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"The Bobath Concept in Neurological Rehabilitation: Historical Foundations, Contemporary Practice, and Interdisciplinary Approaches"

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Introduction :

The treatment described for this patient is based on the Bobath concept. This approach to therapy and rehabilitation comes from the work of Berta and Karel Bobath who, in the 1940s, started to develop treatment based on an understanding of normal movement behaviour, on their clinical experience, and on the scientific knowledge at the time. It is a problem-solving approach to the assessment and treatment of people (adults and children) with disturbances of function, movement and tone caused by a lesion or lesions of the central nervous system.

New models of motor control and a greater understanding of the neurosciences, evolved during the past 50 years, provide the rationale for current practice. A 24-hour interactive process is developed between the patient, the interdisciplinary team, appropriate family members and carers, by addressing their biological and psychosocial needs. Preventive aspects are always stressed and guidance offered. Treatment is based on an understanding of the components of function and normal movement. The goal is to optimize function through an ongoing process of assessment and treatment directed to the underlying impairments. Integrating improved control in functional activities and participation in daily life is crucial, and includes assessing the patient's function at home with family and friends at work and leisure. The focus of treatment is symptomatic and characterized by facilitating the missing components of normal patterns of function, movement and posture while avoiding reactions interfering with efficiency, success and quality of performance. The treatment, preferably performed in the person's natural surroundings, is holistic, yet specific when addressing a 24 particular element. The active participation of the individual together with the specific handling of the therapist, which is gradually withdrawn, is necessary in order to achieve independence. Follow-up treatment, when indicated, may need to continue for the rest of the patient's life. The theoretical framework of the Bobath concept is always evolving and is constantly enriched by new information and knowledge from the movement sciences and the International Bobath Instructors Training Association (IBITA).

General Principles

- Treat the patient as a whole person.
- The physiotherapist works as part of a large inter-disciplinary team. Without co-operation of the team and the family members throughout, the rehabilitation process will not be effectual.
- The rehabilitation process should start immediately after admission to hospital (Perry, 1998 C) and the treatment is symptomatic and functional (Vliet et al., 1995 A; Pobl and Dunn, 1998 C). Each symptom observed always originates from more than one cause.
- Aims of treatment must be functional and specific, with emphasis on quality of performance (Le Vere, 1980 C; Bobath, 1990 C). The functional outlook should focus on individual lifestyle (Bernstein, 1967 C; Carr and Shepherd, 1987 C; Mulder, 1994 C; Dunn et al., 1994 C; Haley et al., 1994 C; Pobl and Dunn, 1998 C).
- Evaluation and treatment are a continuum. Re-examine the patient during and after each treatment to determine whether the desired effect is being achieved. The therapist may choose to work on a particular element of a specific function and not on the function as a whole but it must be remembered that, at the end of a treatment, these elements should be combined within the desired function while retaining specific details.
- Treat primary impairments in order to prevent development of secondary impairments, which may lead to further limitation of function. • Rehabilitation continues 24 hours per day (Shumway-Cook and Wollacott, 1995 C), and the nearer to normal the stimuli given, the more the gains achieved, for example correct positioning in bed and in sitting.
- Although the concept of constraint induced movement and learned non-use (Miltner et al., 1999) were originally used in the treatment of chronic hemiplegia (Wolf et al., 1989 A; Taub et al., 1993 B, 1994 A), it should be remembered that 'learned non-use' should be avoided from the early stages of rehabilitation (Bobath, 1990 C). There is neurological evidence supporting the influence of treatment on the plasticity of the nervous system (Bach-y-Rita, 1987 C; Held, 1987 C; Fisher, 1992 C; Kidd et al., 1992 C; Lee and Van Donkelaar, 1995).
- A large part of the treatment should take place in the patient's natural surroundings: in the ward, rehabilitation department and at home (Bernstein, 1967 C; Mulder, 1994 C; Gentile, 1987 C; Park et al., 1994 A). • A desired movement can often be achieved by changing the

environment, for example rearranging the furniture to produce a narrow passage demanding side walking to navigate it successfully (Gentile, 1987 C; Perry, 1998 C).

