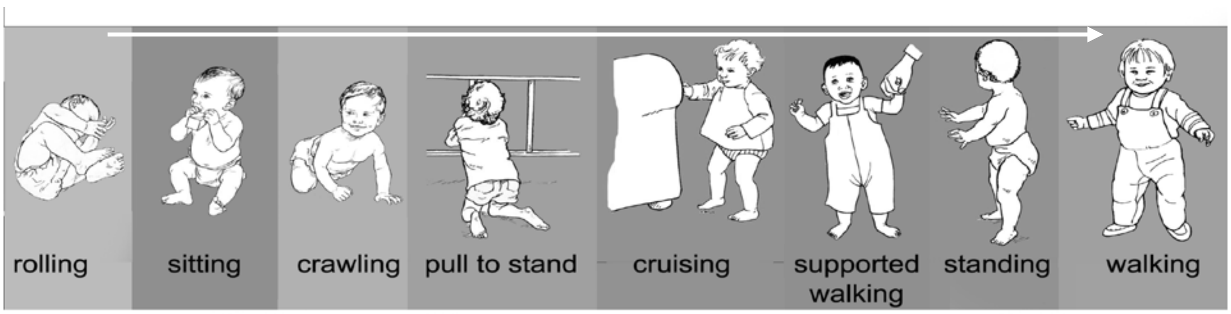
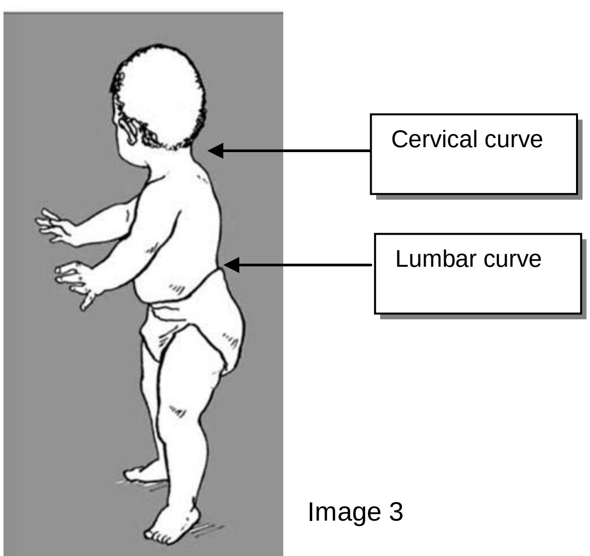


Image 2



As they learn postural control against gravity their spines develop secondary extension curves in the cervical (neck) region first (holding their heads up against gravity when on their tummy or hands and knees) and lumbar region (lower back) as they gain sitting and standing balance (Image 3).

Image 3

Postural control requires achieving normal developmental milestones and includes the maturing of postural reactions (righting, protective and equilibrium

LECKEY

reactions), the integration of primitive reflexes (asymmetrical tonic neck reflex, symmetrical tonic neck reflex, tonic labyrinthine reflex), as well as normal muscle tone, normal postural tone and intentional voluntary movements (Wandel 2000).

Why standing is important

Human beings are designed to stand. When development is unhindered, children start pulling themselves to a standing posture from as early as nine months old. This naturally progresses to cruising along furniture, then walking with hands held, to independent walking from approximately 12 months old. The ultimate goal is being able to move from one place to another at will, and achieve all the day-to-day play, self-care and school or work activities that are still to be learned. When development is seamless, we take this progression for granted, and don’t stop to think how important the upright posture is.

However, when children have moderate to severe physical disabilities (for example, cerebral palsy, spina bifida, muscular dystrophy, developmental delay, osteogenesis imperfecta [brittle bones] or acquired injuries) which prevent them from weight bearing independently, this developmental progression may not take place or skills already gained may be lost. Independent standing or walking may not be achievable. Therefore developing or maintaining an upright posture using specially designed standing frames becomes highly important.

Standing and research

Clinicians are expected to support their clinical decision-making using a process of evidence based practice. The highest level of research evidence is the double blinded randomized control trial (RCT) commonly used in drug trials. This is when neither participants nor researchers are aware of who belongs to the experimental group and who belongs to the control group. It is considered “gold-standard” level because it removes many of the confounding variables which can be found in other research methodologies, therefore reducing the likelihood of the outcome being down to chance.

