Clinical Research Supporting the Prescription of Motion Composites Wheelchairs

Written by: Sarah Matson OT Reg (Ont) - Clinical Educator for Motion Composites

This report provides a summary of the clinical research supporting the prescription of ultra-lightweight manual wheelchairs (ULWC) for wheelchair users who self-propel. An ULWC is defined as a manual wheelchair weighing less than 38 pounds fully equipped that offers maximum ability to customize the chair to the client[1, 2, 3]. This includes maximal rear axle adjustment (horizontal, vertical, camber), caster housing adjustment and wheel options[1, 2, 3]. The following Motion Composites wheelchairs qualify as ULWC: Helio C2, Helio Kids, Helio A7 and Veloce.

More specifically, this report provides a summary of the clinical research supporting the use of ULWC for:

1. Decreasing the incidence of wheelchair abandonment or non-use
2. Preventing upper extremity pain and overuse injuries
3. Increasing equipment cost-effectiveness

1. Use of an ULWC will reduce the incidence of wheelchair non-use.

   Wheelchair non-use can have serious repercussion for the user and for society[4]. For the wheelchair user, non-use can cause decreased participation and independence and increased personal expenses and reliability on community health resources. In terms of a service delivery model, wheelchair non-use can represent an ineffective and inefficient use of provincial or third party funding.

- A 1993 study looking at predictors of assistive technology abandonment found a 39% abandonment rate amongst wheelchair users [4]. Phillips found that older adults who have abandoned or rarely use their manual wheelchair report poor wheelchair performance as a primary reason. Factors affecting wheelchair performance included safety, ease of use, how it impacted the user's mobility, and durability.

  Safety, Ease of Use and Mobility:
  All of the Motion Composites ULWC's have a highly adjustable rear axle plate allowing for precise centre of gravity (COG) adjustment. An individualized COG adjustment will influence balance (safety) and propulsion (mobility, ease of use) [5, 6, 7]. All of the Motion Composites ULWC's are extensively engineered using a monocoque side frame, symmetrical crossbrace and ultra-rigid locking system for reduced frame flexion and maximum propulsion efficiency (mobility, ease of use).

  Durability:
  Motion Composites wheelchairs have proven durability. All of the Motion Composites ULWC's underwent RESNA* testing including the RESNA fatigue/strength test of durability. To be sold in Canada, a wheelchair must withstand a minimum of 200 000 cycles of the fatigue/ strength test of durability without any major component failures. All of the Motion Composites wheelchairs achieved at least the minimum standard of 200 000 cycles. The Helio C2, Helio Kids and Veloce all achieved at least 2 times the minimum standard or 400 000 cycles.

- Mann et al. (8) found that *wheelchair weight* is a primary factor in wheelchair abandonment. The Helio C2, Helio A7 and Helio Kids are the lightest wheelchairs in their category and the Veloce is

the lightest folding wheelchair in the world. This means that a Motion Composites ULWC is less likely to be abandoned than a heavier wheelchair. This is important for two reasons: cost effectiveness but more importantly, user activity and participation levels.

*The Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) advances the field of technology solution for people with disabilities by offering certification, continuing education, and professional development; developing assistive technology standards; promoting research and public policy; and sponsoring forums for the exchange of information and ideas to meet the needs of their multidisciplinary constituency.

2. Use of an ULWC will help to prevent upper extremity pain and overuse injuries

The prevalence of upper extremity pain and overuse injuries in wheelchair users is high (30-70%) and well documented in the literature [9-16]. Due to the high prevalence of upper extremity disorders among wheelchair users, research into the cause, treatment and prevention of these disorders has been well researched.

There are two documents that effectively summarize this research and provide recommendations for the prevention of upper extremity pain and disorders in wheelchair users. The first is *Preservation of Upper Limb Function Following Spinal Cord Injury: A Clinical Practice Guideline for Healthcare Professionals (17).* This clinical practice guideline (CPG) was compiled by members of an expert panel with review by further experts in the field using clinical and empirical evidence. Following the release of this clinical practice guideline, Boninger et al. (7) released a report reinforcing the recommendations in the CPG. Both of these documents focus on upper extremity function preservation for users with spinal cord injuries. The authors state that they believe the findings are applicable to manual wheelchair users who self-propel with other disabilities, however they advise that caution should be exercised when applying the results to other groups.

