

DESTRUCTIVE POSTURAL TENDENCIES: IDENTIFICATION AND TREATMENT
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Introduction

When one considers the progression of postural deformity, pain, and dysfunction among wheelchair users aging with disability, it might be helpful to recognize that the able-bodied visit their doctors for attention to back pain and related problems more frequently than for any other complaint except the common cold. In fact, back pain is the most common cause of work-related disability in the United States, and a leading contributor to job-related absenteeism, according to the National Institute of Neurological Disorders and Stroke. The human body was not designed for long-term sitting, and even able-bodied people with their extensive repertoire of movement and postures in sitting, standing, walking, and lying are virtually guaranteed some variety of back pain and dysfunction in their lifetime. Thus, the goal of mitigating pain, deformity, and dysfunction amongst people who can only sit is daunting.

Perspective

Where do we begin? What is bad seated posture? What causes poor seated posture, and how do we influence improvement?

A recent presentation at the Annual Meeting of the Radiological Society of North America received significant attention, even in the mainstream media. Waseem Amir Bashir, M.B.Ch.B., F.R.C.R., author and clinical fellow in the Department of Radiology and Diagnostic Imaging at the University of Alberta Hospital, Canada, presented his findings from a small study of healthy individuals looking at intervertebral disc morphology in different sitting positions. It was revolutionary for two reasons; the device used to take the measurements and the findings. Dr. Bashir and his co-authors used whole body positional MRI which allows freedom of motion during imaging. The goal was to determine a spinal alignment in seating that showed the least biomechanical stress on the lumbar spine. What they discovered was that a 135 degree trunk-to-thigh angle appears to cause the least strain, most significantly when compared with an upright 90 degree sitting posture. The study also revealed exaggerated tension in forward flexed or slouched positions.

The attention given this small study has focused on its impact on the long-held belief in the value and importance of "sitting up straight". No one should be surprised to discover that slouching in front of a computer for 10 hours may have long-term health impacts for our computer game and internet crazed teens, but to discover that yelling at them to sit up straight won't help much (even if they did) is a blow to all parents and teachers! Apparently we need to be telling our youth to kick back in a Lazy Boy recliner with a lap top computer, an energy drink, and a bag of their favorite munchies.

As interesting as these findings may be, do they have functional application for seating the able-bodied? Consider millions of desk workers comfortably reclined 45 degrees beyond the 90 degree upright position attempting to muddle through their stack of daily tasks. Consider long haul truckers reclined back 45 degrees using mirrors to keep their eyes on the road ahead. This small study raises more questions than it answers, especially in consideration of

full-time sitters, i.e. wheelchair users. For instance, is it the trunk to thigh angle that is important, or the orientation of the trunk relative to gravity (i.e. would tilt be as effective as recline)? What else was influencing the curves of the spines in this study? What was the seating configuration, and shapes of the back supports? Where was the pivot of the seat-to-back support juncture relative to the hip joint and spinal segments studied? Is there a seating configuration that can influence the spine towards improved alignment without such a dramatic amount of recline? How often, and for how long does a reclined position need to be used to reduce the long-term detrimental effects of upright sitting? Where is the nearest positional MRI system, and can I borrow it?

Dr. Bashir certainly identified something of importance; the stresses at the lumbar spine can be influenced through seating intervention. If nothing else, it adds to the body of literature supporting the use of dynamic recline (and possibly tilt) to alleviate spinal dysfunction in addition to their accepted use in promoting good skin integrity. It would be reasonable to consider that a lesser degree of tilt or recline, when coupled with appropriately shaped and oriented seating supports, may be adequate to reduce measurable stress in the spine sufficiently.

Identification of Destructive Postural Tendencies

Identification of destructive postural tendencies is key to supporting long-term health in sitting. Dr. Bashir's study focused on a small group of healthy able-bodied volunteers without any history of back problems. The findings lend understanding to the nearly universal problem of back pain, and on a more metaphysical plane it causes one to ponder why, as an evolutionary species, hasn't the spine evolved into a structure more tolerant of the forces humans have experienced since standing upright?

In a broader sense, this study serves as a backdrop to a philosophy supporting a hierarchy of general goals for wheelchair seating. Seated postures can be task specific. When sitting in a wheelchair, one is typically resting, propelling, or involved in a fine motor task such as keyboarding, eating, or playing poker. These tasks can be categorized as either resting, gross motor functional, or fine motor functional. Which posture is of greatest importance? Do the sums. Which task does the typical wheelchair user find himself using the most? Although no formal research has been conducted regarding this question, experience has shown that a large majority of wheelchair users find themselves resting and/or involved in fine motor activities the majority of the time.

