Evaluation of the Sitting Assessment for Children with Neuromotor Dysfunction (SACND) as a Measurement Tool in Cerebral Palsy: A Case Study

Knox V. (2002) Physiotherapy, 88(9)534-541

Abstract:
The Sitting Assessment for Children with Neuromotor Dysfunction (SACND) measures quality of independent sitting ability across four areas: proximal stability, postural tone, postural alignment, and balance. It was used to measure change in a child with spastic diplegia, who attended for a block of physiotherapy at the Bobath Centre, an outpatient treatment centre for children with cerebral palsy. Following therapy, the patient was observed to sit for longer and was able to reach further without losing her balance. Proximal stability and balance in sitting had improved as measured on the SACND. This measure can provide objective information regarding sitting ability in children with neuromotor disabilities and proved sensitive to change over a short period of time in this patient.

Introduction: It is a challenge to find suitable standardised measures to evaluate outcomes in children with cerebral palsy, especially over shorter time periods, as few measures display sufficient sensitivity. A patient with cerebral palsy attended the Bobath centre for a two week block of therapy. One therapy aim was to improve independent sitting balance and in order to measure change, the Sitting Assessment for Children with Neuromotor Dysfunction (SACND) was used. Apart from publications outlining the development of the test including reliability and validity studies (Reid, 1995; Reid et al, 1996), there is currently only one other report regarding the effects of different seating surfaces on seating posture (Reid, 1996).

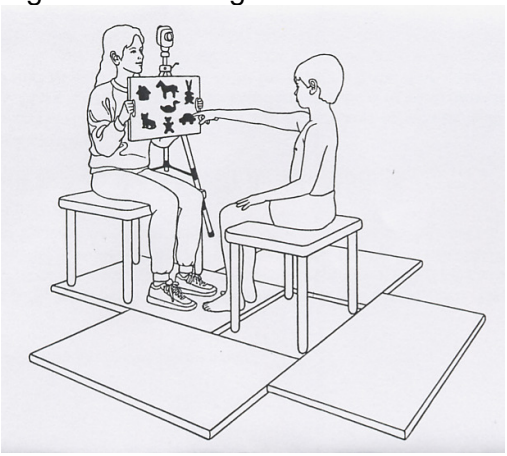
Currently few standardised measures of sitting ability exist for children with cerebral palsy. The Gross Motor Function Measure (Russell et al, 1993) includes a sitting dimension covering abilities such as sitting on the floor, a bench, and movement in and out of sitting. However, there is a ‘ceiling’ effect to the test as the maximum time the child is required to sit is 10 seconds. Also, the test does not purport to measure quality of movement. The Chailey Levels of Ability (Pountney et al, 1999) are designed to assess postural ability of children with neurological impairment. There is a seven point scale of ability, from unplaceable in sitting to being able to move into sitting. It also measures components of posture such as the position of the pelvis. The time the child can maintain sitting is not recorded. Abnormal movements or postures are described, but these do not receive a score, resulting in some limitations in assessment of quality of movement. Other clinical measures of seating which have been described in medical literature have either not yet been published in a standardised form or have had very limited reliability or validity studies (Fife et al, 1991; Myrh & von Wendt, 1991). Measures of sitting ability relying on complex instrumentation such as force-plates, videography or electromyography (Hadders-Algra et al, 1999; Hadders-Algra et al, 1996), have limited clinical usefulness.

The Sitting Assessment for Children with Neuromotor Dysfunction (SACND) The SACND (Reid, 1995) is designed to measure sitting postural control in children with neuromotor disabilities, aged 2 - 10 years, who can sit without constant hand support. The test consists of 2 x 5 minute phases which are videoed *(see Figure 1)*:

1. Rest - sitting independently on a bench while listening to a story or watching a video.
2. Reach - sitting on a bench independently and reaching towards objects on a board - centrally, up, down, and to each side, with the favoured hand.

Propping with hand(s) on the body or bench is acceptable, but the child resting their hands in their lap achieves optimum scoring.

Figure 1: Videoing the SACND



Four constructs were identified by the author of the test, as being important for mature seated postural control, which are assessed within the scoring criteria: proximal stability, postural tone, postural alignment and balance. These constructs are defined including an operational definition An example is:

"Balance is making the postural adjustments necessary to maintain the alignment between the body's centre of gravity and the base of support while having freedom of limb movement " (Reid, 1997).

