

BREAST CANCER SURVIVORS' POSTURAL SWAY EXCEEDS EXPECTATIONS FOR AGE OR VESTIBULAR PATHOLOGY: A CROSS-SECTIONAL ANALYSIS

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Background: Published fall rates for breast cancer survivors, even younger and chemo-naïve women, exceed the 1 in 4 estimated annually for older adults. Balance is known to decline as breast cancer survivors (SURVIVOR) develop chemo-induced peripheral neuropathy (CIPN), but many never develop CIPN, so allied health providers must identify other mechanisms if they seek to combat this public health problem. Hypotheses include cancer-related vestibular damage, and accelerated aging of postural control.

Purpose: We aim to explore the vestibular dysfunction and accelerated aging hypotheses, by comparing the increase in standing postural sway in response to manipulation of vision, support surface, or base of support between midlife (35-60 yrs) SURVIVORS, midlife patients with vestibular dysfunction (VESTIBULAR), and Controls (CONTROL) over age 60 without cancer or neuro-vestibular impairment.

Methods: This is a secondary analysis of postural sway data from 3 cross-sectional studies of the NIH Toolbox Balance Accelerometry Measure Inertial Measurement Unit. We compared 88 females (mean 61.5 ± 11.9 yrs; range 39-86): 41 Stage 0-III SURVIVORS *without* CIPN who were on aromatase inhibitor therapy after curative resection, 13 VESTIBULAR, and 34 CONTROL. We assessed postural sway as Normalized Path Length (NPL) in Anteroposterior (AP) and Mediolateral (ML) directions while standing for 45 sec with Eyes Open (EO) or Closed (EC), and feet: 1) Together 'Narrow,' 2) Heel-to-toe 'Tandem,' or 3) Narrow on Foam Cushion 'Narrow Foam.' We normalized sway in each of 5 subsequent positions to the initial position of Narrow EO. Using an age cut-off of 60.5 years, we stratified SURVIVOR, VESTIBULAR, and CONTROL groups into Midlife (Mid) and Older (Old). We compared NPL for the resulting 6 groups using Kruskal-Wallis ANOVA on ranks with Bonferroni correction. For post-hoc pairwise comparison we used Wilcoxon rank-sum tests.

Results: Compared to 75% of Mid-CONTROL, only 56% of Mid-SURVIVOR could hold the most challenging position, Tandem Stance EC. Compared to 87% of Old-CONTROL, only 60% of OLD-SURVIVOR could hold Narrow Stance on Foam EC. Among those able to hold, normalized AP sway for Mid-SURVIVOR was at least 1.5-fold greater than Mid-CONTROL (1.5 to 1.9-fold, $p < 0.0001$) and Mid-VESTIBULAR (1.5 to 1.7-fold, $p = 0.02$ to 0.004) for Narrow Foam EC and Tandem EO/EC. For Narrow Foam EC, Mid-SURVIVOR exceeded even Old-CONTROL (1.6 to 1.7, $p < 0.0001$). In the ML direction, NPL in Narrow EC for Mid-SURVIVOR increased ~1.5-fold more than Mid- and Old- CONTROL & VESTIBULAR groups ($p 0.004$ to < 0.0001).

Discussion/Conclusions: In response to manipulation of vision, support surface, or base of support, midlife breast cancer survivors on aromatase inhibitors *without* CIPN demonstrate sway increases, particularly in the AP plane, that significantly exceed those of midlife controls. Sway response in survivors also exceeds that of controls at least one decade older, and patients with known vestibular dysfunction, yet survivor sway patterns appear distinct from both aging and vestibular dysfunction. This may suggest a unique mechanism for balance impairment in breast cancer survivors without CIPN, one that includes greater use of visual input to maintain balance. Further study is needed, with larger samples and longitudinal balance assessment during cancer treatment.

Relevance to Allied Health: These findings inform clinical and research measurement of balance impairment in breast cancer survivors, the design of related falls prevention and rehabilitation strategies, and mechanistic balance research with functional brain imaging. Related roles are identified for physical and occupational therapists, speech pathologists and audiologists, and medical imaging professionals.