

# Cane-Assisted Gait Biomechanics and Electromyography After Total Hip Arthroplasty

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**ABSTRACT.** Ajemian S, Thon D, Clare P, Kaul L, Zernicke RF, Loitz-Ramage B. Cane-assisted gait biomechanics and electromyography after total hip arthroplasty. *Arch Phys Med Rehabil* 2004;85:1966-71.

**Objective:** To quantify the effects of cane use during walking on hip joint kinematics, kinetics, and muscle activity patterns after unilateral total hip arthroplasty (THA).

**Design:** Nonrandomized experimental design.

**Setting:** Urban inpatient hospital.

**Participants:** Adults (n=9 men, 2 women) with no history of orthopedic or neuromuscular disease who underwent elective unilateral THA.

**Intervention:** Gait was assessed preoperatively and 4 and 8 months postoperatively.

**Main Outcome Measures:** Three-dimensional hip joint motion and moments and electromyographic patterns of gluteus medius, tensor fascia latae, lateral hamstring, and vastus lateralis were measured during level walking, with and without use of a straight cane.

**Results:** When a cane was held in the contralateral hand, the abduction moment of the affected hip decreased by 26%, whereas that of the contralateral hip increased by 28%. Use of a cane in THA rehabilitation is important because it reduces the load on the operative hip so that bone and soft tissues can heal. Our results suggest that load reduction was successful on the operative side, but the loads on the contralateral side were increased.

**Conclusions:** After unilateral arthroplasty, subjects using a cane had increased hip abduction moments on the nonoperative hip and decreased hip abduction moments on the operative hip. Clinicians should be mindful of the effects of cane use on the contralateral hip.

**Key Words:** Arthroplasty, replacement, hip; Cane; gait; Electromyography; Rehabilitation.

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**A**SSISTIVE DEVICES are often used in the management of lower-extremity pain or weakness, and in some cases they provide enough assistance to make a difference between func-

tional and nonfunctional ambulation. Canes have also been shown to reduce fall frequency among the elderly.<sup>1</sup> Among patients awaiting total hip arthroplasty (THA), Mont et al<sup>2</sup> reported that 50% of the patients they studied used 1 or 2 canes or crutches. In a similar population, McBeath et al<sup>3</sup> noted that only 29% of patients in their study could walk without an assistive device. While the preoperative use of assistive devices is common, postoperative use presents a dilemma to health care practitioners because most patients strive for unassisted ambulation.

People with lower-extremity instability typically use a cane on the ipsilateral side, whereas persons with pain or weakness use the cane in the side opposite (contralateral) the affected extremity.<sup>1,4-7</sup> Contralateral use encourages a normal reciprocal gait pattern and reduces the hip contact forces more effectively than ipsilateral use.<sup>4,6,7</sup> The reduction in hip contact forces results primarily from the decreased hip abductor muscle force required to balance the pelvis during unilateral stance. Brand and Crowninshield<sup>8</sup> calculated that when patients with unilateral hip disease used a cane in the contralateral hand, hip contact forces decreased by 56% when compared with unassisted walking. Although some of the difference may be accounted for by a decreased walking velocity in the cane-assisted trials, it is clear that contralateral cane use dramatically decreases joint loads. That was supported by Krebs et al,<sup>9</sup> who reported that, in a subject with an instrumented acetabular component, contralateral cane use reduced the peak acetabular contact pressure and gluteus medius electromyographic activity when compared with unassisted walking.

Relative changes in muscle activity and kinetics during cane-assisted gait have been reported. Neumann<sup>10</sup> found a 31.1% decrease in gluteus medius activity during contralateral cane use and a 42.3% decrease in muscle activity when subjects were instructed to push as hard as possible on the cane in the contralateral hand. The data suggested that contralateral cane use effectively reduced demand on the hip abductors, subsequently reducing joint compression forces related to muscle contraction.

Despite those findings, no report has described the muscle activity or joint kinetics on the side ipsilateral to the cane. Bilateral disease is common in people with hip osteoarthritis. If the decreased loading of 1 hip comes at the expense of the contralateral joint, use of a unilateral cane may need to be reconsidered. In this study, we describe the effect of unilateral cane use on bilateral joint kinematics, joint moments, and hip abductor muscle activity in adults preoperatively and 4 and 8 months after THA.

## METHODS

### Participants

We recruited 14 patients scheduled for unilateral THA. Subjects were excluded if they had previous surgery on either hip; recent trauma that precipitated the scheduled total hip replacement surgery; pain or abnormality of the knee or ankle of the operative limb; pain or abnormality of the nonoperative leg; a

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Supported by the Arthritis Society of Canada and Hip-Hip Hurray (Canadian Orthopaedic Foundation).

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated.

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0003-9993/04/8512-8849\$30.00/0

doi:10.1016/j.apmr.2004.04.037