- Treatment is through problem-solving and, as Bernstein said in 1967(C), 'learning is repetition without repetition'.
- Giving feedback is an integral part of treatment. Real, informative feedback should be used and reduced with time (Carr and Shepherd, 1987 C; Schmidt, 1975 C; Winstein, 1987 C, 1991 C; Winstein et al., 1996 A).

Treatment

- The treatment is based on knowledge and understanding of normal function and movement. Normal movement demands the ability to control selected movements, such as movements between the upper and lower trunk or between trunk and extremities.
- It is important to understand the function of the dynamic stabilizing muscles and their influence on other muscles. For example, the abdominal muscles and the function of the serratus anterior muscle, or the importance of the trunk muscles for function of the upper and lower extremities (Hodges and Richardson, 1996 A).The good side may be involved (Arsenault et al., 1987 A; Thilman et al., 1990 A; Yi-Chung Pai et al., 1994 A; Desrosiers et al., 1996 C). • It is important to understand the motor and sensory influence of the base of support on posture and movement. The muscles of the hips and lower trunk, when sitting, and of the feet, when standing, need to receive motor and sensory input.
- Closed kinematic chain (CKC)1 and open kinematic chain (OKC)2 movements should be used in treatment. CKC movements are important for enhancing the dynamic stability of the stabilizers of the upper (1 CKC: The distal part of the body is fixed on a stable surface and the body moves round it. 2 OKC: The distal parts of the body such as the hands and feet move freely in space.)and lower extremities (Brouwer and Ambury, 1994 B; Ryerson and Levit, 1997 C). Usually, using CKC movements away from pathological patterns reduces spasticity and facilitates normal movement (Davies, 1985 C; Bobath, 1990 C).
- Proximal parts of the body, such as the trunk, influence function of the extremities (Tokizane et al., 1951 B; Wyke, 1979 C; Bobath, 1990 C). The abdominal muscles, particularly the transverse abdominus, and deep trunk muscles contract before lifting the arm or leg (proactive response) (Hodges et al., 1996 A; Hodges and Richardson, 1997 A). The range of movement of the trunk is of similar importance when considering the patient's ability to function (Schenkman et al., 1996 A).
- Strengthening of muscles must be functional, specific and of good quality (Davies, 1985 C; Bobath, 1990 C; Vliet et al., 1995 B). Treatment should include concentric, eccentric and isometric muscle contractions. Functions can be used as tools for strengthening muscles.
- Movement of one part of the body can be influenced by movements in another distant part (Davies, 1990 C; Panturin, 1998 C).
- If, despite normal range, patients have difficulty in reaching a specific position, they may first be brought to that position passively, helping them to learn and control this position both motorically and perceptually. Once acquired, the patient can practise moving out and coming back into this position.
- Initially it will be difficult to control many degrees of freedom, therefore, at this stage, the therapist should limit them. Examples include: using the right hand with elbow resting on the table to neutralize the effect that the trunk and shoulder girdle have on the function of the hand. During the first stages of standing, it is often very difficult to cope with many degrees of freedom, such as joints and muscles, or the effect of the surroundings on perception. Therefore it is recommended to stand the patient close to a table with or without back splints (Davies, 1990 C; Edwards, 1996 C).
- Good muscle control demands proprioceptive awareness. Proprioception of the trunk can be facilitated by working actively towards the end range of movement (Wilson et al., 1986 C).
- In the beginning, weak postural muscles need to be isometrically strengthened in the inner range. Later, eccentric contraction can be introduced.
- Frequently the affected muscles of patients suffering damage to their CNS contract quickly and are unable to sustain contraction (Gardiner, 1996 C). Therefore treatment should include maintaining muscle contraction while moving, and fixing should be avoided.
- Treatment must include automatic and voluntary movements (Davies, 1985 C; Bobath, 1990 C) and should include placing and holding (Bobath, 1990 C).
- Before every passive or active movement the joint should be placed in its anatomical position. Improved range of movement achieved passively should immediately be controlled actively.
- To improve or preserve range of motion of joints or soft tissues, various techniques can be used, such as: myofacial therapy or general treatment using movements of the nervous system – neurodynamics (Davies, 1994 C; Panturin, 1998 C).
- Attention to the midline is important. One of the causes of deviation from the midline was explained by Karnath et al. (1994 B): afferent visual, vestibular and proprioceptive input which converge to the neural generation of an egocentric, body-centred image.
- Throughout treatment the good quality of function and movement must be maintained, avoiding spasticity, compensations, fixations and associated reactions (AR) (Davies, 1994 C). **Days 1–4 (ICU before Surgery)**
- Rehabilitation of Zahina should start immediately and the aim, at this stage, is to prevent complications. Treatment will, to an extent, be determined by the intercranial pressure, which will be constantly monitored. Elevating the head, shoulders and upper trunk to just above 30° may help prevent an undesired rise in the intercranial pressure. Minimal stimuli should be present at this time in the surroundings – which should be kept quiet and darkened. The head should be moved as little as possible, therefore position changes are carried out using the log-rolling technique, taking care to stabilize the head and shoulders. Besides helping to prevent pressure sores, from which Zahina suffered, position changes also enhance lung ventilation. Passive movements should be carried out slowly and gently. Regarding respiratory care, there were no complications described in this case. During this stage however, good hygienic care of the tubes is essential; any complication developing should be detected early and treated accordingly (Dean and Frewnfelter, 1996; Brimioulle et al., 1997 A; Dean, 1997 B).

