

Biomechanics and prevention of body shape distortion

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Abstract

Destructive changes in body shape can happen slowly over a long period of time and may affect any person who has difficulty moving efficiently, irrespective of diagnosis or age. Supporting the body in symmetrical supine lying has been found to protect and restore body shape, muscle tone and quality of life for people who would otherwise be left to become static in destructive lying postures. Those described as having complex and continuing health care needs or profound and multiple learning disabilities are likely to be at risk of developing changes in body shape. This article will consider predictable patterns of chest distortion and reduction of internal capacity of the abdomen and thorax with key characteristics for those supporting individuals at risk, non-invasive measurement of body symmetry as a relevant outcome measure in the effort to protect body shape, the consequences for individuals, their families and service providers, positive feedback from families about the benefits of night positioning, the preventable nature of changes in body shape and the practical steps that may be taken to ensure the safety of the individual. Case studies will be presented which demonstrate that the body is a mobile structure which is vulnerable to distortion but also susceptible to restoration as long as the correct biomechanical forces are applied. It is proposed that therapeutic night positioning is an effective intervention which should be made available to those at risk of body shape distortion from an early age, or as a matter of urgency for those with late onset or temporary immobility.

Key words

therapeutic positioning; postural care; scoliosis; positioning; sterno-spinal line

Patterns of body shape distortion

Changes in body shape could be considered to have become synonymous with individuals described as having complex health care needs. Irrespective of diagnosis, any individual developing a destructive habitual lying posture can be considered at risk of developing distortions of body shape which will compromise

respiration, circulation and digestion. These habitual postures can develop because of movement difficulties, the early stages of skeletal asymmetry or habit. Adults are calculated to spend approximately a third of their time in the lying posture, but the proportion is often greater during childhood and, as a result, habitual lying positions often become recognisable from the pattern of distortion of body shape seen as the

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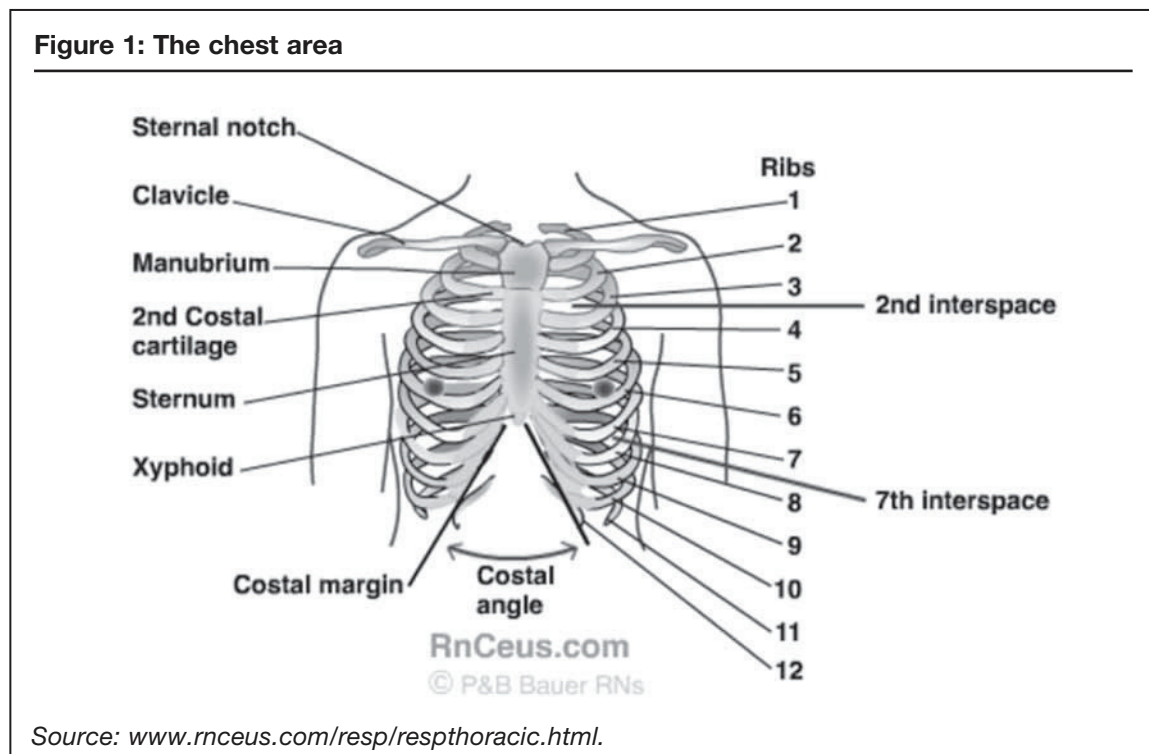
person grows older (Fulford & Brown, 1976; Goldsmith *et al*, 1992; Morris, 1999). Whilst clinicians have not previously identified the origin of the forces causing change in body shape, they have recognised the significance of their destructive capability (Olafsson, 1999; Saito *et al*, 1998).

This article considers forces acting on a body while the person is lying down. It is acknowledged that multi-factorial distorting forces acting on and within the chest in all positions will be compounded when the body is upright. However, characteristics and severity of distortion can be seen to relate to the orientation and length of an imaginary line called the sterno-spinal line in various habitual lying postures. In many individuals there is reported to be a period, usually during the adolescent growth spurt, in which the structure of the chest appears to reach a point of critical instability, and the condition deteriorates dramatically over a relatively short period of time. By understanding the biomechanics of

chest distortion professionals are able to train families to apply therapeutic forces, returning the sterno-spinal line to stable equilibrium, containing compression, and preventing and correcting distortion of chest shape (Carnaby & Pawlyn, 2008; Lacey, 1998; Rennie, 2001). Prevention and early intervention are preferable and may be more relevant to children and young adults. Restorative intervention is possible for those with established distortion, driven and directed by the use of validated, non-invasive outcome measures. For some, established body shape distortion will have caused structural changes that are irreversible; rather than working towards restoration it may be more appropriate to work to prevent further distortion, or simply to make the individual more comfortable and to improve quality of sleep.

