Diffusing Force to Prevent Client Injury and Equipment Breakage

Clients with Increased Muscle Tone and Forceful Movements

Contents

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Seating Dynamics

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Where Force Occurs, What Happens if Force is not Addressed, Dynamic Solutions, and Expected Outcomes

Introduction

Dynamic seating provides movement within a wheelchair. When the client moves, the dynamic seating components move with the client, maintaining alignment with the seating system for postural support, skin integrity preservation, and stability. Clients who extend with force may benefit from dynamic seating. Dynamic components absorb and diffuse force, protecting both the client from injury and the wheelchair seat and frame from damage (Lange, et al., 2017; Lange, 2016). Dynamic seating can improve quality of life for many wheelchair users and their caregivers.

This document is designed to provide Clinical Guidelines for the use of Dynamic Seating with clients who have increased muscle tone and/or forceful movements. Please refer to our other Clinical Guidelines for additional Dynamic Seating applications.

Where Force Occurs: Hips / Knees / Ankles / Torso / Head

What Happens if Force is Not Addressed?

1) Extensor tone will continue against unyielding surfaces

2) Breakage can occur at:

   a) Footrest hangers and footplates

   b) Back canes

   c) Seat frame

   d) Seating system mounting hardware

   e) Head support mounting hardware. Even if breakage does not occur, excessive forces can move the head support out of alignment.

3) Breakage can occur while in transport, placing the client at risk of injury.

4) Injury can occur:

   a) Client may be injured from violent physical contact with the mobility base and the seating system.

   b) Client may be injured from contact with sharp, broken objects after or during the breakage.

5) Loss of posture can occur:

   a) Client may move out of a beneficial position, resulting in poor alignment, poor pressure distribution, and decreased function.

   b) Poor alignment may specifically reduce trunk and head alignment and control.

   c) If the head moves into hyperextension as the result of undiffused tone or of the head support moving out of position, extensor tone may increase, reflexive responses may be elicited, and postural insecurity, startle, and anxiety may increase.

6) Pain or discomfort can occur:

a) Client may experience discomfort / pain due to the excessive forces exerted against the wheelchair components as a result of high muscle tone. This can create discomfort / pain at the point of contact as well as throughout the joints as the force "has nowhere to go" and is not diffused. Pain or discomfort can decrease sitting tolerance.

7) Shear forces can occur:

a) Force and movement against the seating surfaces can create shear which, in turn, increases risk of skin and tissue injury. Shear against head pad can result in loss of hair over the occiput.

8) Excessive energy expenditure can occur as the client continues to extend against unyielding surfaces. This can increase caloric output, body temperature, sweating, and fatigue.

9) Decrease in function can occur as a client generally is not able to use the body functionally while in a pattern of extension. If the head is out of alignment, the client may specifically experience impaired breathing, swallowing (increasing risk of choking and aspiration), and visual field.

10) Client agitation can occur as a result of these issues.

(Eason et al., 2019)

Dynamic Solutions

What Dynamic Components may be used to Address or Reduce the Likelihood of the Above Issues?

1) Dynamic Back support hardware

2) Dynamic Legrest support hardware

3) Dynamic Head support hardware

4) Dynamic secondary support components (i.e. shoulder straps)

Expected Outcomes

1) When extension forces occur, the dynamic component will move, force will be diffused (Avellis, et al., 2010; Hahn, et al., 2009), and the energy built up in the dynamic component will return the client to their starting position without loss of postural alignment.

2) Due to force diffusion:

a) Decrease in frequency and intensity of extreme extension patterns (Phadke, et al., 2015; Adlam, et al., 2014; Samaneein, et al., 2013; Avellis, et al., 2010; Cimolin, et al., 2009; Hahn, et al., 2009; Crane et al., 2007; Incoronato, 2007; Ferrari, 2003)

b) Reduced equipment breakage (Hahn, 2009; Crane, et al., 2007; Incoronato, 2007; Hong, 2006)

c) Reduced client injury (Whitney, et al., 2018; Lange, et al., 2017; Avellis, et al., 2010; Cimolin, 2009; Crane, et al., 2007; Hong, 2006)

d) Reduced loss of posture (Crane, et al., 2007; McNamara & Casey, 2007; Ferrari, 2003)

e) Improved head posture and, as a result, improved swallow (Ferrari, 2003), breathing (Crane, et al., 2007), and visual field

f) Increased sitting tolerance / comfort (Lyons, et al., 2017; Frank & DeSouza, 2017; Cimolin, et al., 2009; Incoronato, 2007; Crane, et al., 2007)

g) Reduced shear forces (Avellis, et al., 2010; Cimolin, et al., 2009; Crane, et al., 2007; Incoronato, 2007; Incoronato, 2006; Dawley & Julian, 2003)

h) Reduced energy expenditure (Ferrari, 2003)

i) Increased function, including access to assistive technology (Adlam, et al., 2015; Adlam, et al., 2014; Dalton, 2014; Cimolin, et al., 2009; Crane, et al., 2007; Incoronato, 2006)

j) Reduced agitation (Pfeiffer, et al., 2011; Crane et al., 2007; Watson, et al, 1998)

3) Due to provision of movement:

a) Reduced agitation (Pfeiffer, et al., 2011; Watson, et al., 1998)

b) Increased active range of motion (Adlam, et al., 2014; Avellis, et al., 2010; Hahn, et al., 2009; Incoronato, 2007)

c) Increased sensory input (Presperin-Pedersen & Eason, 2015)

Conclusion

Many people use seating and wheeled mobility. For clients who exert force within the seating and mobility equipment, such as clients with increased muscle tone, injury and equipment damage can occur. Dynamic Seating diffuses these forces to reduce risk of injury, damage, and pain. Diffused forces have also been shown to improve posture and function.

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