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POSITIONING STUDENTS WITH CEREBRAL PALSY TO USE AUGMENTATIVE AND ALTERNATIVE COMMUNICATION*

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Many students who use augmentative and alternative communication have severe forms of cerebral palsy which make it necessary to consider positioning as part of their communication intervention. This paper reviews the interrelated communication and positioning needs of these students, and then proposes the wheelchair as the primary position for use of a communication aid. Guidelines for good wheelchair positioning are presented.

KEY WORDS: aided communication, augmentative and alternative communication, cerebral palsy, positioning

Augmentative and alternative communication (AAC) intervention for students with severe speech impairments has developed in several directions during recent years. The developments include not only some highly technological, sophisticated devices (Brandenburg & Vanderheiden, 1987), but also improved teaching strategies (Blackstone, 1986), identification of critical AAC issues (Zangari, Kangas, & Lloyd, 1988), and a greater emphasis on delivery of AAC services and communication aids (ASHA, 1981). Even though the progress is impressive, effective AAC intervention often remains a considerable challenge, especially when students are severely physically disabled and have multiple, complex problems that must be resolved. For these students, good positioning is one of the most essential considerations if AAC intervention is to be successful.

Vanderheiden and Harris-Vanderheiden (1976) emphasized that successful use of a communication aid or technique can be directly attributed to proper seating. Similarly, Hardy (1983) observed that a child's ability to control AAC devices may be totally dependent on adequate positioning. Good positioning has also been described as a facilitator of maximum participation (Utley, 1982), and as a distinct communication need that must be part of an AAC evaluation (Yorkston & Karlan, 1986).

Although good positioning is emphasized as an important factor in effective communication, it is rarely discussed in the AAC literature. Physical or occupational therapists, physicians, rehabilitation engineers, and equipment vendors may be primarily responsible for the prescription and fitting of positioning devices, but everyone involved in case management must know enough about positioning to recognize when it is not optimal and know how to make simple adjustments and recommendations that will help maximize students' communication skills. In addition, knowledgeable input about a student's interrelated communication and positioning needs is invaluable during selection of wheelchairs and other positioning devices, so that an integrated, effective, and manageable adaptive equipment package can be devised (Hardy, 1983).

This paper will provide basic information about positioning for AAC by first reviewing some of the communication needs of students who are severely disabled by cerebral palsy. Relations between positioning and communication will then be discussed and rules for good wheelchair seating will be described in detail. Although the emphasis is on positioning of students with cerebral palsy, most of the principles and guidelines are equally applicable to children with other disabilities as well as to motorically impaired adults.

POSITIONING FOR COMMUNICATION

The communication needs and AAC methods of students who have cerebral palsy vary widely and, in general, will depend upon their cognitive, academic, motor, sensory, and sociocommunicative abilities (Munson, Nordquist, & Thuma-Rew, 1987; Yorkston & Karlan, 1986). However, regardless of a student's levels of functioning or AAC system, rarely will only one form of communication be used. Nondisabled individuals use a variety of aided and unaided methods, such as speech, gestures, traditional orthography, and pictographs, to meet everyday communication needs (Vanderheiden & Lloyd, 1986). Severely physically impaired students are the same (Harris & Vanderheiden, 1980; Light, Collier, & Parnes, 1985). An example is a student who, quite appropriately and effectively, nods and shakes her head for "yes" and "no," approximates the sign for "toilet" when she signals the teacher who is across the room, talks with her mother who understands much of her speech, eyepoints to symbols on a communication board to express complex and out-of-context thoughts, and uses a row-column scanning system with a single switch to operate a word processor.

Just as students need more than one mode of communication, they also need more than one position to meet

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their various activity and physical needs. When students use several positions, it is sometimes thought that a communication method is not useful it if it not functional in every position, or that there is an optimal "communication position" that must be discovered and used all of the time. It is more productive, however, to assess positioning needs and communication needs together.