Terminology and key characteristics of the chest

Figure 1, below, shows the architecture of the chest area and the names of important features.



Positions

- Supine – on your back.
- Prone – on your front.
- Clockwise rotation – looking from the person’s feet, the chest is rotating in a clockwise direction.
- Anti-clockwise rotation – looking from the person’s feet the chest is rotating in an anti-clockwise direction.

Normative data on chest dimensions

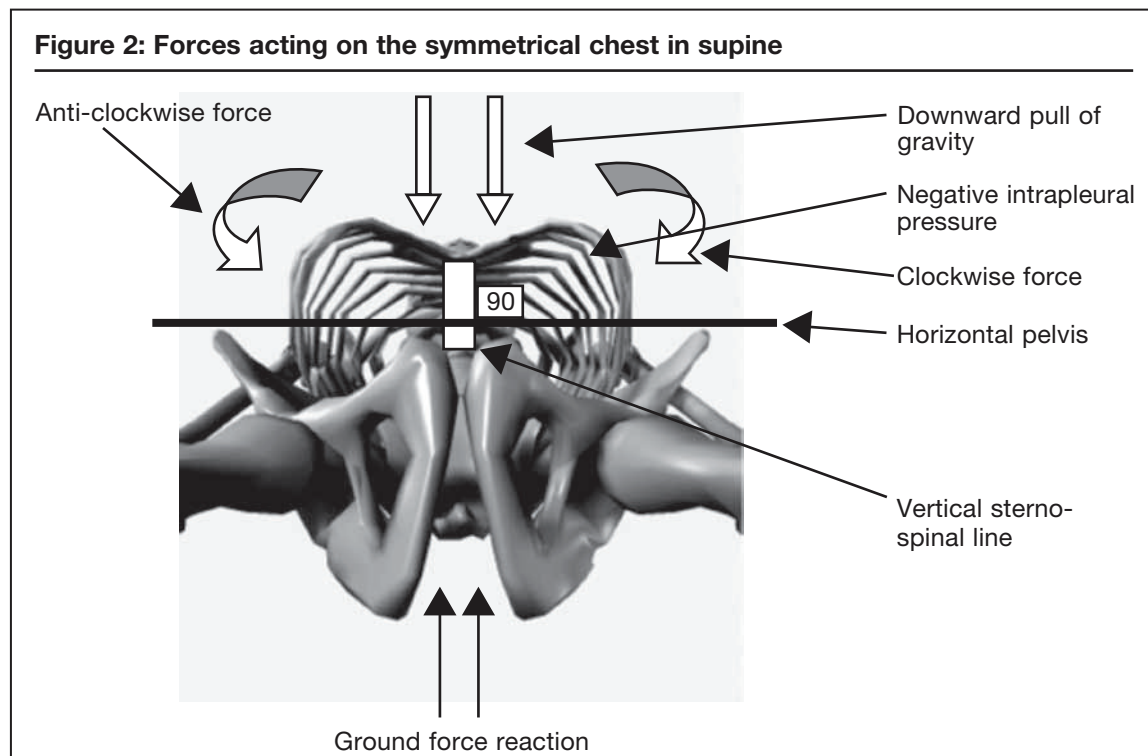
The chest depends on normal proportions in order to operate efficiently (West & Williams, 1990). The Goldsmith Indices of Body Symmetry (Goldsmith *et al*, 1992) is a set of validated, non-invasive outcome measures of critical proportions and movement of the body. The measures are taken in supine crook lying.

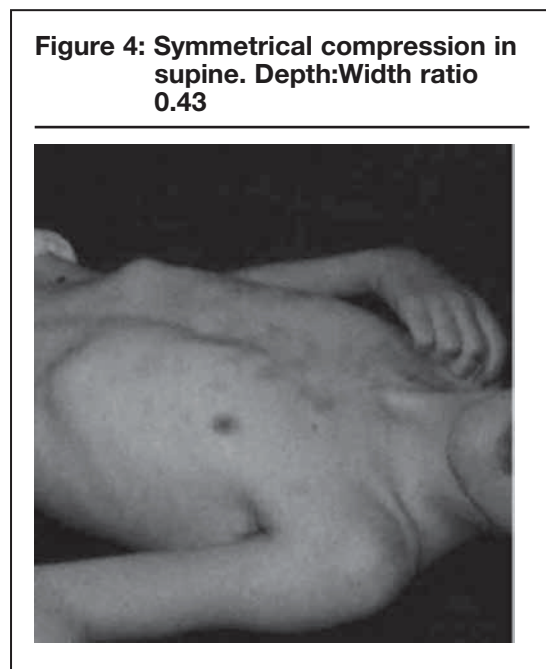
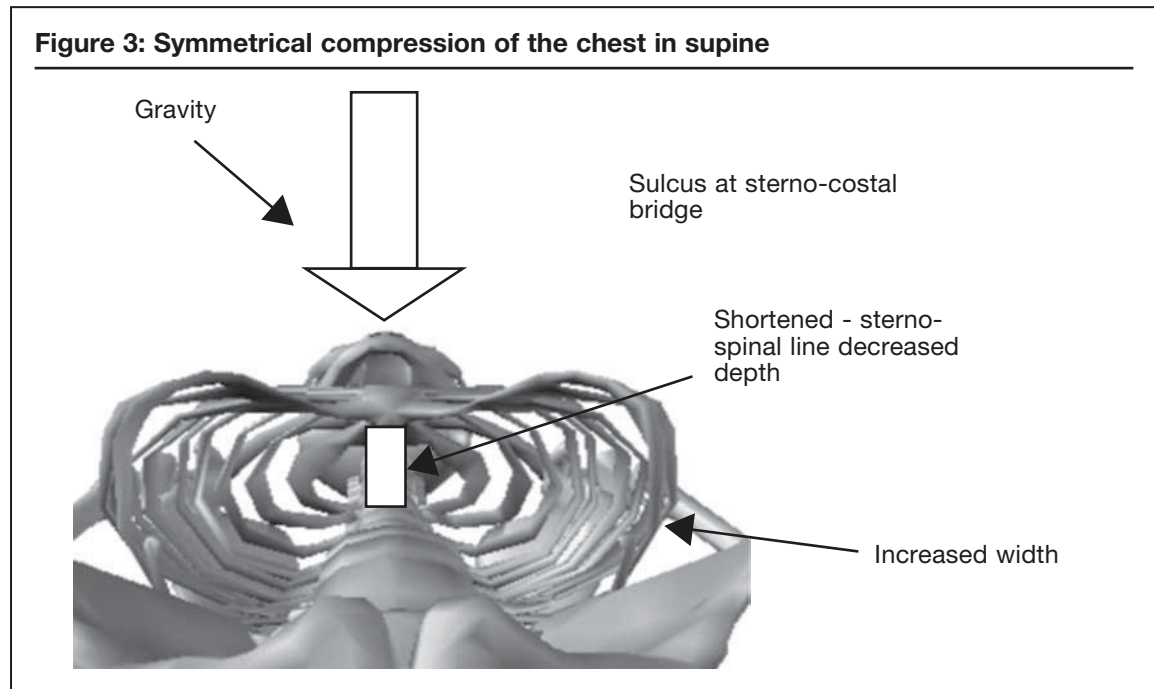
- Depth: width ratio of the chest (calculated by dividing the depth of the chest from the supporting surface to xyphoid process by the width from lateral border to lateral border)