The *operational definition* of *balance* is: "the ability to shift body weight and resume midline orientation without using hand support" (Reid, 1997)

For further definitions *see Appendix*.

The test is scored from the video. Criteria are given for 'normal' behaviour for each of the constructs, including three key features (score=1); and lower levels of behaviour, missing one or more of those features (scores = 2, 3, or 4). Lower scores therefore indicate higher ability and a score of four indicates that independent sitting balance was not maintained. Examples of these criteria are below:

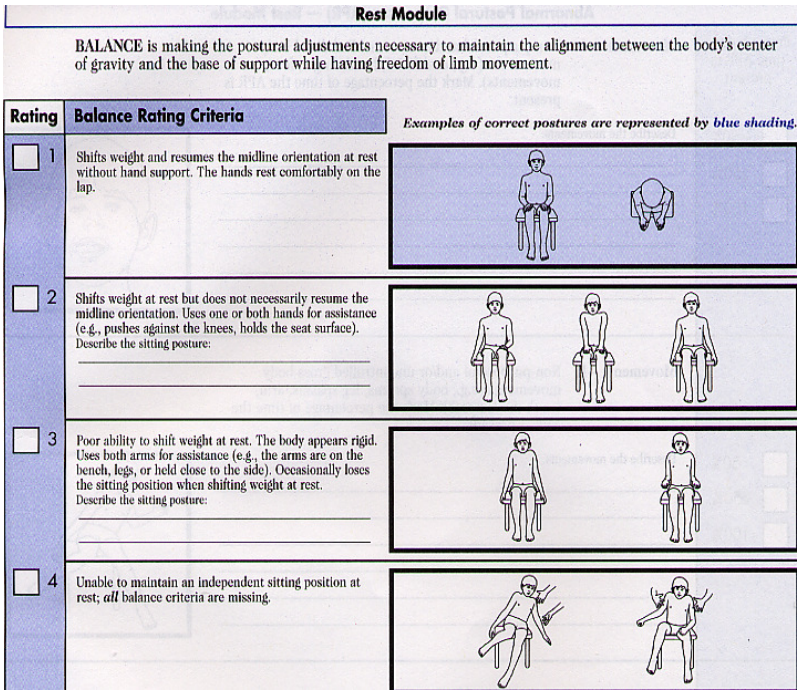
"Balance

1. Shifts weight, and resumes the midline orientation at rest without hand support. The hands rest comfortably on the lap.

2. Shifts weight but does not necessarily resume the midline orientation. Uses one or both hands for assistance (e.g. pushes against knees, holds the seat surface).
3. Poor ability to shift weight at rest. The body appears rigid. Uses both arms for assistance (e.g. the arms are on the bench, legs, or held close to the side).
4. Unable to maintain an independent sitting position at rest; all balance criteria are missing." (Reid, 1997)

Diagrams of examples of postures (correct & abnormal) are also given, *see Figure 2*. For other criteria, *see appendix.*

Figure 2: Balance Rating Scale with Examples of Postures



Also, the presence and duration of any unwanted abnormal postural responses (APRs) such as involuntary movements, which take place during each module, are recorded.

The Patient:

Sarah has spastic diplegia associated with prematurity. She attended the Bobath Centre at the age of 3 years 11 months, receiving 1 ½ hours of physiotherapy daily for two weeks, with parents being trained in a programme of home activities. Sarah presented with low tone in her trunk, which is characteristic of the pre-term child with cerebral palsy (Georgieff et al, 1986). Under minimal stimulation, she had mildly increased tone in her limbs, rising to moderate on activity. Hypertonus was more marked on the left side compared with the right. Sarah could crawl slowly with elbow flexion and increased hip flexion, stand with support and sit precariously on the floor or bench, but was unable to reach out of her base of support in sitting, without losing her balance.

Intervention:
One of the parent's main concerns was delay in achieving walking. It was explained that prior to making progress towards walking, Sarah first needed to develop more muscle activity in her trunk (Hadders Algra et al, 1999), and to improve her arm support during sequences of movement (Bly, 1994). Achievement of these aims might be demonstrated by improved sitting ability and sustaining extended elbows during sequences of movement such as crawling. The SACND was chosen as an objective measure of quality of sitting, as it requires sustaining sitting for five minutes at a time and reaching while sitting, which were considered appropriate to the patient's current level of function.

