

ASSISTIVE DEVICES FOR AMBULATION

AN UPDATE ON DESIGN

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Background information

- The United States Census Report 2008¹
- More than 10 million people age 15 or older used a cane, crutches or a walker for at least six months
- More than 8 million adults used an assistive device for longer than six months
- More than 15% of those using ambulation devices over 65 years of age used an ambulation assistive device for more than six months
- With the rapidly aging population, more assistive devices will be used.

Objectives

- Are these assistive devices safe?
- What devices are new on the market?
- What are the uses for these devices?
 - Improved balance and stability
 - Reduce pain or injury to one or both lower limbs by reducing the vertical load
 - Compensate for muscle weakness, sensory loss or other limb injury pathology

Fit of Device

- Poor fitting of any assistive and/or improper training of how to use the device can lead to problems. These include:
 - Inefficient gait pattern
 - Injury to other parts of the body
 - Increased risk for falls
 - Increased cost with little to no benefit

Research on Assistive Devices

- Youdas, Kotajarvi, et. al., 2005 study indicated that healthy subjects could be taught to reduce weight bearing by 50% with axillary or forearm crutches, but this was much more challenging with a wheeled walker or cane.⁴
- Take home message? Gait training requiring reduced weight bearing may be difficult, especially with walkers, or canes.

Research on Assistive Devices

- Stevens JA, Thomas K, et al. in 2009 studied United States emergency room records within a year, finding that 45,312 older adult fall injuries were associated with walking aids. Walkers were associated with seven times as many injuries as canes.⁵
- Certainly, more frail older adults use walking devices and are more likely to fall.
- Take home message? People may have problems using walking aids safely and effectively. They may benefit from a comprehensive falls prevention program.

Research on Assistive Devices

- There is some evidence that assistive devices may inhibit natural balance reactions.
- Bateni and Maki in 2004 found that use of a standard walker or straight cane interfered with compensatory stepping reactions when normal subjects underwent large lateral perturbations.⁶
- Take home message? Normal stepping reactions that occur with a fall may be difficult when using a walker or cane when large and unpredictable balance disturbances occur.

Canes

- Research on canes suggest that there is a need for trained health care professionals to be involved for proper fit and function.
- A comprehensive balance program should be provided whenever an assistive device is recommended.
- Canes are very useful for unweighing a limb with painful osteoarthritis
- A tripod may add stability and efficiency



Able Tripod latex rubber base for canes

Hurry Cane

Portable



Stable, flexible base



Hurry Cane Base

Reported to add stability.

No research available.

Internet sales and marketing
phenomenon.

Cost is \$40.00 to \$70.00 based on
availability of promotional deals and
shipping costs.



Crutches

- Research on crutches indicate that axillary crutches may provide more stability than forearm crutches.
- Crutches may be better than walkers with sternal precautions.
- Spring loaded crutches may reduce the 'jarring' of crutches but does not reduce the energy required to walk with crutches.
- There are some new designs for forearm crutches and for standard axillary crutches.