Much of a student's communication, particularly that which is unaided, can take place in any position. One can vocalize in bed, gesture in the bathtub, eye point while standing on a proneboard, and answer "twenty questions" in the swimming pool. Although it would be difficult to express complex thoughts, tell jokes, or order a pizza through some of these means, effective communication is possible, especially with a skilled listener. When students use communication aids to express complex thoughts and communicate with unfamiliar partners, body position usually becomes more critical. This is because making selections on a communication aid requires one or more motor responses, and the accuracy, speed, and ease of movements of students with cerebral palsy can depend heavily upon body position.

When a student is correctly positioned, muscle tone can be normalized, abnormal reflexes and reactions inhibited, and the postural support needed for more normal patterns of movement can be provided (Munson, Nordquist, & Thuma-Rew, 1987). Prevention of contractures and deformities is another important reason for positioning (Finnie, 1975; Levitt, 1977). To maintain good body alignment, adaptive equipment is usually needed, such as wedges, sidelyers, standers, adapted chairs, and different types of wheelchairs. However, it is often more difficult for students to use communication aids when placed in some of the devices than in others (McEwen & Karlan, in press).

An upright, seated position is usually the one in which the greatest amount and complexity of communication can take place (Levitt & Miller, 1973). This position also provides related physical and functional advantages. For instance, an upright position has been suggested as an aid in maximizing cognitive abilities, motor skills, and improving the variety of life experiences (Fulford, Cairns, & Sloan, 1982; Trefler, Hanks, Huggins, Chiarizzo, & Hobson, 1978). Wheelchair seating is also the position in which students are likely to be able to use communication aids the most successfully. Furthermore, a wheelchair can aid functional independent mobility, which has been said to have a major influence on communication development (Butler, Okamoto, & McKay, 1984; Harris & Vanderheiden, 1980). Because of the many potential benefits offered by a properly fitted wheelchair, it should usually be considered the primary position. If it is to provide its benefits, however, the components of good seating must be understood and the guidelines to achieve them must be practiced diligently by everyone involved with the students.

GUIDELINES FOR WHEELCHAIR SEATING

By following a few general guidelines, good wheelchair positioning is achievable for most students, regardless of the type of chair or severity of the cerebral palsy. It is important to remember, though, that optimal wheelchair seating is rarely achieved on the first attempt. To determine what to incorporate into a chair to enable a student to function the most successfully, it is usually necessary to experiment, using such things as blocks, rolled towels, cushions, straps, a hand, or anything else that can temporarily position a student. Speech-language pathologists should be involved in such experimentation to discover means to optimize students' communication skills. Some students have severe deformities or extremely abnormal muscle tone that make good seating difficult to achieve, but most often functional seating can result from attending to the following important rules.

Control the Hips and Pelvis

Proper control of the hips and pelvis is the key to functional, therapeutic seating of any student (Bergen & Colangelo, 1982; Hundertmark, 1985; Trefler et al., 1978). If the physical disability is not too severe, controlling only the hips and pelvis can result in improved posture and balance, hand use and head control (Levitt, 1977).

To provide the greatest stability, facilitate the greatest function, and help to prevent deformities, the pelvis must be level, the hips flexed to 90 degrees, and the student's

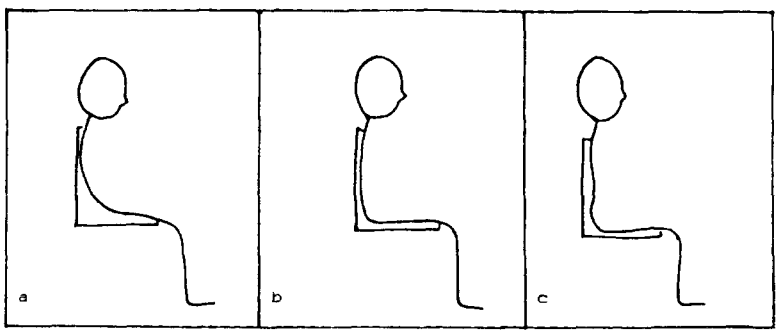

FIGURE 1. Pelvic tilt in sitting positions of students with cerebral palsy: (a) posterior pelvic tilt, (b) neutral pelvic tile, and (c) anterior pelvic tilt.

bottom firmly back into the back of the chair. Quite often students with cerebral palsy sit with their pelvis tilted posteriorly, causing "sacral sitting," in which the low back is rounded and the upper trunk is usually flexed (Figure 1). Proper positioning can provide a neutral or slight anterior tilt (Figure 1), which will facilitate a more erect, therapeutic, and functional position. Some children and many adults have pelvic obliquity (pelvis lower on one side), hip dislocations, and scoliosis that make it difficult to achieve an ideal position, but approximations are achievable through modifications to the contours of the chair, which should be referred to an expert.