Pre-treatment, Sarah had been observed to sit unaided on a bench when holding a toy. In the test situation Sarah required minimal support (her mother placed one finger on the hand with which she was propping on the bench). Sarah therefore scored four for all sections *(see table 1)*. Sarah chose to use her more involved left hand for reaching as she was depending on her preferred right hand for postural support. When Sarah allowed her neck to extend beyond neutral, her abdominals and neck flexors were not active enough to enable her to restore her posture and sudden arm and upper trunk extension followed further compromising her balance. We felt the explanation for this to be a retained Moro response due to insufficient head control, and the duration of these responses was timed from the video.

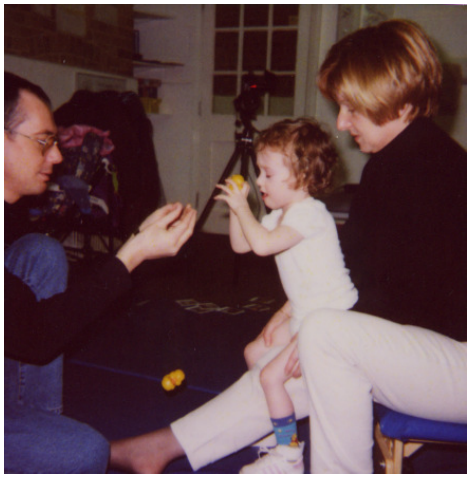
The goal of the visit was to achieve a reduced score (representing improved quality of sitting) on the SACND, after the 2 week intervention. An additional goal related to improving arm support during sequences of movement.

Treatment: This consisted of activities to facilitate use of both trunk flexors and extensors simultaneously and to facilitate arm support over extended elbows. The activities included: working on sequences of movement (moving through sitting, side sitting, all fours and crawling); improving the ability and quality of reaching in sitting and supported standing; and facilitating balance reactions in sitting. *See Figures 3-6*

Figures 3 & 4: Bench sitting to All Fours

Figure 5: Reaching while Kneeling with arm support

Figure 6: Reaching in Perch standing



Outcome:
Clinically, Sarah was observed to sit confidently on a bench for over five minutes while listening to a story and could reach in all directions just outside her base of support, without losing her balance. When reaching she used her preferred right hand, as this was no longer required for propping, giving another indication of improved sitting balance. Sarah improved in all sitting behaviours measured by the SACND *(see Table 1)*, making most progress in the Reach phase. Episodes of Moro responses reduced, indicating improved proximal stability. Two paediatric physiotherapists scored the videotapes independently and gave the same scores for all constructs. They differed in the actual time in seconds of the 'abnormal postural responses' (retained Moro responses). This is timed using a stop-watch while reviewing the video and may be subject to more errors, as the rater has to switch the stopwatch on/off in time with the APRs on the video, without looking at the watch.

Table 1: SACND Results – Pre and Post Intervention

Behaviours	**20/01/00**		**29/01/00**	
	Rest	**Reach**	**Rest**	**Reach**
Postural Tone	4	4	3	3
Proximal Stability	4	4	3	2
Postural Alignment	4	4	3	3
Balance	4	4	2	2
SubTotal	**16**	**16**	**11**	**10**
Total Score	**32**		**21**	
APRs (Moro Responses)	65 sec	2 sec	5 sec	None observed
APRs (2nd rater)	*30 sec*	*2 sec*	*None observed*	*None observed*

Implications For Practice:
Clinical observations suggested that Sarah's sitting ability had improved and the SACND test proved a sensitive outcome measure for measuring these changes, providing an objective assessment of progress. Parents also thought that Sarah's sitting had definitely improved, but that she had been slightly anxious on initial testing, as it was her first therapy session at the Centre. This may have affected her initial scores. Use of more pre treatment measurements would be preferable, to determine whether progress occurred in response to the described therapeutic input or was related to other factors.

The SACND measures an activity commonly addressed during therapy. It has the advantages of being quick to administer, straightforward to score and requires little equipment. It may be used to objectively compare and analyse the effects of using different pieces of sitting equipment or postural support e.g. ramped cushion or flat surface (Reid, 1997), or the effect of saddle seating, (Reid, 1996).