in a chest of normal proportions will fall between 0.65 to 0.85.

- A right: left ratio of the chest of 1 indicates no rotational distortion in the chest (calculated by dividing the distance between the xyphoid process and lateral border on the subject’s right with the distance between the xyphoid process and lateral border on the subject’s left). If this ratio is less than 1, the rotation in the chest is described as anti-clockwise. If the ratio is more than 1, the rotation in the chest is described as clockwise.
- A measure of symmetry of rotation of the body as the knees are moved to the right and left between fixed points of the shoulders and feet, with comparison of angles formed so that zero equals symmetry.

The measures can be used to support early identification of individuals at risk of developing further changes in body shape and to monitor therapeutic intervention.





17). When the sterno-spinal line is either vertical or horizontal in the habitual lying posture the chest is in stable equilibrium, and the combined force of gravity acting on the chest wall mass and negative intrapleural pressure will compress the chest symmetrically. If the sterno-spinal line is not vertical, the combined force will rotate the sterno-spinal line towards the horizontal, distorting the chest in a predictable manner.

Without lateral support, the combined force will compress the rib cage, decreasing depth and increasing width, so that the chest, although flattened, will become more stable. In these circumstances compression of the chest will cause its own complications, but the chest will become more resistant to rotational distortion (*Figures 3 and 4*).

Characteristics of symmetrical compression of the chest

- Low depth: width ratio.
- Increased resistance to rotational distortion.
- The sterno-costal bridge may stretch and be sucked inwards by negative intrapleural pressure, creating a sulcus.

Viewed in transverse section in supine, the chest consists of two halves distributed around a central area, indicated by an imaginary line, the sterno-spinal line, with the sternum at the top and the spine on the bottom. This line will run through the centre of gravity (*Figure 2*, page

- Reduction in internal capacity may have an impact on digestive and respiratory function.
- Risk of hip dysplasia remains.

Types of distortion

Rotational distortion in supine

When a habitual posture develops in which the chest is tilted to one side, the orientation of the sterno-spinal line is displaced so that the central core is arranged obliquely, with the sternum and spine being rotated to opposite sides (*Figures 5 and 6, below*).

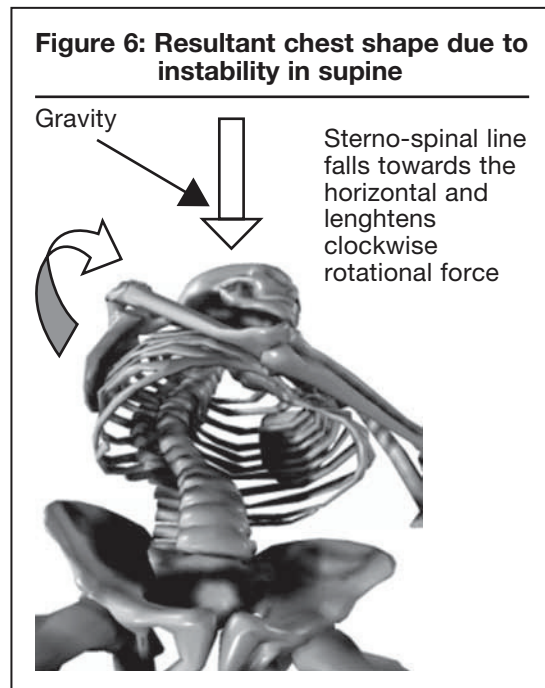
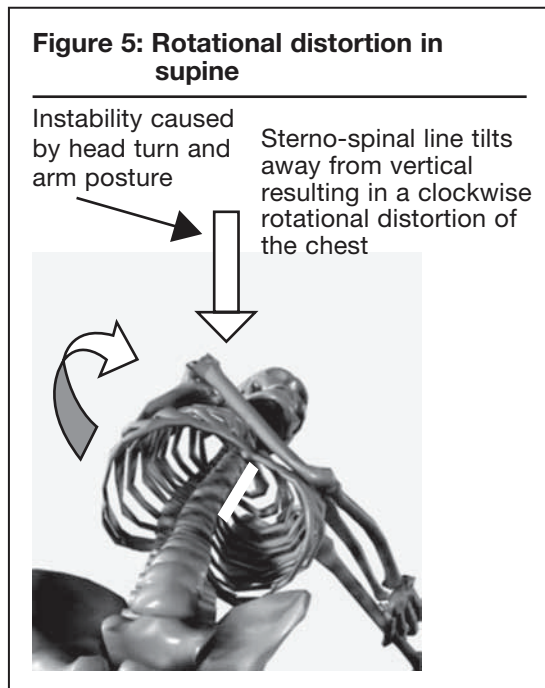
With rotational distortion of chest shape the sterno-spinal line lengthens. The distortion can be identified first on examination of the costal margin across the area of the sixth and seventh ribs as a prominence or rib flare on the side to which the sternum is displaced. As this is the least rigid part of the rib cage, any asymmetry can be apparent before it is recognised in the larger, more resistant, structures such as the spine and hips.