However, when we think of children with disabilities and standing frames, it is neither practical nor ethical to take this sort of approach. It would not be possible to prevent children, therapists and researchers from knowing who was using a stander and who was not (it would be obvious), nor is it ethical to withhold treatment (as would be necessary for a control group) when there is no evidence that standing is *not* beneficial.

Therefore researchers have no choice but to use alternative study designs, which although may be perceived as less rigorous in research terms, are more suited to the complex variables which affect individuals with disabilities.

For example, a group of 10 year old children with Cerebral Palsy Spastic Quadriplegia will not present clinically in exactly the same way. In addition there are many other extraneous factors which cannot be controlled for by researchers - such as social circumstances or other medical issues. As a result, researchers invariably have small sample numbers, or use case series or single case study designs. This does not reduce the value of the research, and in terms of evidence based practice, clinicians must use the *best available* evidence to them. Expecting research with this population of clients to be a gold-standard RCT is asking the impossible.

The benefits of standing

However, as with most topics about postural management, published research evidence is limited regarding the effectiveness of using standing frames. Nonetheless the research that exists, along with other published material, and the clinical experience of therapists, indicate significant benefits of standing for a range of physiological and psychological reasons.

Standing increases bone density and reduces the risk of fractures

Bone density is a measure of bone strength and strong bones are more resistant to fractures. Normal bone growth and development needs a combination of good nutrition, weight-bearing (loading of the bones against gravity, for example, standing, walking or running), and the use of muscles (Pope, 2007). Therefore children with conditions which inhibit them from doing these things lose bone density (Clarke, 2010; Pope, 2007). Paleg (2008) as part of a larger systematic review, examined 10 good quality research studies published from 1964 to 2006 which looked at the effects of standing on the bone density of non-ambulatory, spinal cord injured or cerebral palsied children. All but one study report increases in bone density.

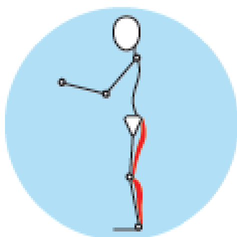
A more recent study by Alekna et al (2008) assessed bone mineral loss in people with a spinal cord injury (SCI) and how weight-bearing activity (passive standing) affected this during the first two years post-injury. The sample size was 64, with people choosing their own intervention programme: Group A – those with regular physiotherapy and a standing programme (1 hour 5 days per week); and Group B – regular physiotherapy intervention.

Results indicated that after one year, both groups had reduced BMD which was not statistically significantly different. However, after two years patients in the standing group had statistically significantly higher BMD in the legs and in the pelvis, in comparison with non-standing patients. Therefore the authors concluded that a standing programme has a statistically significant effect in the longer term on reducing the loss of bone mineral density in the lower extremities and pelvis in those with SCI.

Posture, How it Develops, and why Standing is Important

There are also many clinical publications which reiterate that bone density is maintained or improved by standing (Labandz, 2011; Dobrich, 2010; Puliti, 2010; Miles, 2010; Wechsler, 2009; Meyer, 2008).

Standing stretches muscles, preventing the onset of contractures



When children are unable to stand independently due to increased muscle tone, weakness or imbalance, they are at risk of shortening (contracture) of the muscles which bend the hip (iliopsoas); those which straighten the hip and bend the knee (hamstrings); the calf muscle which bends the knee and points the toes (gastrocnemius); and/or the calf muscle which points the toes (soleus) (Salem et al, 2010; Hagglund 2009; Young, 2008; Pope, 2007).Together the tendons of gastrocnemius and soleus are more commonly known as the Achilles tendon. Krueger & Coleman (2010) and Meyer (2008) argue that standing provides proprioceptive input (the feedback from joints and muscles which tells you where your body parts are in space without looking at them) to young developing muscles and joints and therefore builds endurance to standing and regulate resting muscle tone. Watanabe (2010) and Hicks (2008) add that the stretch provided by changing position alleviates pain.

Paleg's 2008 systematic review included 32 research articles published from 1981 to 2008 about the effects of standing on motor ability, spasticity and range of movement. While the studies vary in research design, all report some level of improvement regarding movement ability, reduction in spasticity or increased range of movement.