Strong-Arm Crutch

Design that shifts weight from the wrist to the forearm

Ergonomic hand grip with an offset hand component

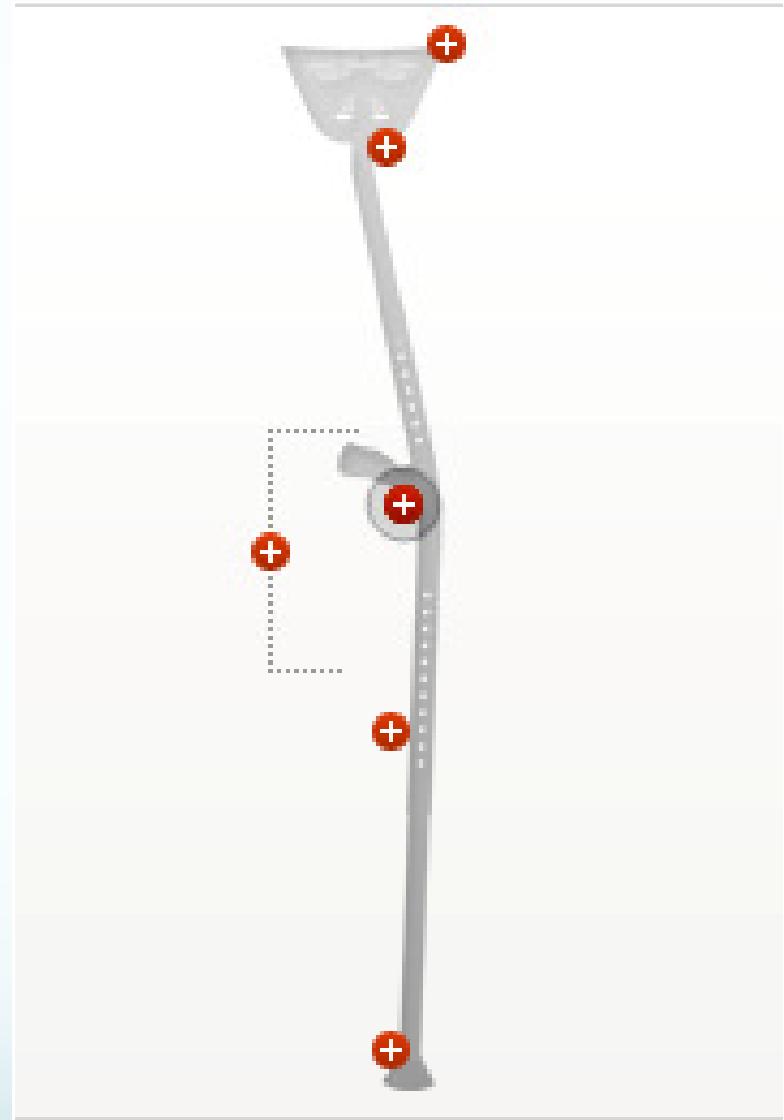
Forearm component which contours the UE limb to provide increased lateral support compared to that offered by standard forearm crutches.





Crutches

Mobi-legs crutches





Mobi-legs



- The saddle grips naturally and is well-ventilated for continuous air circulation. Articulated saddle design pivots and rotates in tandem with body movement and features 1 1/4" of built-in dampening. It maintains full contact and will not abrade the soft tissue. The pliable membrane sling provides suspended support, creating a rest for the underarm of unparalleled comfort.

Mobi-legs



- Ergonomic Handgrips contour to the hand, maintain a natural wrist angle and evenly distribute load across the palm. Ergonomic Handgrips are specifically left/right handed.

Mobi-legs



- The legs are offset to provide hip clearance and limit the potential for tripping.
- Fully adjustable height and arm length to properly fit 96% of all adults 4'9" to 6'4" up to 300lbs.

Mobi-legs



- Rocker Feet with over-molded, natural rubber pads maintain full contact throughout the stride and are proven to require less exertion.

Walkers

- Research on walkers indicates that consideration of the environment as well as the caregivers should influence the decision of type of walker chosen.
- Inappropriate use of walkers may lead to forward bent posturing.
- Gait velocity slows when standard, non-wheeled walkers are used with individuals with Parkinson disease.
- A wheeled walker may be more energy efficient, but only if it is used correctly.

Walkers

Braking devices for standard walkers with wheels on back legs. These brakes engage with weight bearing making the walker more stable, but easy to move forward when walking.