This rib flare gives early warning of the direction of rotational distortion and can be used to identify

the postures in which the individual spends the most time. Early identification at this stage would indicate the need to apply corrective forces to return the sterno-spinal line to the vertical and to support the head and limbs in a symmetrical posture. Without intervention, repositioning becomes more difficult as the limb and head postures become obligatory (*Figure 7, overleaf*).

Characteristics of rotational distortion in supine

- Rotational distortion evidenced by right: left ratio deviating from 1.
- The direction that the knees fall gives an indication of the direction of rotation in the chest; in the majority of cases the chest rotation will follow the knees.
- Predictable damage to the hips in relation to direction of dislocation.
- The direction of development of scoliosis is predictable from the habitual lying posture.
- Compression and rotation of the chest increases the risk of contact between lower ribs and iliac crest.



- Rotated torso in seating.
- The pelvis will usually rotate in the opposite direction to the torso in seating, often with pelvic obliquity.
- Prominent rib distortion will develop on the person's back.

Figure 7: Rotational distortion in supine, resultant chest shape



Figure 8: Equilibrium in prone with abduction

Symmetrical compression in prone



- Reduction in internal capacity may have an impact on digestive and respiratory function.

Equilibrium of the immobile chest in prone

Prone positioning is often recommended to aid respiration or control muscle tone in the short term, but for those who are immobile the uppermost weight of the spine will crush the more delicate ventral structures in the long term. As there is nothing solid to support the spine, it pulls the pelvis into anterior tilt to create a lumbar lordosis. In the long term this creates difficulties in seating for many, and in extreme cases the vertebral bodies can be palpated and sometimes seen under the anterior wall of the abdomen. Two patterns of distortion occur when individuals lie in prone habitually. For those whose original lying posture features symmetrical abduction (**Figure 8**, below) or adduction (**Figure 9**, below), symmetrical flattening of the chest often occurs.

Characteristics of symmetrical distortion in prone

- Low depth: width ratio more severe than in supine.

Figure 9: Equilibrium in prone with adduction



- High risk of anterior hip dislocation and associated difficulties with seating.
- Anterior tilted pelvis and associated difficulties with seating.
- Reinforced head turn.
- Characteristic arm and hand posture.
- Possible impact of reduction in internal capacity on digestive and respiratory function.
- Considerable difficulty associated with personal care for those with adduction.

Rotational distortion in prone

For those who draw the legs into a windswept posture, the same rotational forces occur as in an unstable supine posture (*Figure 10*, below). Severe internal rotation of the adducted leg with abduction on the other side is common, and subsequent lack of mobility will apply secondary distorting forces when the individual is seated.

It is important to recognise that, even when a person has reached adulthood, changes in body shape will continue to affect them since gravity will continue to act upon them, as shown in *Figures 11, 12* and *13*.

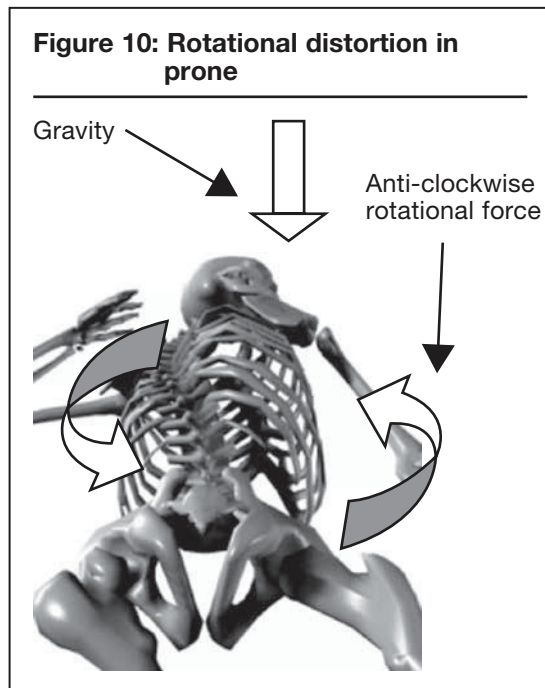


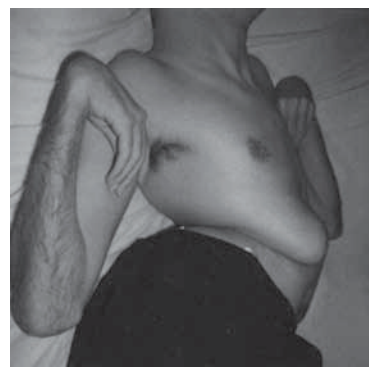
Figure 11: Rotational distortion in prone



Figure 12: Effects of rotational distortion caused by prone lying on the individual's seated posture



Figure 13: Development of a complex and life-limiting pattern of distortion over time