In addition, a more recent study by Gibson et al (2009) examined whether static weight-bearing in a standing frame affected hamstring length and ease of activities of daily living (ADLs) in non-ambulant children with cerebral palsy. Using an ABABA design where A=regular physiotherapy intervention (6 weeks); and B=regular physiotherapy intervention + standing programme (standing for 1 hour, 5 days per week for 6 weeks). Six children participated.

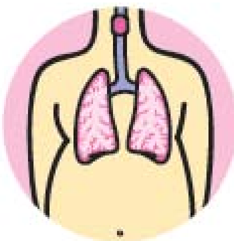
Results showed that participants' hamstrings significantly lengthened during the first standing phase ($P<0.01$), significantly shortened during the first non-standing phase ($P=0.02$) and significantly lengthened during the second standing phase ($P=0.03$). During the second non-standing phase the hamstrings shortened, but was not statistically significant ($P=0.2$). Overall, parents and staff reported a small improvement in ease of performing ADLs at the end of each standing phase.

Gibson et al's results indicate that prolonged standing significantly improves extensibility of the hamstrings, and also show that it enables the child to carry out ADLs with more ease. However, standing programmes need to be maintained to have continued benefit for the child.

Posture, How it Develops, and why Standing is Important

Clinical publications also promote standing for stretching these muscle groups (Labandz, 2011; Wechsler, 2011; Dobrich, 2011; Puliti, 2011; Rosen, 2010; Meyer, 2008) in addition to improving the joint ranges of movement, and reducing spasticity.

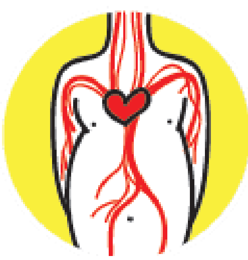
Standing improves respiration and voice control



When we breathe in, the thin muscle which separates the chest cavity from the stomach cavity (diaphragm) becomes smaller (contracts). In turn, this expands the chest cavity, allowing our lungs to suck in air. When we breathe out, the opposite happens. So when we stand, the diaphragm has more room to expand and contract, meaning we can breathe in and out more easily, deeply and efficiently (Labandz, 2010; Watanabe, 2010; Wechsler, 2009; Meyer, 2008). Paleg's 2008 review includes 3 articles published from 1995 – 2001 which specifically report improved breathing.

Meyer (2008) describes how individuals can speak with improved volume due to greater breath support, aiding communication; while Krueger & Coleman (2010) goes further, observing that standing during play and therapy increases vocalization and use of language in general.

Standing enhances circulation and blood pressure



Effective circulation is closely related to breathing, as it is the efficient supply of oxygen to the blood, followed by the efficient pumping of this oxygenated blood to the rest of the body which helps to keep us healthy. Paleg's 2008 review identified 9 articles published between 1964 – 2007 which reported improvements in participants' blood pressure (reduced orthostatic hypotension – the sudden drop in blood pressure when standing), heart rate, and circulation and decreased swelling (oedema) in legs and feet.

More recent clinical commentaries also support standing for improved circulation (Miles, 2010 & 2008; Wechsler, 2010); cardiac exercise (Watanabe, 2010; Mogul-Rotman, 2008); and oedema (Mogul-Rotman, 2008).

Standing aids digestion, bowel function and bladder drainage

Standing is believed to help with digestion and toileting through a combination of gravity (Wechsler, 2011; Watanabe, 2010; Meyer, 2008;

and the activation of the stomach muscles (Labandz, 2010). From a research evidence perspective, Paleg's 2008 systematic review reveals more evidence to support digestion and bowel function than bladder drainage. Seven studies (1990 – 2007) looking at digestion and bowel function (in spinal cord injured [SCI] or elderly participants) reported up to 53% improvement in the regularity and time spent in bowel clearance. By comparison, only 4 studies (1998 – 2001) looked at bladder function in SCI participants, again with up to half of participants reporting either improvements in bladder emptying or reduction in urinary infections.

One study reported by Paleg (2008) demonstrated in "normal" participants that bladder pressure increased 2-3 fold with a 60^0 tilt from supine indicating that a more upright posture is more efficient for bladder awareness and emptying.

