

# Stop the Stoop

## Can PT Make a Difference in Age-Related Hyperkyphosis? A Case Report Using Manual Therapy and Exercise.

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*Editor's Note: This clinical case commentary is part of content for the January 2022 Journal Club discussion on Katzman WB, Parimi N, Gladin A, Wong S, Lane NE. Long-Term Efficacy of Treatment Effects after a Kyphosis Exercise and Posture Training Intervention in Older Community-Dwelling Adults: A Cohort Study. J Geriatr Phys Ther. 2021;44(3):127-138. doi:10.1519/JPT.0000000000000262*

*These case studies are intended to demystify the more formal statistics and format of a peer-reviewed article and translate key concepts into clinically usable information. Join us for Journal Club on the third Tuesdays of January, March, May, July, September and November at 8 pm ET to discuss current concepts with a wide range of peers. Register to join us or view archived recordings at [geriatricspt.org/journal-geriatric-physical-therapy](http://geriatricspt.org/journal-geriatric-physical-therapy).*

Art, an 88-year-old male, is referred by his geriatrician to physical therapy (PT) on the request of his daughters. They report a decline in his posture and balance over the last 6 months. Specifically, they noticed that his forward trunk lean was worse; he seems to lose his balance when turning.

### PMH

- Type 2 diabetes mellitus for over 20 years (estimated by patient report), controlled with Metformin, diet, and exercise. His most recent A1c was recorded 2 months prior to PT at a 6.9.
- Osteopenia, diagnosed 3 years ago, believed to be due to primary hyperparathyroidism. Bone Mineral Density (DXA) scan T-Scores for lumbar spine were -0.7, right femoral neck -2.2, and right total hip -1.7. Parathyroid glands were removed 3 years ago. No follow-up bone scan available.
- Motor vehicle accident 6 years ago with bilateral rib fractures, left clavicular fracture, left radial head dislocation (s/p reduction), pelvic fractures, left hip fractures (s/p ORIF), left femoral shaft fracture (s/p rodding), and a torn left PCL. Art also had a ruptured spleen and underwent splenectomy.

### Subjective Interview

Patient initially presented with no complaints, no pain, and no history of falls in the last year. He reported that functionally he is “doing fine”. When pressed further he does admit to being “off balance” with initial standing, his cane helps. He reports walking the loop (~.5 mile) in his neighborhood once a day using his cane but that he used to walk it twice a day. His family also reports difficulty with transfers; he requires the use of both arms to stand, squat, and perform tub transfers even when using a tub bench.

**Social/environmental history:** Art lives with his 3 daughters and son in a 1.5 story house with 1 step to enter. He does not go upstairs. He is a retired teacher, active in his church choir, likes to go on day trips to local area parks, and enjoys reading. He has a social personality and a remarkably good sense of humor.

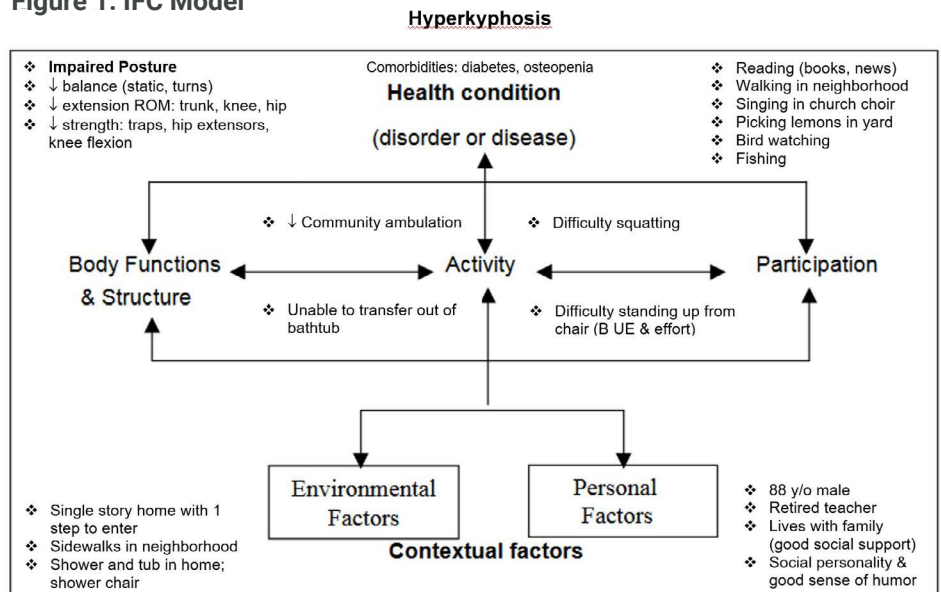
All components of the history and interview were placed in the ICF model for a pictorial view of the patient as a whole person and the areas of his life influenced by hyperkyphosis.<sup>1</sup> See Figure 1.