There have been validity and reliability studies of the SACND. Thirteen paediatric occupational therapists reviewed the test items in a content validity study and further refinement of the test took place as a result of their feedback (Reid, 1995). During initial test development, two inter rater reliability studies took place resulting in excellent agreement (weighted Kappa statistic of 0.72 to 1.00) for postural tone, proximal stability and postural alignment. The results for balance items were not satisfactory (Kappa = 0.35 to 0.55) (Reid, 1995). Changes were made to the scoring criteria, to improve accuracy, and a further reliability study then took place. The SACND was administered on two occasions, 14 days apart, to twenty children with diagnoses of cerebral palsy, spina bifida and other syndromes, by the same rater. The videotaped tests were scored by two raters independently (an occupational therapist and an occupational therapy student). Kappas ranged from 0.91 and 1.0 demonstrating excellent inter-rater reliability. Test re-test reliability was also good (Kappa = 0.87 to 1.0) (Reid et al, 1996).

A discriminant validity study investigated whether children without disability would perform differently to children with cerebral palsy, the latter being

expected to have higher SACND scores. Ten children with no known disability and eight children with spastic cerebral palsy participated. Children with disability had significantly higher scores than children without disability (Rest p=0.02; Reach p=0.001) (Reid, 1995). Construct validity studies included investigating whether a more supportive saddle surface would result in lower SACND scores compared to a flat seating surface in children with cerebral palsy. This was tested on six children with spastic diplegia or quadriplegia. Overall static postural control was significantly better on the saddle seat (Reid, 1996). Also it was suggested that static and dynamic sitting postural control are different constructs and therefore children will have different scores for Rest and Reach phases. Analysis of item scores from the reliability studies did not support this construct. It is possible that the SACND may be measuring the broad construct of seated postural control rather than two different constructs (Reid, 1995). No studies of the sensitivity of the test took place.

Several of these studies were conducted on very small numbers of children. More research is needed regarding both reliability and sensitivity of the SACND on larger numbers of children and on different populations of children. Children with different types of cerebral palsy may perform differently overall and on the different test modules. Further validity studies including criterion validity studies would be of benefit in confirming whether the test measures what it purports to measure.

Key Message:
The SACND is a useful standardised outcome measure for children with neuromotor disabilities, which is quick to administer and can provide objective information regarding aspects of independent sitting ability.

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APPENDIX

"Postural Tone is the readiness and balance of postural muscles to respond to gravity, actively and reactively, to forces generated from support surface contact and body movements. This is operationally defined as the ability to maintain an erect head and 90-90-90 degree relationships among pelvis, thigh, leg and ankle while maintaining relaxed shoulders, arms, hands and legs.

Proximal Stability is the dynamic interaction of stability and mobility between the body parts to yield freedom of movement from a stable base in distal body parts with graded muscle control. This is operationally defined as the ability to move the head or arm freely from the trunk while maintaining an upright and relaxed sitting position.

Postural alignment is the body's orientation around the force of gravity and to the support surface contact, necessary to restore the head position with the trunk, pelvis and extremities, for the maintenance of aligned antigravity postures while continuing to have freedom of movement. It is operationally

defined as the ability to maintain a symmetrical sitting position while maintaining the head, pelvis and legs aligned in frontal and sagittal planes. *Balance* is making the postural adjustments necessary to maintain the alignment between the body's centre of gravity and the base of support while having freedom of limb movement. This is operationally defined as the ability to shift body weight and resume midline orientation without using hand support.

Rest Module

Postural Tone

1. Maintains an independent sitting position at rest with
   a) the head level so the eye gaze is horizontal, not tilted upward or downward
   b) the shoulders and arms relaxed, so that the shoulders are depressed, and the forearms and hands are comfortably resting on the lap, and
   c) the legs relaxed so that they are slightly separated and hips, knees, and ankles form approximate right angles
2. Maintains an independent sitting position at rest; however, one of the above

criteria (a, b, c) is missing. Identify the missing criteria.

3. Maintains an independent sitting position at rest; however, two or more of the above criteria (a, b, c) is missing. Identify the missing criteria.
4. Unable to maintain an independent sitting position at rest; all tone criteria are missing.

Proximal Stability

1. Moves the head freely from the trunk at rest. The head moves side to side, up and down, and shoulder to shoulder without causing compensatory movements of the trunk.
2. Moves the head freely from the trunk at rest for only one or two of the above movements without causing compensatory movements of the trunk.
3. Poor disassociation between the head and trunk at rest. Any head movement involves compensatory movements of the trunk.
4. Any head movement results in the loss of an independent sitting position at rest.