There are several features of the chair to consider when attempting to achieve good hip and pelvis positions. The first is that the chair must have a firm and stable seat. The standard sling seat, commonly used in wheelchairs, is nearly always inadequate because it tends to encourage asymmetrical and deforming postures, and does not provide the necessary stability. Undesirable internal rotation of the hips is a common problem. There are a number of replacements for the sling seat, or an insert can be placed on top of the sling. Today many chairs come with a firm seat which, if not entirely appropriate, can be modified as necessary. Regardless of the design of the seat, it must have a rigid base covered with a high-quality cushion that is comfortable and safe for hours of sitting (a thin layer of padding over plywood is *not* sufficient). The cushion can be any one of several that are commercially available or can simply be made of good quality foam. One commercial seat that has been useful is the Jay Cushion,[2] which has a posterior depression, that helps in maintaining the position of the pelvis, as well as providing good thigh alignment, comfort, and protection against skin breakdown. These and other seats can be custom contoured, when necessary, to accommodate individual problems such as pelvic asymmetry and dislocated hips.

A second important consideration in locating the child's hips and pelvis are the angles of the chair seat and back to each other and to the floor. Many students with cerebral palsy have extensor hypertonus and thrusting, which professionals sometimes attempt to control by increasing the students' hip flexion angles to more than 90 degrees. This is usually done by "jackknifing" the seat or by reclining the back of the chair. A reclined position is sometimes also used for students with low tone or increased flexor tone, in an attempt to help them to sit more upright. Recent research, however, suggests that these seat and back angles may be counterproductive (Nwaobi, 1987; Nwaobi, Brubaker, Cusick, & Sussman, 1983). These studies have shown that the least amount of extensor hypertonus and fastest hand function rates tended to occur when the hips were flexed to 90 degrees, the seat-back angle was at 90 degrees, and when the seat was parallel to the floor and the back perpendicular to it.

A number of clinical observations have also linked poorer functioning with tipped seats and reclined backs (Fulford, Cairns, & Sloan, 1982; Hundertmark, 1985; Trefler et al., 1978). Some of the associated problems include difficulty raising the head and seeing, problems getting the hands forward, increased trunk and neck flexion by students who have righting reactions, and stimulation of extensor hypertonus and thrusting. For these reasons, it is important to evaluate the necessity or desirability of hip flexion angles over 90 degrees or chair backs reclined more than a few degrees. Some chairs have mechanisms that allow the angles to be changed easily. With others the back wheels can be elevated on blocks or books, or perhaps a wedged seat cushion can be removed, to assess the effect.

Once a good base for the hips and pelvis has been established, the question becomes how to help the student maintain that position. Usually, the more severely physically involved the student is the more controls will have to be provided. Many need blocks of some sort to keep their hips from slipping sideways and an abductor block to keep their legs separated. Sitting with the legs apart is important, not only because it provides a wider, more stable sitting base, but because it can help prevent hip deformities. (Abductor blocks are *not* to be used to keep a student from sliding forward in the chair.) Some students' legs are too far part, requiring blocks on the outside of the thighs to maintain a more neutral position.

A good snug seatbelt, or other lap restraint, is an essential part of any seating system. The most effective position for the belt is usually low across the hips, below the "hip bones" (anterior superior iliac spine) at a 45-degree angle to the seat. It is important to be able to tighten the belt with one hand while holding the student's hips in position in the other, so an auto-type seatbelt or a Velcro belt that goes through a rectangular "D" ring usually work well. Any belt that requires two hands, such as simple overlapping Velcro without a ring, or that cannot be tightened easily and comfortably, such as a man's dress belt, must be replaced.