### Initial Measures

**Posture:** Forward head, rounded shoulders, hyperkyphosis, forward trunk lean, right lateral trunk lean, and increased hip, knee, and dorsi-flexion. Photos were taken with the patient facing forward (frontal view) and a sagittal view.

**Height:** 166.3 cm using wall stadiometer. Patient was unable to put his heels against the wall. A 2x6 board was placed on the floor against the wall and with patient heels

Figure 1: ICF Model



against the board. This modification allowed the patient to feel balanced as well as providing a consistent measurement method. [See an instructional video on height measurement modification.](#)

**Flexicurve:** usual posture measured in standing. Flexible ruler tracing used to calculate the Kyphotic index (KI).  $KI = \text{Thoracic Width (W)} / \text{Thoracic Length (TL)} * 100$ .  $KI = 12.16$ .<sup>2</sup>

**Block Test:** measured in supine by stacking blocks under the head until the plane of the face is parallel with the table. This test was modified by using blocks of different thicknesses to achieve the most level facial plane. Block measured 7.7 cm. [See an instructional video of modification to block test.](#)

**Functional Reach:** Patient performed a practice trial and then 2 trials that were averaged for a result of 6.6 in.

**TUG test:** Patient performed a practice trial and then 3 trials that were averaged for a result of 13.3 seconds. He was allowed to use his cane.

**PROM:** All measures taken in supine. Shoulder flexion 170°, Hip extension lacking 6° from neutral, Knee extension lacking 5° from neutral, Popliteal angle (hamstring length) 115°.

**Strength:** Shoulder flexion 5/5, Prone scapular hori-

zontal adduction 4-/5, Prone hip extension 4-/5, Knee extension 4+/5, Knee flexion 4-/5, Standing calf raises (bilateral) 25/25 reps.

**Joint and soft tissue mobility:** Cervical (upglide, downglide, and lateral glide), thoracic (PA springing), and lumbar spine (PA springing) were hypomobile. The rib cage (general springing) including the first rib (inferior glide), and the general mobility of the hip and knee were all hypomobile. The following muscle groups were found to be tight and short: suboccipital, sternocleidomastoid (SCM), scalene, pectoralis minor, iliopsoas, and hamstrings.

**Sensation:** Using a Semmes – Weinstein 5.07 (10 gram) monofilament on the standard locations for diabetic neuropathy on the plantar surface of the foot, the patient detected 2 of 9 trials correctly.

**Gait:** Gait parameters were collected using a 14-foot Gaitrite™ walkway. Patient was instructed to walk at his usual pace and was allowed to use his cane. Patient was given one practice trial; then 3 trials were averaged. Left and right measures of step length (SL) and heel to heel base of support (H-H BOS) were averaged. Velocity (V) was also recorded. The results were SL = 38.65 cm, H-H BOS = 18.73 cm, and V = 0.8 m/s.

## Assessment

Art is an active older adult with flexed posture and lateral trunk lean. He was unable to achieve upright standing against the wall due to a feeling of falling forward when he attempted to back his heels against the wall. When a 2x6 board was placed between the wall and his heels, he reported feeling balanced over his feet to allow for height measurement. Patient's usual functional level was ambulation community distances with a cane. Functional reach of 6.6 inches placed him at a moderate risk for falls and was below the norm of 13.2 inches for men aged 70-87.<sup>3,4</sup> TUG score was just under the 13.5 second cut-off score for risk of falls.<sup>5</sup> However, he was slower than the mean TUG score of 9-11 seconds for his age and sex which may have indicated decline beyond age-related change.<sup>6</sup> Patient had slightly limited hip and knee extension with severely limited hamstring length. Additional impairments relevant to posture and function included weakness in middle trapezius, gluteal, and hamstrings. KI (12.16) was slightly above the median of 11 for men 80 years or older that may indicate greater kyphosis than typical for his age.<sup>7</sup> A block score of 7.7 cm (greater than 1.7 cm) indicated a forward head position that may also be associated with thoracic hyperkyphosis.<sup>8,9</sup> Art exhibited many of the signs of upper and lower crossed syndrome with a forward head, tight muscles: suboccipital, scalene, pectoralis, iliopsoas, hamstrings and inhibited muscles: mid trap, gluteal, quads and general stiffness of the joints.<sup>10</sup> Patient had impaired protective sensation in both feet secondary to diabetic neuropathy that may impact his balance and gait.<sup>11</sup> Gait parameters showed a wide BOS and velocity of an intermediate gait speed.<sup>12</sup>



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### Treatment and Intervention