Postural alignment

1. Maintains an independent sitting position at rest with:
   a) the head aligned with the trunk, in the midline, and level in the horizontal plane (not tilted forward, backward or sideways) and
   b) the pelvis in a relatively neutral position (not tilted anteriorly, posteriorly or laterally), and
   c) The feet placed on the floor in alignment with the knees (not pulled under the seat, or thrust forward, or out to the sides).
2. Maintains an independent sitting position at rest; however, one of the above criteria (a, b, c) is missing. Identify the missing criteria.

3. Maintains an independent sitting position at rest; however, two or more of the above criteria (a, b, c) are missing. Identify the missing criteria.
4. Unable to maintain an independent sitting position at rest; all alignment criteria are missing.

Balance

1. Shifts weight, and resumes the midline orientation at rest without hand support. The hands rest comfortably on the lap.
2. Shifts weight and but does not necessarily resume the midline orientation. Uses one or both hands for assistance (e.g. pushes against knees, holds the seat surface).
3. Poor ability to shift weight at rest. The body appears rigid. Uses both arms for assistance (e.g. the arms are on the bench, legs, or held close to the side).
4. Unable to maintain an independent sitting position at rest; all balance criteria are missing.

Reach Module

Postural Tone

1. Maintains an independent sitting position while reaching with
   a) the head level so the eye gaze is horizontal, not tilted upward or downward
   b) the shoulders and arms relaxed, so that the shoulders are depressed, and the forearms and hands are comfortably resting on the lap, and
   c) the legs relaxed so that they are slightly separated and hips, knees, and ankles form approximate right angles
2. Maintains an independent sitting position while reaching; however, one of the above

criteria (a, b, c) is missing. Identify the missing criteria.

3. Maintains an independent sitting position while reaching; however, two or more of the above criteria (a, b, c) is missing. Identify the missing criteria.
4. Unable to maintain an independent sitting position while reaching; all tone criteria are missing

Proximal Stability

1. Reaches forwards and across the midline with the arm moving freely from the trunk. Keeps the trunk stable with the non-reaching arm resting comfortably on the lap.
2. Reaches forwards and across the midline with the arm moving freely from the trunk, but uses the non reaching arm for stability (e.g. holds the bench).
3. Poor ability to cross the midline. Occasionally attempts to reach the objects across the midline. Changes hands to reach objects on each side of the board. Uses the non-reaching arm for stability (e.g. holds the bench or clothing).
4. Unable to maintain the independent sitting position while reaching. All stability criteria are missing.

Postural alignment

1. Maintains an independent sitting position while reaching with:
   a) the head aligned with the trunk, in the midline, and level in the horizontal plane (not tilted forward, backward or sideways) and
   b) the pelvis in a relatively neutral position (not tilted anteriorly, posteriorly or laterally), and
   c) The feet placed on the floor in alignment with the knees (not pulled under the seat, or thrust forward, or out to the sides).
2. Maintains an independent sitting position while reaching; however, one of the above criteria (a, b, c) is missing. Identify the missing criteria.
3. Maintains an independent sitting position while reaching; however, two or more of the above criteria (a, b, c) are missing. Identify the missing criteria.
4. Unable to maintain an independent sitting position while reaching; all alignment criteria are missing.

Balance

1. Shifts weight, and resumes the midline orientation while reaching, without hand support. The non-reaching hand rests on the lap.
2. Shifts weight while reaching but does not necessarily resume the midline orientation. Uses the non-reaching hand for assistance (e.g. pushes against the knees, holds the seat surface or holds the arm flexed by the side).
3. Poor ability to shift weight while reaching. The body appears rigid. Uses the non-reaching hand for assistance (e.g. the hand is on the bench, legs, or held close to the side). Occasionally loses the independent sitting position when attempting to shift weight while reaching.
4. Unable to maintain an independent sitting position while reaching; all balance criteria are missing.

Abnormal Postural Responses

Movements I – Non-purposeful and /or uncontrolled distal body movements (e.g. oral/facial, hand, finger, foot, toe movements).
Movements II – Non-purposeful and/or uncontrolled gross body movements (e.g. body spasms, leg spasms, arm, trunk movements).
Leg extension – A stereotypical lower extremity position characterised by increased extensor tone.
Mark the percentage of time each type of APR are present within each phase (<50%; $\geq$50%; 100%) and describe the movements."

Reid (1997)