Establish what tasks are being accomplished, for how long, and in what setting, and you are well on your way to developing an appropriate order of goals for the sitter you are serving. This exercise will influence the entire process of evaluation through intervention.

Use of this exercise has revealed to this author a common hierarchy with broad application across virtually all populations, and it serves as a compass to guide intervention:

- Support non-destructive resting postures.
- Ensure sufficient support is provided so that fine motor functional activities can be superimposed onto the resting posture without loss of alignment and stability at the core, i.e. thighs, pelvis, and lumbar spine.
- Do not obstruct transitions into gross motor functional postures.

Certainly there are significant outliers such as paralympic and professional athletes, but the majority of wheelchair users' tasks will most likely fall in this order.

Assessment

An all too familiar scenario is the elderly person sitting in her wheelchair parked along side the nurses' station in an extended care facility. Her destructive postural tendency typically results in a slow slide out of the wheelchair, and this is the primary complaint of the care providers. Where does the assessment begin?

1. Establish what tasks are to be accomplished, for how long, and in what setting.
2. Complete the interview to gain full understanding of medical (inclusive of skin integrity), social, recreational, and other background history relevant to the client.
3. Identify the destructive tendency.
 - a. In this scenario you would expect to see a strong posterior tendency at the pelvis, with or without asymmetry, and associated spinal, head, neck, upper and lower extremity alignment.
4. Establish preliminary goal hierarchy. For this case, the above hierarchy would apply:
 - a. Support non-destructive resting postures.
 - i. The sums most likely add up to reflect that resting is the primary task.
 - b. Ensure sufficient support is provided so that fine motor functional activities can be superimposed onto the resting posture without loss of alignment and stability at the core, i.e. thighs, pelvis, and lumbar spine.
 - i. Determine what fine motor tasks will be targeted such as independence with meals, hygiene, social activities, etc...
 - c. Do not obstruct transitions into gross motor functional postures.
 - i. How does this client propel the wheelchair and transfer? How can propulsion be improved without compromise of the above goals?
5. Complete a mat assessment. (NOTE: Before moving forward with evaluating flexibility, a thorough skin check should be accomplished.)
 - a. Focus on establishing flexibility of postural segments in directions opposite the destructive tendency.
 - b. In this case:
 - i. Pelvis: The destructive tendency is a posterior tilt and possibly asymmetry. Can it be leveled and passively moved towards a neutral to anterior pelvic tilt?
 - ii. Hips: The destructive tendency is hip extension. Do the hips have adequate flexion for upright sitting?
 - iii. Knees: The destructive tendency may be knee flexion. Do the hamstrings have sufficient length to allow a reasonable popliteal angle with hips flexed to optimal seated alignment?
 - iv. Ankles/feet: The destructive tendency may be plantar flexion. Do the ankles have adequate range towards dorsiflexion for foot flat support?
 - v. Lumbar spine: The destructive tendency is flexion. Step "i" above may have already revealed the extent of lumbar flexibility.

- vi. Thoracic spine: The destructive tendency is flexion, i.e. kyphosis. When stabilizing the pelvis and lumbar spine in best alignment, does the kyphosis reduce?
- vii. Cervical spine: The destructive tendency may be lower cervical flexion with upper cervical and capital extension. Does the cervical spine relax into a normal lordosis in response to reduction of proximal segment malalignment, and do the capital extensors have adequate range for capital flexion?
- viii. Scapula-thoracic relationship: The destructive tendency is protraction. Do the shoulder girdles demonstrate range towards a more neutral and balanced alignment?
- ix. Shoulder: The destructive tendency is most likely flexion, adduction, and internal rotation. Again, is there available range opposite this tendency?
- x. Elbow: The destructive tendency is flexion. Is there sufficient elbow extension for desired tasks?

The idea is to focus the assessment towards determining flexibility opposite destructive tendencies. The supine assessment typically allows the clinician to control for any neurological condition, and reduce the impact of gravity, affording the most objective ROM assessment possible. Assume the questions above were all answered in the affirmative. Does this mean the client can “sit up straight”? Probably not as this question can only be addressed in sitting.