Braking devices for standard walkers





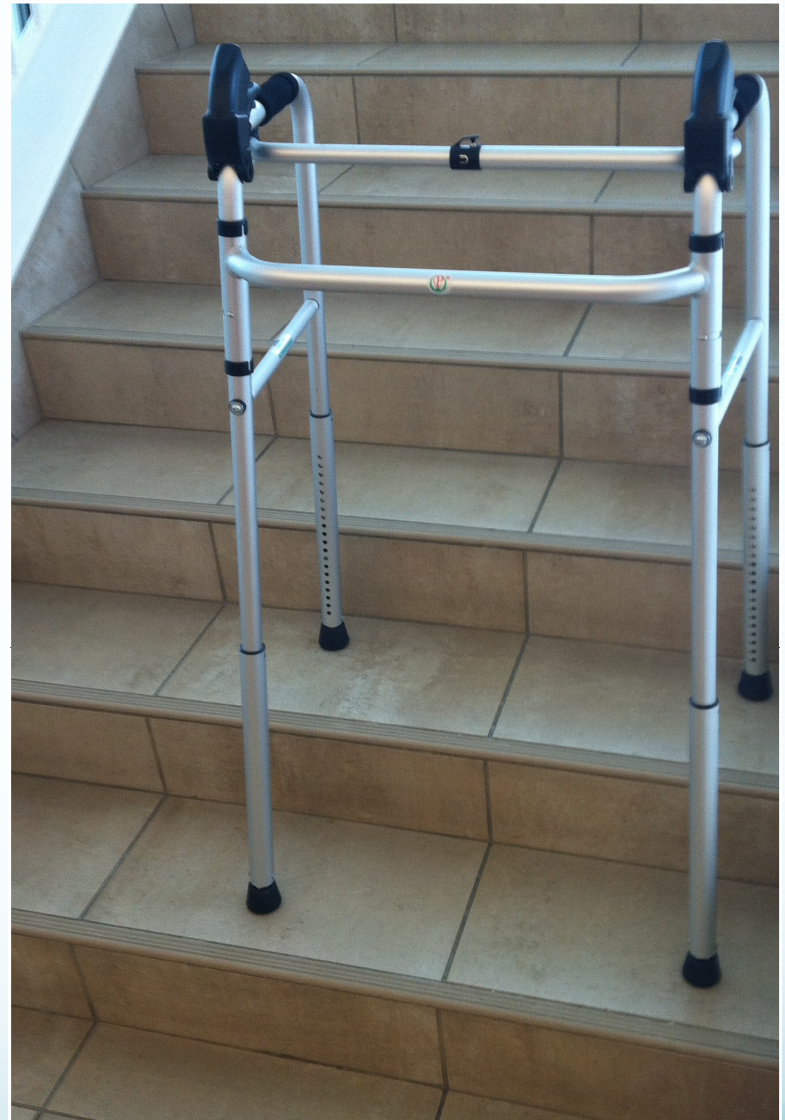
Rollator walker; seated 4 wheel walker

Walkers: Knee walkers or rollabouts



Walkers

Stair climbing walker
manufactured in
China





Walking Poles

- Research on walking poles
- Study by Willson JM, Torry JMR, et al.2001
- The use of walking poles enabled subjects to walk at a faster speed with reduced vertical ground reaction forces, vertical knee joint reaction forces, and reduction in the knee extensor angular impulse and support moment, depending on the poling condition used.

Walking poles

Fitness for all ages and stages

Nordic walking poles help improve posture and balance, while taking stress from hips and knees.



Summary

Assistive device price	Potential use	Advantages	Disadvantages
Strong arm \$50 to \$60 each	More lateral support needed	Shifts weight from wrist to forearm	Not easily available, more expensive
Mobilegs \$50 to \$130/pair	Long term use or need stability	Fit and comfort	More expensive than traditional crutches
Abletripod cane base \$20	More stability	Provides stable base	Amount of stability unknown
Walking poles \$18 to \$50 each	Active patients wanting stability	Folding, wide variety of types	Not as supportive as other devices
Knee walker \$170 to \$300	Non-weight bearing ankle-foot	Freedom of mobility	Not on stairs, more expensive
Rollator walker \$170 to \$600	Long term walker use, provides seat	Durable, brakes, seat	Heavier, more expensive
Stair walker (not available)	Long term stair use	Level and stair use possible	Not currently available in USA

References

- 1. Kaye HS, Kang T, LaPlante MP. *Mobility Device use in the United States*. Washington, DC: United States Department of Education. National Institute on Disability and Rehabilitation Research; 2000:60 p.
- 2. Faruqui SR, Jaeblo T. Ambulatory assistive devices in orthopaedics: Uses and modifications. *J Am Acad Orthop Surg*. 2010;18(1):41-50.
- 3. Salminen A, Brandt A, Samuelsson K, Toytari O, Malmivaara A. Mobility devices to promote activity and participation: A systematic review. *J Rehabil Med*. 2009;41:697-706.
- 4. Youdas JW, Kotajarvi B.J. P, D.J., Kaufman KR. Partial weight-bearing gait using conventional assistive devices. *Arch Phys Med Rehabil*. 2005;86:394-398.
- 5. Stevens JA, Thomas K, Teh L, Greenspan AI. Unintentional fall injuries associated with walkers and canes in older adults treated in U.S. emergency departments. *J Am Geriatr Soc*. 2009;57(8):1464-1469.
- 6. Bateni H, Maki BE. Assistive devices for balance and mobility: Benefits, demands, and adverse consequences. *Arch Phys Med Rehabil*. 2005;86(1):134-145.
- 7. Bateni H, Heung E, Zettel J, McLlroy WE, Maki BE. Can use of walkers or canes impede lateral compensatory stepping movements? *Gait Posture*. 2004;20(1):74-83.
- 8. Wellmon R, Pezzillo K, Eichhorn G, Lockhart W, Morris J. Changes in dual-task voice reaction time among elders who use assistive devices. *J Geri Phys Ther*. 2006;29(2):74-80.