The seat of the chair should be of sufficient depth to support the length of the thighs, except for the necessary clearance behind the knees. The footrests should be low enough to allow the body weight to be distributed along the thighs. A seat that is too short can be uncomfortable and can also allow the thighs to drop over the edge. This will lead to hip extension, which may elicit extensor hypertonus or thrusting. Occasionally footrests are raised intentionally to increase hip flexion angles (or children grow and footrests aren't lowered). Footrests that are too high will cause the student to sit on only a small area of the bottom, which can lead to an unstable sitting base and to excess pressure that can cause discomfort and skin breakdown.

Placing a Student in a Chair

A chair can be ideal, but the position may still be poor if the student is not placed in the chair properly. It usually works best to hold the student in a flexed position and place the bottom as far back into the seat as possible.

[2]Information about the Jay Cushion can be obtained from: Jay Medical, 805 Walnut, Boulder, Colorado 80302.

With the student's neck and trunk still flexed, pull up and back on a belt, waist band or other stable piece of clothing to help tilt the pelvis anteriorly and lift the bottom all the way back. While holding the student in that position, fasten and tighten the seatbelt. Only after all of this is done, allow or help the student to sit up straight. Sitting up slowly can be important to prevent startle reactions and to enable the student to adjust to and assist with the postural change. This method, or some slight variation, is almost always necessary to properly locate and maintain the hips and pelvis. Far too often students are placed in chairs from an extended position (for instance while being held under the arms), or are tipped back in an attempt to let gravity help slide their bottoms back, or are simply put in the chair, however they happen to be. These methods must be avoided. With the hips and pelvis well placed and secured, the other parts of a good seating position often fall into place quite easily.

Place the Knees and Ankles in 90 Degrees of Flexion

The second basic rule, after controlling and securing the hips and pelvis, is to arrange the chair so that the knees and ankles can be flexed to 90 degrees. Quite often standard wheelchairs come with footrests that cause less than 90 degrees of flexion. Not only can this cause the feet to slide off the back of the footrests, but, more importantly, knee flexion less than 90 degrees can contribute to total extension and thrusting patterns. This footrest placement can also lead to undesirable posterior pelvic tilt, especially if the student's hamstring muscles (which cross both the hip and knee joints) are tight and the only way to get enough knee extension to place the feet on the footrests is to extend the hips. Changing the angle or position of the footrests usually requires replacing or constructing parts, so the problem is often best referred back to the wheelchair vendor or whoever else can make the necessary changes.

Feet should be placed in a neutral position with the ankles at 90-degree angles. Sometimes it is necessary to secure the feet on the footrests with straps, or provide a posterior strap to prevent them from sliding off the back end of the footplates. Unless students need their feet strapped down for stability or safety (primarily those with athetosis), it is often preferable to allow leg movements to be unrestricted. Occasionally children, and frequently adults, have contractures that limit knee extension and ankle dorsiflexion to less than 90 degrees, so their footrests need to be designed to accommodate their own ranges of motion.

Determine the Best Possible Head Position

The importance of an adequate head position cannot be overemphasized. Head position influences vision, breathing, listening, vocalization, feeding, and attention, and through its effects on reflexes, reactions, and generalized muscle tone, also influences posture and hand and arm use (Finnie, 1975; Levitt & Miller, 1973). Musslewhite and St. Louis (1982) state that visual attention and tracking, which are dependent upon a good head position, may be the key to establishing a communication system.

Especially with younger children, a good head position will often follow a good trunk position. However, many older children and adults have trunk deformities that defy usual approaches to positioning, and attempting to align the trunk without looking at the head can result in a nonfunctional head position. For example, using the typical straight, firm chair back with a student who has a structural kyphosis (forward flexion of the spine) could force the head out over the knees, making it difficult for the student to lift the head, and require excessive neck extension to get the face forward (Figure 2). In this situation the problem would actually be accentuated if the positioner was diligent about placing and securing the student's bottom all the way back in the chair. If we first consider where the head should be and then position the trunk, to complement that position, the overall result is likely to be more successful than when trunk position is established first.