Days 5–9 (ICU Post-surgery)

Positioning and Changing Position

As Zahina is restless and disoriented she needs to be given more environmental reference points in bed, such as surrounding her with firm packs which will help her to feel where she is in space (Affolter, 1987 C; Davies, 1994 C). Position changing continued by log-rolling to prevent complications, taking into account the intracranial pressure. When this is normal the bed can be level while the patient is side lying. In this position, on either side, the back should be supported, the lower leg placed with the hip and knee in flexion, and the upper leg placed behind the lower leg, supported on a pillow, with some hip extension and knee flexion. This gives relative extension to the hip, an essential component of movement when standing and walking, and good airing of the genital area. The persistent tightness of both Achilles tendons may be improved with inhibitory casting (Conine et al., 1990 A; Davies, 1990 C; Edwards, 1996 C; Moseley, 1993 A). As the signs of right unilateral neglect develop, and providing that Zahina is now permitted to move her head, the bed should be placed so that the centre of the room is to her right (Herman, 1992 C; Riddoch et al., 1995 C). If this causes Zahina to be more restless the change should be carried out gradually.

Respiratory System

The physiotherapist's evaluation should include inspection, palpation and auscultation. This case study states that Zahina displayed no respiratory problems throughout her hospitalization. Her restlessness, spontaneous movements of the left side and the specific movements provided by the therapist may all have helped to prevent respiratory complications from developing. **Movement**

Zahina's haemodynamic state will dictate the rate of progress, which will also depend on her medical condition, her consciousness level and her ability to learn and concentrate. At this stage she may need several short treatments each day, with repeated explanations given in short, clear, simple sentences. All movements should be performed slowly. Maximum stimulation to her right side should now be given, encouraging the staff and visitors to stand to her right, place the night table to the right and feed her from the right (if she is allowed to move her head). It is also advisable to give sensory stimuli to the right side, such as feeling objects of different materials and size (Herman, 1992 C; Riddoch et al., 1995 C). Active and assisted active movements of trunk and extremities will be introduced, while continuing to perform passive movements to preserve the ranges. When she is permitted to move her head, neck movements should be introduced. All these movements should be integrated into functional activities. Motor and sensory treatment of the mouth should be started now, taking for granted that hygienic care is being performed (Davies, 1994 C).