References

- 9. McCulloch K. Attention and dual-task conditions: Physical therapy implications for individuals with acquired brain injury. *J Neurol Phys Ther.* 2007;31(3):104-118.
- 10. Thomas B, Connelly D, Laliberte-Rudman D. The impact and use of walkers among older adults: A pilot. *Phys Occup Ther Geriatr.* 2008;27(1):36-72.
- 11. Pape TL, Kim J, Weiner B. The shaping of individual meanings assigned to assistive technology: A review of personal factors. *Disabil Rehabil.* 2002;24(1):5-20.
- 12. Liu H, (Howe), Eaves J, Wang W, Womack J, Bullock P. Assessment of canes used by older adults in senior living communities. *Arch Gerontol Geriatr.* 2011;52(3):299-303.
- 13. Hall CD, Jensen JL. The effect of cane use on the compensatory step following posterior perturbations. *Clin Biomech (Bristol, Avon).* 2004;19(7):678-687.
- 14. Jones A, Silva PG, Silva AC, et al. Impact of cane use on pain, function, general health and energy expenditure during gait in patients with knee osteoarthritis: A randomised controlled trial. *Ann Rheum Dis.* 2012;71(2):172-179.
- 15. Allet L, Leemann B, Guyen E, et al. Effect of different walking aids on walking capacity of patients with poststroke hemiparesis. *Arch Phys Med Rehabil.* 2009;90(8):1408-1413.
- 16. Nolen J, Liu H, Liu H, McGee M, Grando V. Comparison of gait characteristics with a single-tip cane, tripod cane, and quad cane. *Phys Occup Ther Geriatr.* 2010;28(4):387-395.
- 17. Liu H. Assessment of rolling walkers used by older adults in senior-living communities. *Geriatr Gerontol Int.* 2009;9(2):124-130.

References

- 18. Liu H, Grando V, Zabel R, Nolen J. Pilot study evaluating fear of falling and falls among older rolling walker users... including commentary by hakim RM, huang M, and pearson B. *Int J Ther Rehabil.* 2009;16(12):670-677.
- 19. Pasquini SM, Peterson ML, Rattansi SM, et al. The impact of assistive device prescription on gait following total knee replacement. *J Geriatr Phys Ther.* 2010;33(2):64-70.
- 20. Cubo E, Moore CG, Leurgans S, Goetz CG. Wheeled and standard walkers in parkinson's disease patients with gait freezing. *Parkinsonism Relat Disord.* 2003;10(1):9-14.
- 21. Gupta RB, Brooks D, Lacasse Y, Goldstein RS. Effect of rollator use on health-related quality of life in individuals with COPD. *Chest.* 2006;130(4):1089-1095.
- 22. Priebe JR, Kram R. Why is walker-assisted gait metabolically expensive? *Gait Posture.* 2011;34(2):265-269.
- 23. Goehring M, Kenyon L. Axillary or forearm crutches: Comparing postural sway in single leg stance and perceptions of safety. *J Acute Care Phys Ther.* 2011;2(2):72.
- 24. Sanders LHA, Chen W, Cindric SE, Newman MAJ. Sternotomy and crutches. *Interactive CardioVascular and Thoracic Surgery.* 2011;13(2):237-239.
- 25. Segura A, Piazza SJ. Mechanics of ambulation with standard and spring-loaded crutches. *Arch Phys Med Rehabil.* 2007;88(9):1159-1163.
- 26. Zhang Y, Liu G, Xie S, Liger A. Biomechanical evaluation of an innovative spring-loaded axillary crutch design. *Assist Technol.* 2011;23(4):225-231.
- 27. Willson JM, Torry JMR, et al. Effect of walking poles on lower extremity gait mechanics *Medicine and Science in Sports and Exercise* 2011;33 (1).

Thank you!