In regards to wheelchair selection, both of these documents recommend “providing a high-strength, fully customizable manual wheelchair made of the *lightest possible material*”. As previously stated, the Motion Composite ULWC’s meet all three of these criteria.

These evidence based guidelines also advocate for the following set-up practices: “adjusting the rear axle as far forward as possible without compromising stability “and “placing the rear axle so that when the hand is placed at the top dead-center position on the pushrim, the angle between the upper arm and forearm is between 100 and 120 degrees”. Both of these adjustments require an adjustable rear wheel axel plate like that found on all of the Motion Composite ULWC’s. The Motion Composites axle plate allows for a large range of centre of gravity adjustment with excellent precision (3 ¼ inches in ¼ inch increments). This combined with 5 inches of rear wheel height adjustment in ¼ inch increments means that ideal rear wheel placement will be easily achieved ensuring a custom fit and ideal ergonomics for propulsion for each individual user.

Based on reviews of the research and clinical practice guidelines including the two discussed above, RESNA released the following summary statement in a March 2012 position paper on the application of ULWC and the prevention of upper extremity disorders[3].

“The Clinical Practice Guidelines, in conjunction with the current peer-reviewed articles, recommend a fully customizable wheelchair made of the lightest high-strength materials. The evidence concerning

upper extremity pain and injury in the population of manual wheelchair users suggests that the proper selection and configuration of ULWC's can significantly reduce the secondary complications associated with overuse syndrome".

Avoiding or minimizing upper extremity injury and pain is important for any wheelchair user. Motion Composites ULWC's meet the weight and adjustability criteria that the research indicates are vital for reducing the incidence of upper extremity pain and injury.

3. Use of an ULWC will increase equipment cost effectiveness.

How long a piece of equipment lasts and the frequency of repairs required is important to the user as well as the funding agency. The evidence indicates that an ULWC is a more durable and cost effective option compared to depot or standard manual wheelchairs in that they last longer and cost less to operate[18,19].

As previously stated, all of the Motion Composites ULWC's meet or exceed the testing requirements for strength and durability required by RESNA. They are made of high quality carbon fibre or 7000 grade aluminum, both of which are incredibly strong, durable and will resist fatigue and corrosion over time. Motion Composites also boasts a warranty to total sales ratio below the industry average indicating high quality materials and construction.

Choosing to prescribe an ULWC over a depot or standard wheelchair, especially a Motion Composites ULWC with proven strength, durability and quality will increase equipment cost effectiveness over time.

Summary

Motion Composites ULWC's are lightweight, highly adjustable, efficient and durable. The research indicates that these criteria are essential in a wheelchair to help reduce wheelchair abandonment, preserve upper limb function, and increase wheelchair cost effectiveness. The following summary statement, taken from a RESNA position paper on the application of ULWC, effectively summarizes the information presented in this report supporting the prescription of Motion Composites wheelchairs: *The evidence available regarding ULWC suggests that a properly configured ULWC will contribute to long-term functional success, decreased incidence of secondary complications, and will cost less to maintain over time. An ULWC should be considered for all individuals who are manually propelling a wheelchair to ensure maximum function and safety[3].*

References

1. Ministry of Health and Longterm Care Assistive Devices Program (2009). Device Listing Application Package. Manufacturers and Distributors. Available from: URL: http://www.health.gov.on.ca/en/pro/programs/adp/manufac_distributors.aspx

2. National Government Services (2009). Manual Wheelchair Bases - Policy Article - Effective October 2009 (A47082)2009 [cited 2012 1/17/2012]. Available from: URL: http://apps.ngsmedicare.com/applications/Content.aspx?DOCID=20508&CatID=3&RegID=51&ContentID=34387.