Standing

Besides its importance in everyday life, standing aids the function of internal organs and systems, helps to maintain a full range of motion of the joints of the lower extremities, reduces spasticity, affords sensory stimulation, and is of psychological importance (Davies, 1990 C; Richardson, 1991 C; Edwards, 1996 C). Standing Zahina on a tilt table, or leaning her forward on a high table with long back splints applied to both legs, or sitting her up as soon as permitted, is very important. Of course, this will depend on her haemodynamic status and the doctor's decision.

Days 10–33 (On the Ward)

As the treatment programme is a continuum, part of the following will have been initiated immediately following surgery, and continue throughout rehabilitation and after discharge. As Zahina has poor concentration and exercise tolerance, short but frequent therapy sessions during the day are recommended. Therapy should be given in a restful, quiet atmosphere. **Respiratory System**

Because of her swallowing difficulties, weakness (particularly of the abdominal muscles), spasticity and the fact that she had been artificially ventilated, Zahina had the potential to develop respiratory failure and my aim would be to prevent this. It is worth remembering here that movements, especially of the trunk (including extension of the thoracic spine), sitting and standing all help to prevent respiratory complications (Annoni et al., 1990 C; Davies, 1990 C). **Aphasia**

This should be treated by a speech therapist.

Function and Movement

From the beginning, the aim of my assessment would be functional, choosing, together with Zahina, tasks relevant to her present condition, in the ICU, medical ward, rehabilitation department or at home. I would assess each component and treat whatever is missing or preventing good quality performance. For example:

• movements in bed, including: pelvic lifting, turning – with trunk rotation – in both directions (also the first stage of sitting on the side of the bed), movements of the lower limbs, using her hands – one at a time and both together – for feeding, washing and grooming;

• for functions while sitting – such as dressing or holding the baby – Zahina needs good trunk control, midline orientation and sitting control;

• propelling and transferring to and from the wheelchair;

• standing and walking to the toilet. Besides the importance of function itself, it must be remembered that while performing each particular function Zahina will be strengthening muscles, encouraging selective movements of the trunk and limbs, inhibiting increased tone and fixation, and receiving sensory (proprioceptive and tactile) stimulation.

For example: • While turning to the paretic side, with hip or shoulder leading, Zahina is working the left side of her body selectively, using rotation of the trunk (an important element for developing normal movement), strengthening abdominal muscles and reducing spasticity (Tokizane et al., 1951 B; Wyke, 1979 C; Dewald, 1987 C; Bobath, 1990 C; Schenkman, 1996 A; Franchignoni et al., 1997 C). Weight bearing on the paretic right side affords Zahina proprioceptive and tactile stimulation.

• Pelvic lifting, in itself an important function, together with contraction of abdominal muscles, provides dynamic stability of the lower trunk and contains elements of movement for walking. To achieve this we need, amongst other things, active movement of both legs, to attain and retain crook lying, adaptation of the soles of both feet to the surface, range of movement of dorsiflexion of the ankles, extension of the hips, muscular power to lift the hips and maintain the position and normal sensation – all while preventing compensations or the appearance of ARs (Bobath, 1990 C). It is worth remembering that pelvic lifting can be made easier by placing a pillow below the buttocks thus reducing external torque.

• Abdominal muscles can be facilitated by lifting the head and shoulders from the pillow towards the paretic side, while the therapist places her hands on the lower ribs. Zahina is asked to 'pull her tummy in' in order to activate her transverse abdominus muscle.

• Every function demands active and selective movements – between different areas of the trunk, between the trunk and the limbs, between different parts of the limbs themselves (Davies, 1985, 1990 C). We have to check that all the passive ranges are full and, if not, treat passively following with placing, holding and active control. Zahina had a weak trunk, which inhibited effective function of her extremities. Rotation is important for all daily tasks, enhancing movement and reducing spasticity. Extension of the trunk is important for many functions, for example when raising the arms (Crawford and Jull, 1993 A).