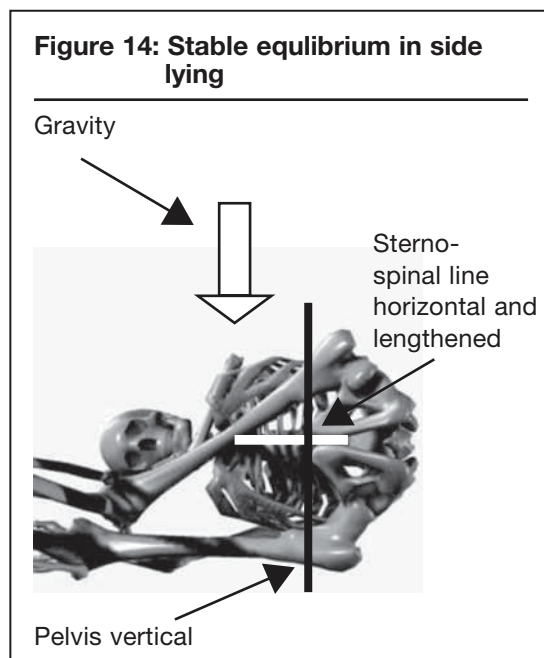


Characteristics of rotational distortion in prone

- Asymmetric lordosis and associated difficulties with seating.
- Reinforced head turn.
- Low depth: width ratio more severe than in supine.
- Rotational distortion evidenced with right: left ratio deviating from 1.
- Anterior tilted pelvis and associated difficulties with seating.
- Predictable damage to the hips in relation to direction of dislocation.
- Possible impact of a reduction in internal capacity on digestive and respiratory function.
- Characteristic arm and hand posture.
- Compression and rotation of the chest increase the risk of contact between lower rib and iliac crest.

Equilibrium of the immobile chest in side lying

Side lying has traditionally been recommended as a suitable position to assist function and reduce tone during the day. However, in the long term this position can be seen to cause



severe asymmetry with rotational elements to the pattern of distortion.

Three main patterns can be identified among those who adopt side lying as an habitual posture.

Stable equilibrium in side lying

If an individual lies in the foetal position the sterno-spinal line may be supported horizontally, and therefore the chest flattens symmetrically (*Figures 14, 15 and 16, below*).

Figure 15: Resultant chest distortion with symmetrical compression in side lying. Depth:Width ratio 0.92



Figure 16: High shoulder girdle, prominent sternum and kyphosis



Characteristics of symmetrical distortion in side lying

- Prominent sternum.
- Kyphosis.
- Narrow, high shoulder girdle.
- Flattened ribs at the interface with the arms.
- Tendency to develop contractures at the hips and knees, making seating difficult.

Rotational distortion in side lying

Many individuals do not lie directly on the supporting shoulder and there is also a tendency for the top leg to draw the pelvis either forwards or backwards. These factors will affect the orientation of the sterno-spinal line, resulting in rotational distortion.

A person lying on their right hand side with their top leg back (**Figure 17**, below) will experience anti-clockwise rotation and compression of the chest, and clockwise rotation of the pelvis with obliquity, and this may result in the right iliac crest making contact with the lower ribs.

A person lying on their right hand side with their top leg forward (**Figure 18**, below) will experience clockwise rotation and compression of the chest, and anti-clockwise rotation of the

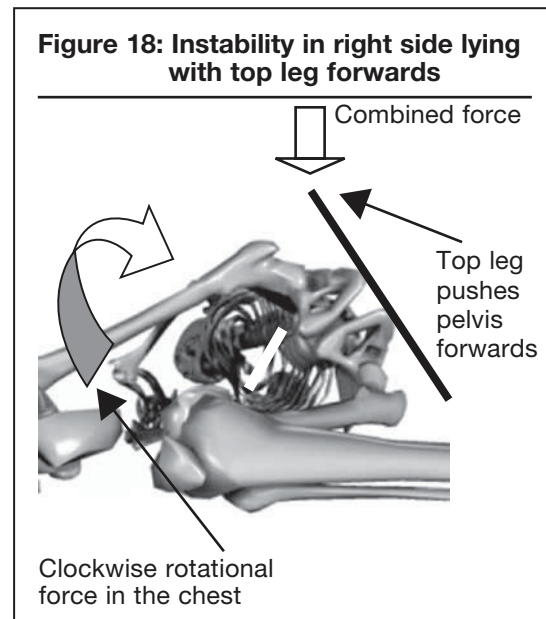
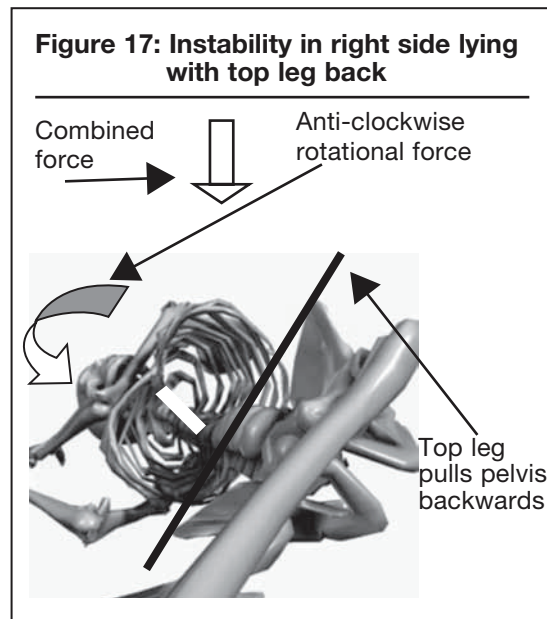
pelvis with obliquity, which may result in left iliac crest making contact with the lower ribs.

Characteristics of rotational distortion in side lying

- Rotational distortion of the chest evidenced by right: left ratio deviating from 1.
- Predictable damage to the hips in relation to direction of dislocation.
- Predictable direction of development of scoliosis.
- Possible impact of reduction in internal capacity on digestive and respiratory function.
- Compression and rotation of the chest increasing the risk of contact between lower rib and iliac crest.