3. Rehabilitation Engineering & Assistive Technology Society of North America (RESNA). 2012. Position on the Application of Ultralight Manual Wheelchairs [position paper]. Available from: RESNA: www.resna.org/resources/position_papers.dot. (2011). Position on the Application of Ultralight Manual Wheelchairs [position paper].

4. Phillips, B., & Zhao, H. (1993). Predictors of assistive technology abandonment. Assistive Technology, 5(1), 36-45.

5. Cowan RE, Nash MS, Collinger JL, Koontz AM & Bonninger ML (2009). Impact of surface type, wheelchair weight and axle position on wheelchair propulsion by novice older adults. *Archives of Physical Medicine and Rehabilitation*, 90(7): 1076-1083.

6. Freixes O, Fernandez SA Gatti MA., Crespo, MJ, Olmos LE & Rubel IF (2010). Wheelchair axle position effect on start-up propulsion performance of persons with tetraplegia. *Journal of Rehabilitation Research & Development*, 47(7): 661-668.

7. Bonninger ML, Baldwin MA, Cooper RA, Koontz AM & Chan L (2000). Manual wheelchair pushrim biomechanics and axle position. *Archives of Physical Medicine andRehabilitation*, 81(5): 608-613.

8. Mann WC, Goodall S, Justiss MD, Tomita M. Dissatisfaction and nonuse of assistive devices among frail elders. Assist Technol 2002;14:130–9. [PubMed: 14651251]

9. Beekman CE, Miller-Porter L, Schoneberger M. Energy cost of propulsion in standard and ultralight wheelchairs in people with spinal cord injuries. Phys Ther. 1999;79(2):146–58.

10. Boninger ML, Koontz AM, Sisto SA, Dyson-Hudson TA, Chang M, Price R et al. Pushrim biomechanics and injury prevention in spinal cord injury: Recommendations based on CULP-SCI investigations. J Rehabil Res Dev 2005; 42(3 Suppl 1):9-20.

11. Boninger ML, Cooper RA, Baldwin MA, Shimada SD, Koontz A. Wheelchair pushrim kinetics: body weight and median nerve function. Arch Phys Med Rehabil1999;80(8):910-5.

12. Boninger, M.L., Dicianno, B.E., Cooper, R.A., Towers, J.D., Koontz, A.M., Souza, A.L., 2003. Shoulder magnetic resonance imaging abnormalities, wheelchair propulsion and gender. Archives of Physical Medicine and Rehabilitation 84, 1615–1620.

13. Curtis KA, Drysdale GA, Lanza RD, Kolber M, Vitolo RS, West R. Shoulder pain in wheelchair users with tetraplegia and paraplegia. Arch Phys Med Rehabil. 1999;80:453–57.

14. Sawatzky BJ, Slobogean GP, Reilly CW, Chambers CT, Hol AT. Prevalence of shoulder pain in adult- versus childhood-onset wheelchair users: a pilot study. J Rehabil Res Dev 2005;42:1-8.

15. Gellman H, Chandler DR, Petrasek J, Sie I, Adkins R, Waters RL. Carpal tunnel syndrome in paraplegic patients. J Bone Joint Surg Am 1988;70(4):517–19.

16. Davidoff G, Werner R, Waring W. Compressive mononeuro-pathies in the upper extremities in chronic paraplegia. Paraplegia 1991; 29: 17–24.

17. Paralysed Veterans of America Consortium for Spinal Cord Medicine (2005). Preservation of upper limb function following spinal cord injury: A clinical guideline for health-care professionals. *Journal of Spinal Cord Medicine*, 28(5):434-470.

18. Fitzgerald, S.G., Cooper, R.A., Boninger, M.L., & Rentschler, A.J. 2001. Comparison of fatigue life for 3 types of manual wheelchairs. *Arch Phys Med Rehabil.*, 82, (10) 1484-1488 available from: PM:11588758

19. Cooper RA, Robertson RN, Lawrence B, Heil T, Albright SJ, VanSickle DP et al. Life-cycle analysis of depot versus rehabilitation manual wheelchairs. J Rehabil Res Dev 1996;33(1):45-55.