• We need to check whether the weakness is symmetrical or asymmetrical and strengthen the muscles accordingly. Asymmetrically weak muscles should be strengthened asymmetrically. In order to strengthen a specifically weak muscle, it should be placed in a shortened position while elongating all the compensatory muscles, for example, sitting with the weak buttock raised and exercising the abdominal muscles on the same side. The trunk can be strengthened in all starting positions, taking care to prevent fixations or ARs appearing on the right side. While sitting – with the therapist giving, if needed, external support from behind or supporting the arms from the front – general and selective movements in all directions are performed. If Zahina's trunk shows signs of collapsing when sitting, extension should be encouraged first – either in mid-position or with the trunk in rotation, always paying attention that hip flexion does not exceed 89º – in order to avoid total extension. Raising the good left hand will also facilitate active extension. I would now follow with selective movements, which will also activate the abdominal muscles and those around the hip joints.

• If Zahina pushes on the floor with her feet, in addition to raising the height of the bed slightly, so that her feet are not in contact with the floor, passive movements of the joints and soft tissues of the foot will improve range and proprioceptive awareness, and reduce the pushing.

• The presence of unilateral visual neglect demands that the therapist address herself especially, but not only, to the patient's right side. Owing to Zahina's difficulties with the midline, exercises should be performed after she has been brought towards the end range of rotation and side flexion. Zahina should be encouraged to follow her movements with her head and eyes (Rothwell, 1994 C). Karnath (1994 B) suggested that facilitating proprioception in the cervical area will improve awareness of the midline. He recommended vibrating the cervical erector spine muscles on the neglected side. This should be performed gradually and with caution, noting whether Zahina suffers from, or complains of, nausea during or following the treatment. Proprioceptive stimulation – while lying and sitting – can also be given with the whole body rotating against the cervical spine (Wiart et al., 1997 A).

• When appropriate, balance reactions (BR) may be introduced to the treatment. If necessary, to keep her upright against gravity, I would choose treatment in a standing position to encourage normal extension of the whole body (Davies, 1990 C; Edwards, 1996 C), and when lying supine to encourage selective hip movements. While sitting, together with treatment of the trunk, active movements of the limbs should be encouraged while practising partial weight bearing on the paretic hand (CKC) and maintaining range of movement of the right upper extremity. This should be performed while giving manual support to the upper trunk and axilla. CKC movements, away from pathological patterns, reduce spasticity and facilitate normal movement (Davies, 1985 C; Bobath, 1990 C). Why is Zahina's left side overactive? Explanations may include compensation for the motor, proprioceptive involvement and neglect of the right side; lack of knowledge of the midline; searching for information because of perceptual difficulties or slight involvement of the left side with abnormal recruitment of motor units (Desrosiers et al., 1996 C). Performing placing of Zahina's left upper and lower extremities, different passive and guided movements of the left hand and foot and partial weight bearing on a supporting surface of various textures may all help. Environmental references should be given, such as sitting or standing with a table in front, or in a corner (Affolter, 1987 C; Davies, 1994 C). Zahina has partial active movements in the right leg, which should be encouraged with OKC and CKC movements, and by placing in many different starting positions. These movements must all be performed without fixations or ARs. Zahina has no active movements in the right upper extremity, which is spastic, has developed shortening of various muscle groups and ARs appear on effort (Dvir and Panturin, 1993 A; Dvir et al., 1996 A). This shortening can have many causes (Gardiner, 1996 C) and should be avoided and treated. Treatment possibilities, holistic and specific, are many, in both lying and sitting: • movements of the trunk (an integral part of the shoulder complex) affecting the tonus of the extremities (Tokizane et al., 1951 B; Wyke, 1979 C; Dewald, 1987 C; Bobath, 1990 C); • passive, and, if possible, active movements of the scapula (Bagg and Forrest, 1988 B), followed by movements of the whole upper extremity (CKC and OKC); • sitting with partial weight bearing on the hand while moving the trunk. This will affect the tonus and encourage active selected movement (Brouwer and Ambury, 1994 B). Weight-bearing is always partial and the therapist's hand must always support the patient's armpit. Weight-bearing should be performed with the hand in different positions: (a) flat, though never with a completely flaccid hand, in position of use which means maintaining the arches of the hand, and with a clenched fist; or (b) with elbows supported on a table, moving the trunk (CKC) and encouraging active movement of the right arm (Davies, 1985 C; Ryerson and Levit, 1997 C). If possible, all these activities should be performed in relation to appropriate specific functions, such as eating, dressing and holding the baby. Using self-assisted pulleys to gain range in the glenohumeral joint is not recommended (Kumar et al., 1990 C); • passive movements using neurodynamic principles (Davies, 1994 C; Panturin, 1998 C).

