

How Posture Goes Wrong: Body Shape Distortion in Cerebral Palsy

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Distortions of posture and impaired movement are key challenges in the care of children and adults with cerebral palsy.

Cerebral palsy (CP) is the one of the most common physical disability affecting children. CP is "an umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development [1].

During early development, a child with CP inevitably stays in limited lying postures for long durations, due to difficulty changing positions [2]. At early stages of development, most children freely flex their legs up in the air and sway them from left to right. A child with CP has the same desire to move and swing his legs from side to side, but eventually his/her legs land more onto one side repeatedly. This often results in habitual asymmetrical posture that continues to cause distortions at the hip, pelvis, spine, knees and feet [3]. These distortions are further influenced by factors such as abnormal reflexes, muscle tone (high or low), joint ligament type (loose or stiff), the force of gravity, and motor impairment, which might be asymmetrical as well. The resultant body distortion sequela was appropriately identified in an original article (1976): "Position as a cause of deformity in children with cerebral palsy." [4]

The purpose of this article is to further explore the mechanism within the "position leading to distortion" hypothesis. The article will elaborate on how and where distortions can be predicted, prevented and cared for by supported supine lying.

To counteract asymmetrical postural distortions it is proposed by some that therapeutic night positioning is an effective intervention.

[5]. The article will suggest similarities between alignment of the body in the supported supine lying positioning, for postural care and in the supported yoga posture of Savasana. These positions gain benefit of relaxation and elongation of the body via gravity and prop support at key bodily regions.

The Mechanism of Distortions

At a very early age, children in supine positions will attempt to swing their body from side to side in order to roll to the side and eventually onto prone positions. Rolling to the side can be performed either with the trunk as one unit where the shoulders and pelvis are aligned, or with shoulders rotating before the pelvis [6]. Children with cerebral palsy who have limited repertoire of movements have difficulty completing rotation, and frequently land and stay halfway – in asymmetric, unstable postures. The following is a hypothesis for the mechanism of distortion. Incomplete rotation can lead to one of two main scenarios: either the pelvis opposes the rotation of the knees or it follows the rotation in a delayed sequence. In either case, the result is asymmetrical supine posture with distortional force around the central axis of the body. This pulling force will rotate the thoracic vertebrae with the ribcage attached to it. The next event will cause the pelvis to be pulled either forwards or backwards by the weight of the top leg compounding rotational destruction, stressing the hip joints and establishing gross asymmetry of the leg posture [7].

Lower Extremities and Pelvis

The child's difficulty bringing the legs back to center will result in the legs falling onto the side, creating an asymmetrical position with distortion influencing the whole body as described above. This common distortion is often called "windswept deformity" in professional literature, though it would be more appropriately called a "windswept distortion." This condition is described as change in body shape presenting asymmetry of lower extremities [8]. It is worth remembering that this terminology refers to the winds' effects on clouds. Windward is the direction upwind from the point of reference. Leeward is the direction downwind from the point of reference [9]. Habitual position of the legs causes the structure around the hip joint and pelvis to adapt by lengthening and tightening depending on the direction of the distortion. In an example (Figure 1) where the knees fall to the left side the lateral structures of right leg and medial structures of the left leg are lengthened, while the medial structures of the right leg and lateral structures of the left leg are shortened. Shortened soft tissues are often incorrectly referred to as 'contractures', which emphasizes the resultant



Figure 1: Lower extremities - Distortion Process.

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Figure 2: Trunk, neck and head - Distortion Process.

shorter soft tissues while ignoring the inevitably accompanying overlong antagonists which are an integral part of the distortion [10].

In the “Classic” windswept scenario, the knees fall to one side while the pelvis drops to the opposite direction as if searching for a supporting surface, stopping the body from a complete turning. This thus creates a torque at the hip joint, and indeed often creates hip migration. In a different scenario, which is described as “Type 1”, the pelvis follows the windswept side.

The mechanism of development for either a Classic or Type 1 is not clear [11]. It might be related to timing in the developmental milestones when the child starts to roll. It is not easy to predict who will fall into one or the other windswept type. In addition to the many additional reasons including severity of motor impairment, reflexes and ligamentous laxity, another hypothesis has been proposed. It suggests that classic windswept will develop if the feet reach the supporting surface early on, so that a torque will be created at the hip. In type I the feet are in the air and the pelvis follows the legs to find the supporting surface [12]. Windswept distortions are known to be a main contributor to increased risk of hip dislocation [13]. The long-term effects of hip dislocation often lead to difficulty with daily activities, pain, difficulty in hygiene care and discomfort sitting [14].

The Chest, Trunk and Thoracic Spines

Scoliosis and thoracic distortion develop with age in children with CP [15]. There is an association between the direction of scoliosis, thoracic distortion and the direction of the windswept hip deformity such that the convexity of the lateral spinal curve is more likely to be opposite to the direction of wind sweeping [16].

The conventional (Figure 2) chest is a vulnerable and mobile structure which distorts predictably in supine asymmetrical lying. In supine the chest distortion can be viewed by drawing an imaginary arrow – a sterno-spinal line (SSL) – connecting the sternum and its corresponding thoracic vertebrae. This line can accurately be measured by marking lines on CT images, joining the sternum and

the spinous processes of the vertebrae at the level of the xiphisternum in the transverse image [17]. The rotational direction of this line can give us further information on the chest distortion. If the SSL is not vertical it will rotate clockwise or counter-clockwise [18]. Therapeutic positioning is an important factor an effective thoracic pulmonary chest developmental [19]. Chest distortion has consequences on breathing and internal organ function [5].

Let’s Get Serious about Positioning

Children with CP tend to stay inactive and in limited and asymmetric positions during the day and at night [2]. Children at risk for body shape distortion may be assisted into therapeutic positioning where the trunk, pelvis and legs are meticulously aligned and supported [5]. This approach at managing all the interrelated components of postural distortion, rather than focusing solely on the most obvious distortion, seems comprehensive and logical.

Postural Care and Savasana

An approach to postural care that focuses on body shape changes is practiced in several locations in the UK. This approach is based on a model of educating families and caregivers to safely and humanely apply postural care.

The practice of applying postural care can be informed by the yoga posture and practice of Savasana. Savasana means relaxation but also refers to a specific supine posture. In the Iyengar yoga tradition, Savasana is practiced at the end of every yoga class and as preparation for the breathing practice (Pranayama). In the Iyengar tradition, alignment is carefully instructed and the practitioner needs to position the body gradually and slowly. It starts by sitting on a mat (with a line drawn in the middle – to assist with symmetry) with knees tucked in and feet together planted on the floor. Alignment of the back of the body is done by lowering the back down, vertebrae by vertebrae, following the line that was drawn longitudinally on the mat. *While pressing the feet on the floor, the pelvis is actively lifted and the practitioner uses hands to carefully align the pelvis into posterior tilted position and move the soft tissue from the back of the pelvis down towards the feet, before positioning it on the mat. With the pelvis on the mat, the head is actively lifted and the practitioner views the anterior symmetry.* Then the legs are slowly extended one at a time. When both legs are extended, the practitioner joins together heels and knees, respectively. The practitioner can then view a straight midline connecting chin, sternum, naval, pubis and the joined feet. Adjustment of the head is done with both hands ensuring elongation of the back of the neck, so that it is centrally placed on the mat. The body relaxes in this pose and the feet relax and turn out [20]. The position of Savasana can serve as a reference for positioning for postural care. Knowledge of the practice of Savasana can help when assisting or placing a child into the supine lying position.

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