Consequences of body shape distortion for individuals

The consequences of a failure to protect body shape are far-reaching and can be life-threatening, with reduction of the internal capacity of the abdomen and thorax compromising the function of vital organs. In June 2009 the NHS Purchasing and Supply Agency Buyers Guide to Night Time Positioning Equipment for children stated that:



the wider consequences of poor postural management impact on the quality of life of the child (and their carers) and may affect many body systems and functions, for example:

- *the musculoskeletal system (contractures, loss of joint integrity, for example hip dislocation, decreased bone density, reduced range of joint motion and deformity, such as spinal scoliosis)*
- *the neurological system (spasticity/muscle tone, primitive reflexes, altered sensation and joint position sense, pain, weakness)*
- *respiratory function*
- *digestion (including swallowing and choking, both of which are compromised by poor head and neck posture) and kidney/renal function*
- *personal hygiene, ease of toileting and changing*
- *functional ability*
- *environment interaction (sensory perception, body aesthetics, learning, communication), sleep pattern and irritability.*

The potential secondary complications indicate the considerable cost implications of failure to protect body shape. Costs may be associated with surgical intervention, complex equipment for mobility, moving and handling, pressure care, adaptations to the home, enteral feeding, pain management and increased need for medications such as Botox or Baclofen with their side effects and impact on thermoregulation. The human cost to the individual and their family of experiencing avoidable secondary complications is devastating.

Sir Jonathan Michael's Inquiry report *Healthcare for All* (2008) written in response to Mencap's *Death by Indifference* (2009) found that:

There also appears to be a gap in services for children with profound disabilities and

complex needs who have musculoskeletal problems. Early interventions are not undertaken to prevent postural deformities from developing. Many families receive no support or advice about how to manage the sleeping position of their child and the Inquiry heard examples of cases where later wheelchair use and/or back surgery could have been avoided if effective early intervention had been provided.

Practical steps to protect body shape

Symmetrical supine lying has been found to protect and restore body shape, muscle tone and quality of life for people who would otherwise be left to become static in destructive lying postures (DH, 2009; Hill & Goldsmith, 2005; Waugh & Hill, 2009).

The advantages of symmetrical supine lying

- The head can be centralised.
- The shoulder girdle can lie symmetrically in a level, neutral position.
- The arms and hands can be brought into a functional position.
- The weight of the spine is on the supporting surface.
- The softer, more vulnerable part of the chest is uppermost and can be protected.
- The pelvis can be brought to a level position.
- The gap at the waist, between pelvis and lower ribs, can be brought into a position to lie symmetrically.
- The hips can be protected by positioning in secure abduction.
- Gravity can be used to help the knees to straighten (extend).
- Although the feet are the most difficult part of the body to control in supine, they can be supported in a neutral position.

Before the introduction of therapeutic positioning, families and personal assistant teams need quality-assured training in order to make informed choices about risk and benefit. Particular safety issues include the implications of:

- contentment of the person
- pain recognition
- existing body shape distortion
- epilepsy
- pressure care
- breathing
- temperature regulation
- continence
- circulation.

Rating	No. of children
Position	
Much straighter	19
Straighter	5
About the same	5
Less straight	0
Much less straight	0
Could not answer	2
Sleep	
Much better	3
Better	8
About the same	13
Worse	1
Much worse	0
Could not answer	2
Muscle tone	
Much more relaxed	2
More relaxed	17
About the same	9
More tense	0
Much more tense	0
Could not answer	3
Pain	
Much less	1
Less	3
About the same	2
More	0
Much more	0
Could not answer	2

The Mansfield Project (Goldsmith, 2000) remains the only qualitative study of parents' views and experiences of using therapeutic positioning at night. **Tables 1** and **2**, illustrate the findings of this work. Thirty-one families were interviewed, of whom 28 considered that therapeutic night positioning would be beneficial for their child, and their responses after its use for one year are summarised.

The Mansfield Project provided positive feedback from families using night-time positioning, with evidence that, with support, parents were able to overcome the difficulties they faced. Listening to the evidence of families is vital if we are to develop services that make a difference in people's lives.

Reports	No. of children
No problems with use of system	3
Problems now solved	18
Problems – still seeking solution	8
Problems not solved – family had given up	2

Connor's story – measurement of body symmetry as a relevant outcome

Connor is a young man of 13 with a diagnosis of cerebral palsy. We first met four years ago and at that time he was having increasing difficulties in walking and with pain management. It was proposed that he should undergo surgery, a derotational osteotomy of his left femur. Posture analysis revealed a destructive asymmetric sleeping position (**Figure 19**, below) with resultant asymmetric movement and compression and asymmetry of his chest (**Figure 20**, below, **Table 3**, opposite).

Connor was unable to straighten his legs fully and had anti-clockwise rotational distortion of his chest with clockwise rotational distortion of his pelvis, which both contributed to his unstable and uncomfortable gait.

Connor had already had two operations to try to improve his posture. He began to sleep on his back (**Figure 21**, opposite). This took a great deal of commitment, as he had to change his usual sleeping position and needed physical

support to stabilise him in supine. The outcome measure identified improvement in body and chest symmetry and decompression, providing him and his family with positive feedback to support the behavioural changes they had made (**Figure 22**, opposite).

Connor's mother wrote:

'They identified that Connor's rib cage was not symmetrical along with other problems, by looking at the body as a whole. It identified something that had never been addressed before. This then led to a treatment that was non-invasive, does not hurt and has had such a profound effect... Connor is standing much straighter; he has grown over two inches. He is walking much better, has become more stable, he has a greater range of movement around his hips and legs'.

Connor has not required surgical intervention, he is now used to lying supine throughout the night and can achieve this with minimal support. He will continue to be measured every six months in order to identify any difficulties and so that he and his family are able to alter his night time positioning accordingly.