The Passive Components of Treatment

The causes of restriction of movements which Zahina developed in the trunk, in both ankle joints and feet, shoulders, right elbow, right palm and the pain in her right shoulder should all be investigated. Are they caused by spasticity, shortening of soft tissues or both? Routinely, the range of joints, soft tissues,

muscles and the peripheral nervous system must be treated and maintained. If the limitations are due purely to a problem within the joint, the joint should be treated using manual therapy techniques. If the limitation is caused by changes in the muscle or soft tissues (Gardiner, 1996 C), these tissues need to be elongated and mobilized in different ways:

- elongating the muscle by moving another part of the body, for example the latissimus dorsi muscle, by moving the pelvis in different starting positions;
- elongating a localized muscle by kneading the muscle while gently moving the trunk or extremity;
- fascial restrictions can be released by soft tissue mobilization and elongation (Jackson, 1998 C);
- very specific trunk and cervical mobilizations;
- as the nervous system is a continuum, to approach the limitation and pain in Zahina's shoulder I would try to see if side flexion of the neck to either side or straight leg raising (SLR) of the right or left leg relieves, or worsens, symptoms. To attain good movement around the hip joint, I would try either using SLR to improve hip extension, or passive knee bending (PKB) while side lying to improve SLR (Panturin, 1998 C). After achieving a range of movements in the distal parts with the whole extremity in a neutral position, I would attempt to achieve them again with the extremity in different tension positions. For example: elongating the Achilles tendon and mobilizing the foot with the leg in different angles of SLR (and similarly with the upper extremity). Neurodynamic techniques should be used in different lying, sitting and standing positions (Davies, 1994 C; Panturin, 1998 C). Any passive range of movement achieved should be complemented with active control. The causes of the painful shoulder should be established and treated accordingly. The pain is frequently due to poor coordination of muscle contractions, leading to malalignment of the shoulder complex, causing impingement and, therefore, pain. Improving the activity of all the muscles of the shoulder complex usually helps (Laynt, 1992 C). When sitting, resting the hands on a tray or table in front can also relieve pain. Very often, people with hemiparesis present with palpable anterior and/or inferior subluxation (Prevost et al., 1987 B). The causes of inferior subluxation are many (Culham et al., 1995 C). Treatment may include: facilitating the activity of all muscles of the shoulder complex and, as suggested by Faghri (Faghri et al., 1994 A; Pouran et al., 1994 A), giving electrical stimulation to the supraspinatus and posterior deltoid muscles. The upper extremity should be continually supported in an anatomical position. This can be attained in many different ways, for example: using a Bobath sling (using Neophrem), or sitting with the elbows resting on a table (Moodie et al., 1986 A) or specific taping.