There are several things to consider when determining a good head position. For a severely physically disabled student to have the greatest opportunity to achieve and maintain an erect, functional position, the head should be aligned in the neutral or normal position of nondisabled persons. This means with the surface of the face perpendicular to the floor and the underside of the chin more or less parallel to it. As discussed previously, the angle and configuration of the chair back can have a critical influence on head position. Once the desired head position is determined, many students need help to achieve and maintain it, and there are a variety of head supports that can be used. A neck collar or occipital support of some sort is often the most effective way to keep the head centered in midline and also prevent it from falling too far back or to the side. It is usually best to avoid high seat backs or other supports behind the head because they can stimulate extensor hypertonus, or force the head forward, and they also interfere with lateral and posterior vision. Restraints beside the head can also interfere with vision

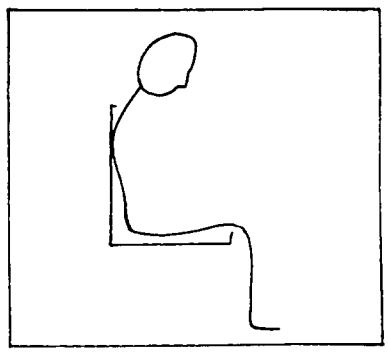

FIGURE 2. The posture of a student with kyphosis seated against a firm, straight chair back.

and students with strong asymmetrical tonic neck reflexes often push their heads against them. Head supports, like any other positioning device, must be constantly reevaluated to be sure that they are doing what they should be doing and are not producing unwanted effects.

Establish Good Trunk Alignment

With the head and lower body positions established, almost all that remains is the trunk. Students who are mildly physically impaired, and have good head control, may not need anything more than a firm back in their chairs to maintain good trunk alignment. Other students will need varying amounts of support. The usual rule, for a student with a straight or flexible back, is to provide a firm, padded, straight chair back, sometimes with a lumbar pad to facilitate anterior pelvic tilt and back extension. This should help maintain the trunk posture and also result in the desired head position.

Often, however, severely disabled students, even some who are quite young, have fixed spinal deformities that necessitate chair backs that accommodate as well as support. The previous example of a student with a structural kyphosis (Figure 2) is typical of the need to accommodate a structural deformity. Most often a slightly contoured back, sometimes just a standard sling back with a firm, but flexible, insert is all that is needed to allow the head to be in a neutral position. Other students have scoliosis, which if mild, usually needs only good, standard, symmetrical positioning. (Body jackets and other spinal orthoses may also be prescribed by physicians.) Students with more severe scoliosis often need to have the backs of their chairs contoured to accommodate and support their trunks, and allow more symmetry and midline orientation of the rest of their bodies. Attempting to flatten a moderate or severe structural deformity against a flat, unyielding chair surface can only result in asymmetry and loss of function somewhere else. If a scoliosis is very severe, causing the student to rotate and lean heavily to one side, it will take the most talented seating experts to achieve appropriate chair seat and back configurations. The student's head must end up in the most neutral, erect, and functional position possible. If it does not, it usually means the chair needs to be sent back for revisions.

Maintain Good Trunk Alignment

Once the position and configuration of the seat back have been determined, it must be decided if other supports are needed for the student to maintain a good position. It is important to give only the amount of support needed to function, letting students control their own bodies as much as possible. However, it is also important to provide enough trunk support so their heads and arms have a stable base on which to move, and so they can concentrate on the task at hand, rather than on maintaining posture. Many students need and use more support for effortful activities such as school work. Effective use of a communication aid may also require more postural support than some other activities, especially during the early stages of learning to use a system.