Many clinical commentaries also support the use of standing for digestion and bowel/bladder function (Dobrich, 2010; Puliti, 2010; Rosen, 2010; Thompson, 2009; Mogul-Rotman, 2008).

Standing facilitates the formation of the hip joint in early development

Perhaps surprisingly, the maintenance of hip integrity as a benefit of standing has very little research evidence to support it. Paleg's 2008 review identified only 3 studies looking at the improvement of hip integrity or the prevention of hip subluxation and dislocation. All of these studies showed improvement or maintenance of hip integrity. Pope (2007) notes that the incidence of congenitally dislocated hips in children with CP is the same as the general population, yet over time, hip dislocation in children with CP becomes a common problem which results in contractures, skin breakdown, difficulties with personal hygiene and other orthopaedic complications (Hagglund, 2009). Hagglund also suggests that perhaps protection of hips may be possible.

Children who stand at the normal developmental age of 12-16 months are considered more likely to form the femoral head and acetabulum (ball and socket) of the hip joint (Labandz, 2011 & 2010; Dobrich, 2010; Rosen, 2010; Silberstein, 2008). In addition, a landmark consensus statement on 24 hour postural management recommended that the most severely affected children should be introduced to standing programmes at 12 months of age (Gericke et al, 2006), while Miles (2010) argues that standing from an early age maintains flexibility, and functional ability to stand and transfer.

Standing enables kids to interact eye-to-eye with their peers

While no formal research exists specifically on this subject, almost every single clinical commentary written about standing cites the eye-to-eye interaction achievable as a major psychological benefit to those who

stand because of the social interaction, communication and educational opportunities it presents (Wechsler, 2011 & 2009; Puliti, 2010; Labandz, 2010; Krueger & Coleman, 2010; Rosen, 2010; Thompson, 2009; Silberstein, 2008; Young, 2008; Meyer, 2008; Miles, 2008). Labandz (2011) and Watanabe (2010) expand further arguing that supported standing can eliminate the fear of falling, allowing the individual to direct their attention towards learning and social interaction. Miles (2010) points out that the child with physical disabilities is able to accomplish tasks in the same manner as typical students.

In turn, this eye-to-eye interaction is reported to improve confidence, self-esteem and self-image (Hohman, 2011; Kreuger, 2010; Rosen, 2010; Thompson, 2009; Wechsler, 2009; Meyer, 2008; Otzel et al, 2008).

Standing improves skin integrity by relieving pressure encountered during sitting

When individuals sit for lengthy periods of time, the sitting bones (ischial tuberosities) and other bony areas like the bottom of the spine (sacrum) can become vulnerable to pressure and potential skin breakdown. It has already been established that standing improves breathing and circulation, so it seems logical that in the standing posture, oxygenated blood can more easily reach the tissues that are usually subject to pressure. Paleg's 2008 review identified 4 research studies published from 1998 – 2001 which showed that up to 19% of participants with spinal cord injuries reported fewer bedsores and improved skin integrity.

However, numerous clinical commentaries provide anecdotal evidence that standing helps to prevent painful and debilitating pressure ulcers because of improvements in circulation (Labandz, 2011 & 2010; Wechsler, 2011; Dobrich, 2010; Puliti, 2010; Miles, 2008; Mogul-Rotman, 2008).

Standing improves wellbeing, alertness and sleep patterns

It is almost impossible to separate one psychological benefit of standing from another as they are so closely related. However, Paleg's systematic review (2008) identified 5 research articles published from 1999 – 2002

which report an increase in alertness, feelings of well-being, improved quality of life, sleep, and a decrease in fatigue.

Clinical commentaries by Labandz (2011), Dobrich (2010), Miles (2010) Smith (2010) and Krueger & Coleman (2010) all report improvements in levels of arousal (alertness). Smith (2010) and Krueger & Coleman (2010) add that in standing, the effects of retained primitive reflexes such as symmetrical tonic neck reflex (STNR) and tonic labyrinthine reflex (TLR) are more controlled, therefore sensory organisation, comfort, energy and attention are maximized. Hicks (2008) advocates a secondary benefit of standing is better quality sleeping patterns.

Standing and every day activities (function)

It can be seen that each physiological benefit of standing is closely related to another, and in turn these benefits provide a wide range of psychological benefits. However, in turn again, these benefits can combine to improve an individual’s ability to carry out every day activities (function).