Standing

Before each attempt to stand and later walk, I would treat Zahina with selective movements of the trunk, upper and lower extremities (Winter, 1991 C), passive and active ranges of extension of the hip while side lying and dorsiflexion and movement of the feet. Treatment should be carried out with and without shoes. The position of the foot on the floor is of great importance and, when treating barefoot, and before deciding on suitable foot supports or orthoses, a towel can be placed under Zahina's right foot to help position it correctly. Sometimes a toe spreader can be used (DeSaca et al., 1994 A). The instability of Zahina's ankle joint may be helped by taping. Associated reactions in the upper extremities should be avoided in all stages of standing, and Zahina's left arm should not be allowed to push against the table in front of her. I would treat her with and without back splints (to right, left or both legs), using a waist-high table to support the hands, and legs apart with weight transfer, and step standing (for Zahina it will be easier to start with the left leg in front), standing on tiptoe and, while standing, raise the good arm diagonally to encourage extension of the hip (Davies, 1990 C; Edwards, 1996 C). My handling and support would always be according to Zahina's ability, for example: using my hands to give external support below the axillary area, or resting her arms on my shoulders. In this position I can also relieve some of Zahina's body weight and facilitate her performance (Barbeau et al., 1987 C). Because of the weakness of the gluteus medius and maximus, I would stand near Zahina's body, keeping the hip joint in normal alignment and enabling the muscles to function better. Standing and walking are made up of many different components of movement (Winstein et al., 1989 A), therefore, when practising the stance phase, in order to imitate this component of gait, inertia must be taken into account by bringing the trunk and the swinging leg forward. Following treatment in the stance phase I would now, using all these starting positions, introduce components of movement in the swing phase. The healthy side is also affected and frequently there is difficulty in transferring weight to this side (Yi-Chung Pai et al., 1994 A). As Zahina pushed with her left hand and foot it had an adverse effect on her ability to swing the right leg, and this should be treated. After attaining the ability to perform anterior and posterior pelvic tilt when sitting, she should practise this in various standing positions, with her knees slightly bent.

Walking

When Zahina began walking, using a figure-of-eight bandage to maintain dorsiflexion of the foot and supported by two therapists, all the components of her walking needed to be analysed and the deficiencies treated (Moore et al., 1993 C; Mosely, 1993 C).

Treatment of Balance

To improve balance when sitting and standing, I would consider the following points:

- Movements should be performed under different conditions, in different surroundings and lighting (Horak, 1997 C; Hines and Mercer, 1997 C).
- I would advise Zahina to practise proactive and reactive balance responses separately (Ragnarsdottis, 1996 C).
- Sensory interaction in balance, such as exercising with eyes closed, standing on a mattress or both, should be encouraged (ShumwayCook and Horak, 1986 C).
- Ankle, hip and step strategies should be exercised (Horak et al., 1990 C; Shumway-Cook and Woollacott, 1995 C). According to Maki (Maki and McIlroy, 1997 C), 'Change in support strategies (step strategies) are not strategies of last resort, but are often initiated well before the centre of mass is near the stability limits of the base of support'. Jeka (1997 A) claimed that in addition to tactile and proprioceptive stimulation

of the feet, fingers touching a surface reduces sway considerably. I would use this strategy while treating Zahina when sitting and standing. Zahina did not, apparently, display vestibular problems requiring treatment.

Sensory Treatment

Zahina has sensory loss in her right arm and leg and quite possibly in the right side of her face, head and trunk. Sensory treatment is very important, to improve not only sensation but also movement (Magnusson et al., 1994 C). Sensory treatment can be specific, demanding both attention and concentration (Yekutiel and Guttman, 1993 A) and can be introduced as an integral part of motor treatment such as using both hands to drink from a glass or while putting shoes on with the left hand – the patient's right hand, guided by the therapist, will slide gently down the right leg, trouser or sock. Throughout treatment care should be taken to prevent secondary loss and learned non-use (Wolf et al., 1989 A; Taub et al., 1993 A, 1994).

Implications

The treatment described here is only a beginning of the whole rehabilitation process, which continues in the rehabilitation centre and in the patient's home, with follow up through life. Of course, many questions remain; most importantly, is the treatment described here effective? More research is required before we can answer this question clearly. We also need to know what the effect of treatment is immediately following the event, and whether an early start to treatment produces significant gains. In a recent systematic review, Langhorne et al. (1996 R) concluded that more physiotherapy is better than less. If so, how much more and when do we reach maximum effectiveness?

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