For some students with mild problems, slight contouring of the chair back, which is common on most standard chairs, can help provide the support and stability needed to remain upright and symmetrical. For those with more severe problems, a variety of trunk supports are available. Some include lateral supports attached to the chair to prevent leaning to the sides, and chest and shoulder restraints to prevent falling forward. Lateral trunk supports should fit snugly and help the trunk maintain an upright, symmetrical position. Trunk supports often need repositioning and tightening as hardware loosens, or a child grows or wears heavier or lighter clothing. Common sense is often the best guide when adjusting the trunk supports. They must be snug enough to provide the needed stability (i.e., the student must not "hang" in them), but not so snug that they interfere with breathing or with arm or hand function.

Arm Position

With the rest of the body well-placed, attention can be directed to arm position. It is common for student with cerebral palsy, especially those who have spent much time on their backs or whose chairs are tipped back, to have a pattern of arm flexion and abduction with shoulder retraction (frog position). Because of this pattern, they have difficulty getting their arms and hands forward and their hands together. These movements are necessary for functional hand use, such as selecting messages on a communication aid. Humoral (upper arm) blocks, attached to the chair, or to a tray, which prevent the arms from going back, can be extremely beneficial. Sometimes other devices are used to improve arm position and function, such as dowels to grip, or wrist weights, which may provide stability. Quite often these are only effective initially, but they may be worth trying.

Check the Tray

Students with severe physical impairments often have wheelchair trays. Although a tray provides a useful surface for toys, communication aids, and school work, as part of the seating system it needs to be considered carefully. Tray height is important because it can affect hand use. If the tray is too high, arm movements may be restricted and it also can be difficult to see items placed on the tray. If it is too low, it may difficult for the student to reach items and can cause increased neck and trunk flexion. Quite often a tray that is higher than a normal desk height can encourage arm elevation and trunk extension, helping to inhibit flexor patterns that make it difficult for many students to us their hands. A slanted tray, or slanted stand placed on the tray, which is higher on the side away from the student, can also help facilitate

trunk and arm extension, and make it easier to reach the objects that are farthest away. Of course this works best for things that will not slide or can be attached, such as papers and communication boards. The only way to know what tray height and angles work best is to try them.

The size of the tray is also important. It has to be large enough for what it needs to hold, usually with a rim to keep things from falling off, but not be so large that it extends beyond the dimensions of the wheelchair, making it difficult to get through doors and turn corners. This is important to remember when designing wheelchair tray communication boards for students who use small chairs.

Place Switches and Other Targets

The placement of switches and other targets also has much potential to influence function—for better or for worse. For instance, if a switch to control a communication aid is placed to the right, and a student has a strong asymmetrical tonic neck reflex (ATNR) to that side, the position of the switch will cause increased abnormal tone and movement, which will then interfere with switch use. When a student uses a hand to press a switch, a position near the midline, which does not require excessive effort to activate, is usually best. It is often necessary, though, to experiment with several switch positions before an optimal one can be determined. Location of head switches can also be critical. Many abnormal reflexes and reactions are elicited by head movements and by the position of the head in space. If the movement required to activate a switch causes significant abnormal reactions, not only can it interfere with function, but over the long term it could also be physically damaging. Head switches that require the head to remain erect and near the midline are usually preferable. Switches behind the head, which can trigger extensor thrusting, and those mounted so they require too much head rotation, are usually best avoided.

Patterns of movement should also be considered when placing a communication board or other communication aid for a student who uses direct selection. Many students have limited active range of motion, so the size of the aid and its placement must be within that range. Other students have difficulty crossing midline or using one side of the body. Again, as with switch placement, it is important not to reinforce abnormal patterns of movement by placing an aid in the direction of the abnormal movement. Sometimes compromises have to be made, allowing students to use abnormal patterns to function. But this decision should only be made after determining that there is no other positioning of the student or placement of the target that would enable more normalized functional movement.

SUMMARY

The positioning of students with cerebral palsy can have a major impact on their abilities to function effectively, including the ability to communicate. The position that usually provides the greatest intellectual, social, and functional benefits is the upright, seated position in a wheelchair. For this reason, the wheelchair should be carefully evaluated as the position of choice when determining the primary position for use of communication aids. By following the basic guidelines of good wheelchair positioning presented in this paper, students with cerebral palsy should be able to function more successfully and independently in a wide variety of activities and settings.

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