Move the client into sitting, and establish where, within the available ROM assessed in supine, can the person be most comfortably supported towards a non-destructive resting posture. Here again lies another question: What is that non-destructive resting posture?

There are three primary postural tendencies in sitting:

1. Posterior
2. Anterior
3. Lateral/rotational (Which is always coupled with posterior or anterior.)

The goal for intervention for each is as follows:

1. Posterior: Control/reduce the tendency toward optimal sitting alignment.
2. Anterior: Whenever possible, reverse the tendency so that, when resting or involved in fine motor activities, the client relaxes back into the back support rather than collapsing forward into a lordotic posture with the trunk moving away from the back support. (Think of the typical posture of a young man with Duchenne’s Muscular Dystrophy.)
3. Lateral: Whenever possible, reverse the tendency so that, when supported, gravity assists in elongation of the trunk opposite the direction of the destructive tendency.

Simulation

Once you have established a general idea of how the client can be supported, it is time to gather equipment and configure a simulation. Everything done to this point, and every evaluation finding will impact the seating and mobility prescription in at least one of the four following general parameters:

- Angles: Angular relationships of postural supports relative to anatomical angles.
- Shapes: Contours and shapes of supports relative to the unique shape of the sitter.

- **Materials:** Materials are selected with skin care, postural control, breathability, durability, and maintenance in mind.
- **Orientation to:**
 - Gravity for stabilization of posture into supports.
 - Mechanism of mobility.
 - Environment of use, including transportation when appropriate.

These four categories can be remembered through the acronym AMOS; Angles, Materials, Orientation and Shapes.

Measure the results of the simulation against the specific goals outlined in the initial hierarchy:

- Support non-destructive resting postures.
 - If possible, encourage the sitter to relax, and observe postural change. A positive result in this case would show an improvement in postural alignment, and no migration of the hips forward on the seat.
- Ensure sufficient support is provided so that fine motor functional activities can be superimposed onto the resting posture without loss of alignment and stability at the core, i.e. thighs, pelvis, and lumbar spine.
 - Does participation in targeted fine motor activities result in loss of core stability?
- Do not obstruct transitions into gross motor functional postures.
 - Can the sitter complete gross motor activities and then restore herself into the non-destructive resting posture? It is nearly inevitable that the stresses of manual propulsion be it with bilateral upper extremities, lower extremities, or one arm and/or one leg will result in a change in the postural alignment of the sitter. The important element is determining if the sitter can propel and then reposition herself back into the supports once she gets where she needs to be.

Use the objective results of the simulation to make alterations to the simulated configuration as necessary until a definitive seating and mobility prescription can be established.

Summary of the Process

1. Identify the destructive tendency in sitting, and determine preliminary goals in a hierarchical fashion.
2. Establish flexibility opposite destructive tendency in supine.
3. Establish correct-ability in sitting, i.e. influence the client's posture in sitting towards the desired objective relative to established destructive tendency.
4. Determine preliminary seating objectives and parameters using AMOS as a guideline.
5. Gather appropriate equipment for simulation of the selected parameters.
6. Measure effectiveness of the simulation, and adjust parameters and goals appropriately.
7. Prescribe final equipment.
8. Fit the equipment.
9. Fully educate the client and care providers on use and care of the equipment.
10. Schedule a follow up visit or call to ensure long term effectiveness and outcomes.

A Brief Note on 24 Hour Postural Care

There will be times when this ideal model of intervention just doesn't or can't work. In the cases of more extreme postural deformity, severe spasticity, and movement disorders, you may discover that the wheelchair is not going to be the primary intervention for maintenance or improvement of sitting ability. In many of these cases the time spent in the wheelchair is considerably less than time spent out of it. It is absolutely imperative that alternative positions and appropriate supports be used out of the wheelchair for this segment of wheelchair users. Positions should be selected that promote reduction of the postural tendencies observed in sitting. It is not uncommon to restore or maintain a person's ability to sit through well-targeted interventions outside of the wheelchair. Remember that the posture that a person is in the majority of the day is the posture that wins!

Conclusion

A consistent approach to wheelchair seating and mobility has been presented. Consistency in approach and methods of evaluation and intervention is the easiest way to apply science to the often subjective and artsy elements of wheelchair seating. Well-organized goals in a correct hierarchy are the compass to guide you through the process. Identification of the destructive postural tendencies will help you to be more focused and directed through the assessment, and in the measurement of outcomes. And remember, it is not just the wheelchair that influences one's long term sitting health.

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