Paleg’s 2008 review identified 3 research articles which report standing helped individuals with daily home activities and self-care activities. In addition, the review identifies research which indicates improved shoulder and arm positioning, hand function and reaching.

Clinical commentary also endorses standing for improved head, trunk and upper extremity control (Smith, 2010); improved functional reach (Thompson, 2009); ability to perform fine motor tasks, hence improving enjoyment and social interaction (Labandz, 2011); improved ability to work as independently as possible (Puliti, 2010); increased play, physical education opportunities, even dancing (Miles, 2010; Labandz, 2010, Wechsler, 2009); and improved ability to participate in transfers and independent dressing, resulting in self-empowerment when coping with a disease (Young, 2008).

Choosing the correct stander

Static standing frames are available in three configurations (although some are designed to move between all three configurations):

Posture, How it Develops, and why Standing is Important

- Supine standers
- Prone standers
- Upright standers

Supine standers
Supine standers are those in which the child or young person is lifted or hoisted into lying on their backs. The stander is then adjusted to an appropriately more upright posture, depending on the individual's ability. Supine standers are best for those who lack antigravity strength in the upper trunk and neck (Labandz, 2011). They can also provide a useful change of posture for those with significant hip and knee contractures. While the full posterior support is useful for those with poor head and trunk control, the backward tilt affects the user's angle of vision, and impacts on social interaction and participation in functional tasks (Dobrich, 2010). Depending too, on the angle of tilt, the amount of weight bearing may be reduced (Wechsler, 2009).

Prone standers
Prone standers are those in which the child or young person is tilted slightly forward. Prone standers provide anterior support requiring adequate head control in the first instance. However this posture is used to encourage head control, strengthen the upper trunk and shoulder girdle (Dobrich, 2010), and inhibit extensor tone (Labandz, 2011). The further the angle from upright, the less the weight bearing advantages of standing.

Upright standers
Upright standers are designed to replicate the natural standing posture as far as possible. At this fully upright angle, weight-bearing forces are directed more typically through the spine, legs and feet (Dobrich, 2010; Puliti, 2010; Labandz, 2010; Rosen, 2010) achieving the maximum possible weight bearing advantages.

Regardless of the stander style, **the most important element is the achievement of desirable postural alignment** (Labandz, 2011). See Appendix 1 for a decision matrix of relevant clinical factors to consider when choosing a standing frame; and Appendix 2 for a spreadsheet of Leckey standing frames.

What is the best angle for standing?

Clearly, the more upright a person can tolerate standing, the greater the load bearing through the feet and therefore the greater the impact of the benefits of standing, in particular on bone mineralisation. A research study by Herman et al (2008) found that, in a group of 19 participants with spastic quadriplegic CP, on average 68% of body weight was transferred through the feet. There was a strong correlation between the inclination of the stander and the percentage body weight transferred and there were often large differences between right and left weight-bearing measures in the same person, perhaps as a result of left/right asymmetries. In addition, it was found that trays, straps and supports reduced the amount of weight through the feet. However what remains inconclusive is how much weight “is enough” to improve bone density.

Therefore the more upright the better, remembering that for some, the upright posture is just too much (Wechsler, 2009).

How long should someone stand in order to gain these benefits?

Unfortunately this is a really difficult question to give a clearly defined answer to. Paleg grouped together the research studies in her systematic review by duration of standing, and found that they range from 12 minutes on average per day to two hours five days a week. However, by far the most common occurrence is 30 – 60 minutes daily.

Clinical experts such as Rosen (2010) advocate 45 minutes to two hours daily, while Paleg, quoted by Silberstein (2008) recommends seven to 10 hours per week if the goal is to increase bone density.

It appears that the duration of standing is dependent on the person’s age, diagnosis, tolerance of the standing posture, and benefit of standing sought (Rosen, 2010). It also seems likely from recent clinical expert opinion that several shorter periods of standing may be more beneficial than one prolonged period (Wechsler, 2011 & 2009; Silberstein, 2008).

An appropriate individual standing programme should be **always** be implemented by a qualified physiotherapist.

When not to stand?