Figure 19: June 2006, original destructive posture



Figure 20: June 2006, Anti-clockwise rotational distortion

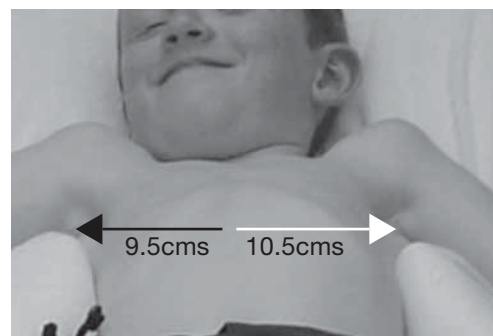


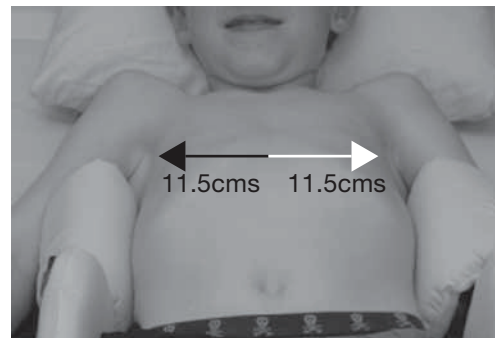
Table 3: Non-invasive measurement of body symmetry results

Date	Right: left ratio	Goldsmith Index
8th June 2006	0.90 – anti-clockwise rotation	20.25 degrees to the right
15th September 2006	1.00 – symmetry	3.25 degrees to the right

Figure 21: September 2006, symmetrical supine posture



Figure 22: September 2006, symmetry and broadening of the chest



David's story – protecting his hips

David was six when he started using therapeutic positioning; he also has a diagnosis of cerebral palsy. He already slept on his back but, due to his hip and knee flexion, his legs fell over to one side creating a clockwise rotational force within his chest. This destructive position was reinforced by the weight of his bedclothes. The predictability associated with different lying postures means that it was known that his hips were at risk of dislocation (**Figure 23** and **Table 4**, overleaf).

His family were enabled to encourage him to use an early form of stabilising support to sleep with his legs in a neutral position, with his knees pointing to the ceiling. This equipment has been updated more recently as illustrated (**Figure 24**, overleaf).

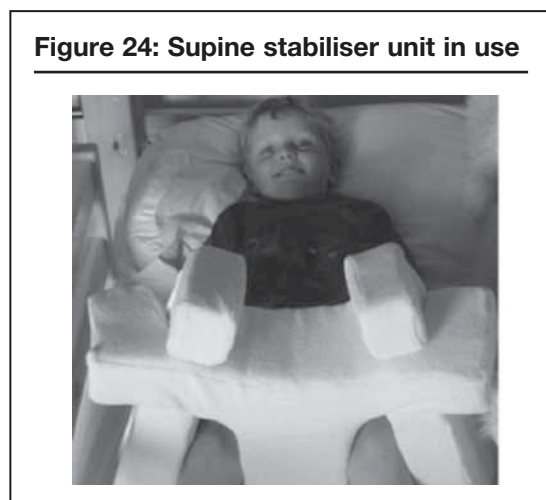
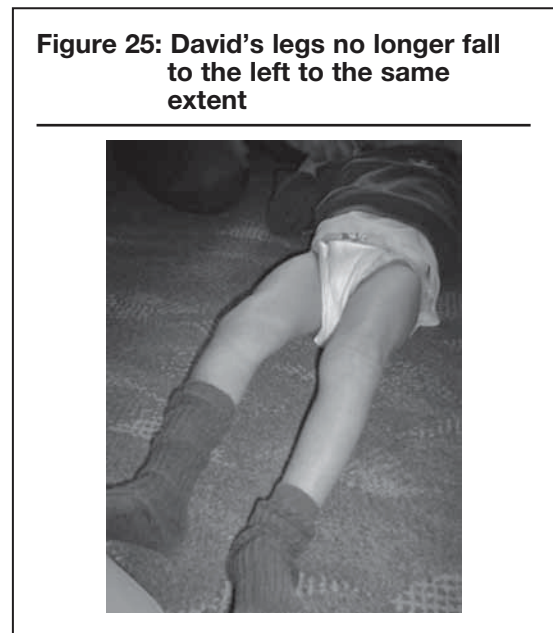
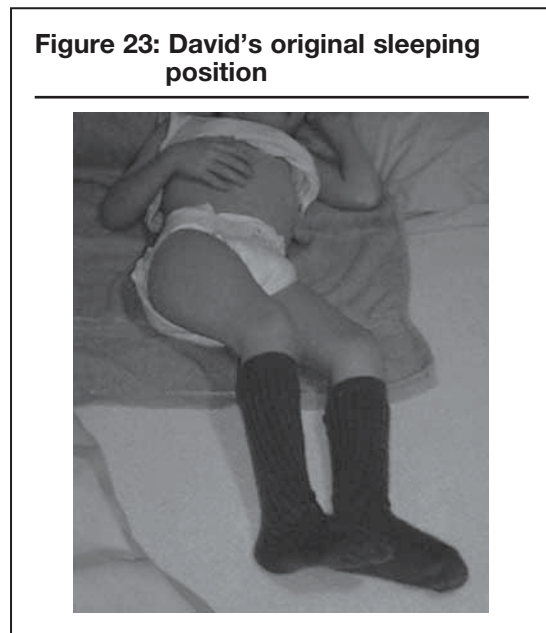
This change in habit resulted in improvement in body symmetry as measured by the Goldsmith Index in the period from December 2000 to June 2001, and a reversal of hip dysplasia revealed by hip x-ray over the period from December 2000 to January 2003 (**Figure 25**, overleaf, and **Table 4**, overleaf).

Avoiding surgery and the associated costs of further loss of mobility for David is good news for health and social care providers. For a parent, avoiding the pain and discomfort associated with hip dislocation, the trauma of having your child undergo surgical intervention and the risks associated with surgery is priceless.

Conclusion

Body shape distortion is a predictable secondary complication associated with an inability to change position easily, if at all. Supporting individuals in symmetrical supine lying wherever possible has been shown to be effective in protecting body shape, muscle tone and quality of life. Measurement of body symmetry can be

Table 4: Body symmetry and hip x-ray results		
Date	Migration %	Goldsmith Index
December 2000	Migration 26% right hip 21% left hip	24.25 degrees to the left
June 2001	No measure available	5 degrees to the left
January 2003	'Both hips in joint and normal' – results from x-ray at Derby Royal Infirmary	No measure available



used to identify those at risk, to support people to understand the nature of the difficulties faced by the individual, and to encourage the behavioural changes needed to combat the predicted pattern of distortion.