There are very few reasons not to stand. However those with orthopaedic or medical complications, for example, a healing fracture, severe osteoporosis, or severe hip, knee or ankle contractures may need to be excluded from a standing programme. Those with compromised breathing or circulation need to be carefully monitored when standing (Rosen, 2010).

Clare Wright (McIinRes, BSc(Hons)OT), Clinical Research Manager, October 2011

References

Alekna V, Tamaultaitiene M, Sinevicius T, Juocevicius (2008) Effect of weight-bearing activities on bone mineral density in spinal cord injured patients during the period of the first two years. *Spinal Cord, 46,* 727-32.

Posture, How it Develops, and why Standing is Important

Clarke, FW (2010) Stander support: does the use of standers in school "stand" up as evidence-based practice?. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 21(20) p40.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/Stander-Support.aspx via the INTERNET. Accessed 5 April 2011.

Dobrich, L (2010) Making a Stand. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 21(24) p14.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/Making-a-Stand.aspx via the INTERNET. Accessed 22 March 2011.

Gericke T (2006) Postural management for children with cerebral palsy: consensus statement. *Developmental Medicine & Child Neurology, 48,* 244.

Gibson SK, Sprod JA, Maher CA (2009) The use of standing frames for contracture management for nonmobile children with cerebral palsy. *International Journal of Rehabilitation Research, 32(4) p316-23.*

Hagglund G (2009) CPUP – Swedish National Health Care Quality Programme for prevention of hip dislocation and severe contractures in Cerebral Palsy. *CPUP website.* Available: http://translate.google.co.uk/translate?hl=en&sl=sv&u=http://www.cpup.se/&ei=ylReToG9MNS68gOM3b3MAw&sa=X&oi=translate&ct=result&resnum=1&ved=0CCEQ7gEwAA&prev=/search%3Fq%3DCPUP%26hl%3Den%26prmd%3Divns via the INTERNET. Accessed 22 March 2011.

Ham R, Aldersea P & Porter D (1998) *Wheelchair Users and Postural Seating A Clinical Approach.* London: Churchill Livingstone.

Herman D, May R, Vogel L, Johnson J, Henderson RC (2007) Quantifying weight-bearing by children with cerebral palsy while in passive standers. *Pediatric Physical Therapy 19(4):283-7.*

Hicks A (2008) Taking a stand on the importance of standing. *NRRTS Directions Vol 1.: p.24-29*

Hohman, K (2011) Upstanding Benefits. *Rehab Management [serial online] (Mar)*. Available: http://www.rehabpub.com/issues/articles/2011-03_01.asp via the INTERNET. Accessed April 5 2011.

Hong C (2002) Positioning for children with learning disabilities. *British Journal of Therapy and Rehabilitation, 9,* 443-446.

Howe T & Oldham J (2001) Posture and balance. In M Trew & Everett T (Ed) *Human Movement An Introductory Text*. London: Churchill Livingstone.

Krueger, LJ & Coleman MJS (2010) Let's stand together. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 21(8),p28.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/Lets-Stand-Together.aspx via the INTERNET. Accessed 5 April 2011.

LECKEY

Posture, How it Develops, and why Standing is Important

Labandz, S (2011) Using standers to position children for success. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 18(20),p29.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/Heightened-Awareness-2.aspx via the INTERNET. Accessed 22 March 2011.

Labandz S (2010) Take a stand for standing. *Exceptional Parent (Jul) p47-9.* Available: http://www.easystand.com/Stock/ResearchStudyFiles/LabandzStephenieTakeastandforstandingEP.pdf via the INTERNET. Accessed 22 March 2011.

Meyer, A (2008) Stand for health. *Rehab Management [serial online] (Sept)*. Available: http://www.rehabpub.com/issues/articles/2008-08_02.asp via the INTERNET. Accessed April 5 2011.

Miles M (2010) The ABC's of standing. *Rehab Management [serial online] (Oct)*. Available: http://www.rehabpub.com/issues/articles/2010-10_04.asp via the INTERNET. Accessed April 5 2011.

Miles M (2008) Upward bound. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 17(5),p69.* Available: http://physical-therapy.advanceweb.com/Article/Upward-Bound-1.aspx via the INTERNET. Accessed 5 April 2011.