In order that services are to develop effective provision, a number of key areas require investment and scrutiny:

- the quality of training available for health care professionals, families and personal assistant teams
- provision of equipment
- development of relevant, person-centred outcome measures.

It is proposed that therapeutic night positioning is an effective intervention which should be made available to those at risk of body shape distortion from an early age, or as a matter of urgency for those with late-onset or temporary immobility.

Ultimately a fundamental shift is needed in the expectations for people with complex and continuing health care needs. Individuals and their families should expect to be provided with accurate information, timely equipment whether through an individualised budget or a traditional model, and the support needed to be given the best possible opportunity to protect body shape. Providing postural care to protect body shape is a commonsense, cost-effective and person-centred approach which will provide tangible benefits for a highly vulnerable population.

Key learning points

- To understand the predictable patterns of body shape distortion.
- To consider the consequences of predictable and preventable changes in body shape.
- To be aware of the potential benefits of therapeutic positioning and the use of objective outcome measures.

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Biomechanics and prevention of body shape distortion

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This paper reports the predictable nature of changes in body shape that can affect people who have difficulty moving, and discusses the importance of good positioning, especially during the night when the person is in bed asleep. The causes of body shape distortion, key characteristics associated with each lying position and potential consequences for the individual are outlined. The paper sets out a lot of detailed technical information, which will be vital for some readers. It is also important to draw out the implications for 'inner circle' supporters – family members, support workers – of people who are at risk of changes in body shape.

Understanding the predictable patterns of body shape distortion

Individuals described as having multiple and complex associated health care needs are most at risk of developing changes in body shape. This risk may be compounded if the person is unable to communicate in traditional ways and depends on others to meet their needs. A truly person-centred approach is required if individuals are to be protected in a way that is respectful,

safe and acceptable both to the person and to their first circle of support. It is not a subject purely for the medically trained or the therapist, but a multi-faceted and complicated issue that requires understanding and input by all those involved with a person's care. How a person is positioned and supported, 24 hours a day, seven days a week, will affect their spine, rib-cage and internal organs (such as lungs and digestive tract). This means that attention to positioning and support is required wherever the person is and whatever they are doing, for the whole of their life. Through such care it is possible both to prevent damage as a child grows up and – in some cases – to reverse damage done earlier in life.

What can be done?

The consequences of failure to protect body shape are serious and can be life-threatening. First, distorted body shape affects many of a person's choices: where they live, where and how they spend their days, the activities they can enjoy, how they move about (indoors and out), where they are able to go to the toilet and get changed. People with badly distorted body shape will have fewer choices and require more

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complicated equipment and much more of the time and energy of their supporters will be taken up with managing the complexities of their care.

The following comment is taken from the BDF report (Newlife, 2007) *It's Not Too Much to Ask*.

We have met children who cannot go to school – no wheelchair, who have had to sleep on a mattress on the floor – no bed to keep them safe, and children who are clearly in pain and distress as ill fitting equipment fails them.

The situation in relation to equipment provision for adults is hard to gauge, but anecdotal evidence from sources such as the UK Health and Learning Disability Network suggests that families find sourcing appropriate equipment in a timely fashion a challenge.

Second, changes in body shape will cause serious health problems: pain, problems with breathing, problems with swallowing and digesting food, repeated respiratory infections, increased risk of pressure sores. These health problems are likely to mean that the person needs more medication and more health care (including hospital admissions). They may have to have operations that could have been avoided. For some people these health consequences of failure to protect body shape will result in premature death. Thus predictable and preventable damage has enormous costs for people and their families, and also for health and social care provision.

Equal Treatment: Closing the Gap (DRC, 2006) stated that:

People with learning disabilities die younger than other citizens. They also have high rates of unmet health needs, which may contribute to early death.

The article details how therapeutic positioning may be used to prevent body shape distortion.

It can also help – very slowly – to undo the damage done over years of poor positioning. The results described should encourage everyone to think about how they can apply these principles with people they support. Most people spend a third of their lives in bed and another third at home. This is where consistent postural care is most needed and can have the greatest positive impact.

What else is needed?

Use of objective outcome measures would be of benefit to individuals and their families, professionals from both health and social care, and those who commission services. If we look nationally at health support for people with learning disabilities, the responsibility for body shape protection, often referred to as postural care, lies predominantly within the remit of allied health professionals.

The *NHS/PASA Buyers' Guide to Night Time Positioning Equipment* (NHS PASA, 2009) reported that 54% of therapists who responded to their survey have at least one child on their caseload who would benefit from a sleep system but who did not currently have access to this provision. *It's Not Too Much to Ask* (BDF Newlife, 2007) paints a picture of under-resourced and over-stretched services.

The number of individuals with complex health care needs is increasing. Professor Eric Emerson (2009) predicts:

sustained and accelerating growth in the numbers of adults with PMLD in England over the time period 2009–2026... with an annual percentage increase of 1.8%.

Isolated pockets of good practice in relation to the protection of body shape will not support such an increase in numbers. A fundamental shift is required if we are to provide individuals with effective and timely support based on clinical evidence and objective outcome measures.

The following could all be considered.

- Supporting person-centred care with comprehensive training and support for families and the primary circle of support; this would be in line with the current health policy context of management of long-term conditions (DH, 2009).
- Use of personal health budgets so that people are able to purchase appropriate equipment, including wheelchairs, as independently as in other countries.
- Implementation of national standards including effective use of objective outcome measures in order that services can be compared fairly and easily.
- Wholesale review of current service provision with future service provision based on clinical evidence and outcomes.

In conclusion, the work carried out by the Postural Care Skills team (www.posturalcareskills.com) is a major contribution to our understanding of this highly complex and vulnerable group of people. It is of fundamental importance for all people concerned with the health and well-being of individuals with complex movement issues.

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