Mogul-Rotman, B (2008) Rise and conquer. *ADVANCE for Physical Therapy & Rehab Medicine [serial online] 71(4),p27.* Available: http://physical-therapy.advanceweb.com/Article/Rise-and-Conquer.aspx via the INTERNET. Accessed 5 April 2011.

Ot zel D, Hass CJ, Tillman MD, Chow JW (2008) Effects of whole-body vibration on spasticity, balance, and hamstring flexibility in a child with cerebral palsy: a case report. Available: http://www.asbweb.org/html/regional/2008/seasb/abstracts/Otzel,%20Dana.pdf via the INTERNET. Accessed 5 April 2011.

Paleg G (2008) Synthesised literature review on Supported Standing. *Doctoral Thesis.* Shortened version accessed from Easystand website: http://www.easystand.com/health-benefits/research-categories.cfm. Accessed 5 April 2011.

Pope PM (2002) Posture management and special seating. In Edwards S (Ed) *Neurological Physiotherapy.* London: Churchill Livingstone.

Pope PM (2007) Severe and complex neurological disability: management of the physical condition. London: Elsevier.

Puliti, B (2010) Today's standing and seating options improve pediatric patients' quality of life. *ADVANCE for Physical Therapy and Rehab Medicine [serial online] 21(22) p37.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/On-the-Go.aspx via the INTERNET. Accessed 5 April 2011.

Posture, How it Develops, and why Standing is Important

Rosen, L (2010) The need to stand: finding the appropriate standing system to find a client's needs. *Rehab Management [serial online] (Jan)*. Available: http://www.rehabpub.com/issues/articles/2010-01_03.asp via the INTERNET. Accessed April 5 2011.

Salem Y, Lovelace-Chandler V, Zabel RJ, McMillan (2010). *Physical & Occupational Therapy in Pediatrics.* 30(1) p54-65*.*

Silberstein, N (2008) It takes a team. *Rehab Management [serial online] (Oct)*. Available: http://www.rehabpub.com/issues/articles/2008-10_04.asp via the INTERNET. Accessed April 5 2011.

Smith, Y (2010) Stand for success. *ADVANCE for Physical Therapy and Rehab Medicine [serial online] 21(20) p40.* Available: http://physical-therapy.advanceweb.com/Archives/Article-Archives/Stand-for-Success.aspx via the INTERNET. Accessed 5 April 2011.

Thompson, G (2009) The Rising. *Rehab Management [serial online] (Jun)*. Available: http://www.rehabpub.com/issues/articles/2009-06_05.asp via the INTERNET. Accessed April 5 2011.

Wandel JA (2000) Positioning and handling. In JW Solomon (Ed) *Pediatric Skills for Occupational Therapy Assistants.* London: Mosby.

Watanabe L (2010) Up and At 'Em: the physics and benefits of standing for wheelchair users (Apr). *Mobility Management.* Available: http://mobilitymgmt.com/articles/2010/04/01/standing.aspx?sc_lang=en via the INTERNET. Accessed 5 April 2011.

Watanabe l (2010) The "other" benefits of proper positioning (Mar). *Mobility Management.* Available: http://mobilitymgmt.com/articles/2010/03/01/proper-positioning.aspx?sc_lang=en via the INTERNET. Accessed 5 April 2011.

Wechsler K (2009) Stand up! *QUEST: MDA's Research and Health Magazine 18(1).* Available: http://quest.mda.org/article/stand via the INTERNET. Accessed 5 April 2011.

Wechsler, K (2011) Stand up and go with mobile standers and standing wheelchairs. *QUEST: MDA's Research and Health Magazine 18(1).* Available: http://quest.mda.org/article/stand-and-go-mobile-standers-and-standing-wheelchairs via the INTERNET. Accessed 5 April 2011.

Wright C, Casey J, Porter-Armstrong A (2010) Establishing best practice in seating assessment for children with physical disabilities using qualitative methodologies. *Disability and Rehabilitation: Assistive Technology, 5(1),* 34-47.

Posture, How it Develops, and why Standing is Important

Young S (2008) On the move: considerations for comfort, performance and safety in mobility devices. *Physical Therapy Products (Sep).* Available: http://www.ptproductsonline.com/issues/articles/2008-09_07.asp via the INTERNET. Accessed 5 April 2011.