Art received treatment 3x/week for 4 weeks from a PT with manual therapy certification. Each treatment session was 30 minutes to an hour in duration. He received a combination of joint mobilizations, myofascial release, passive stretching, and exercise that targeted his areas of joint stiffness, muscle tightness, and muscle weakness. Patient received the following joint mobilizations at a grade III or IV to improve mobility: PA rib mobilization, first rib depression, clavicular mobs – inferior and superior glides, scapular glides, posterior glenohumeral glides, cervical downglides and distraction, thoracic PA and screw home mobilizations, hip mobilizations – anterior, lateral, and long axis distraction. Soft tissue mobilization (STM), proprioceptive neuromuscular facilitation (PNF), and/or passive stretching (PS) were applied to the suboccipitals (STM), SCM (STM), scalenes (STM), erector spinae (STM and PS), upper traps (PNF and PS), pec minor (STM and PNF), hip flexors (PNF), hip adductors (PS), and hamstrings (PNF). Active and elastic band resisted exercise were performed by the patient for 1-2 sets of 10 reps to activate the muscles through their new available range of motion. Physical and verbal cueing for proper movement, muscle activation, and stabilization were provided as needed. Exercises included scapular retraction with core activation, scapular rows, bear hugs for lower traps, punches with a plus, posterior pelvic tilts, single knee to chest, and clam shells with transverse abdominis activation. A selection of these treatments was adapted each visit according to the restrictions identified on that visit.

The same sequence of mobilize the joints, then lengthen the soft tissue, and lastly exercise in the new range was followed on each visit: Move it, then use it.

### Final Measures at 4 weeks

**Posture:** A/P view with minimal right lateral trunk shift. Sagittal view with a neutral pelvis and minimal forward head posture. See pre- and post-intervention photos in Figure 2.

**Height:** 168.4 cm (with 2x6 board between heels and wall)

**Flexicurve:** KI = 10.99

**Block Test:** 4.5 cm.

**Functional Reach:** 2 trials averaged = 8.9 in.

**TUG test:** Avg of 3 trials = 9.5 secs

**PROM:** Shoulder flexion 157°, Hip extension 5° (side lying), Knee extension 0°, Popliteal angle (hamstring length) 155°.

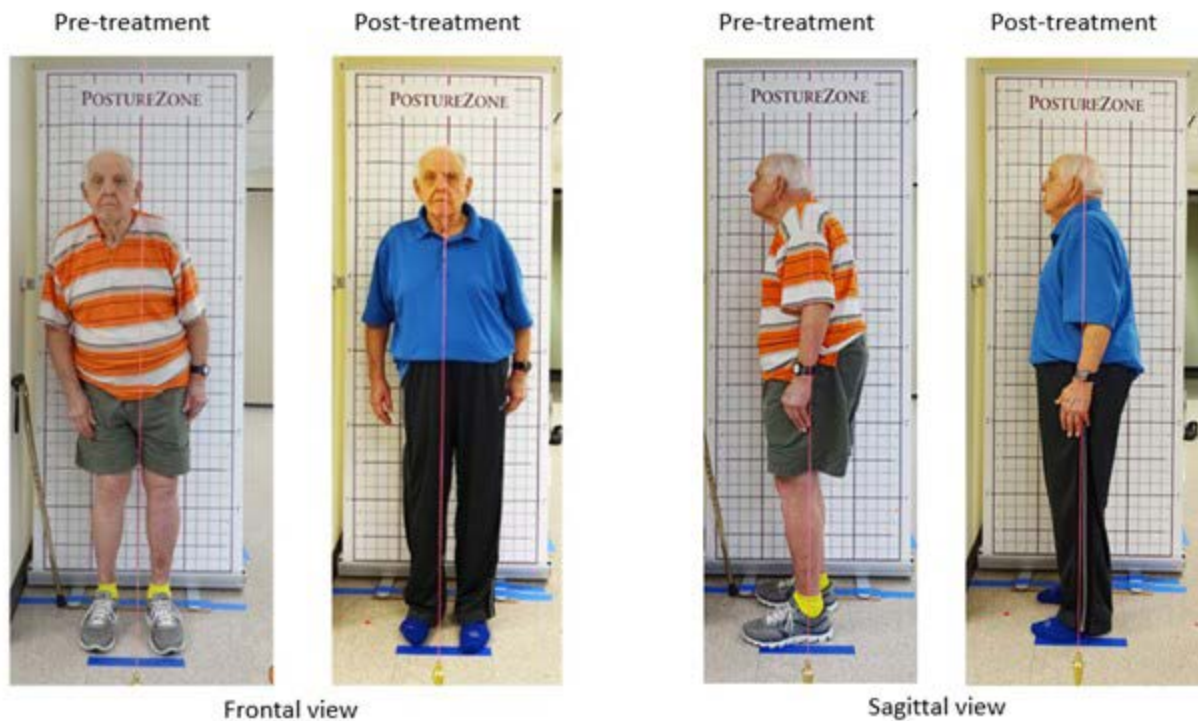
**Strength:** Shoulder flexion 5/5, Prone horizontal adduction 4/5, Prone hip extension 4/5, Knee extension 5/5, Knee flexion 5/5, Standing calf raises (bilateral) 25/25 reps.

**Joint and soft tissue mobility:** Spinal and rib cage mobility remained hypomobile with the greatest change occurring in the rib cage. Soft tissue mobility improved most notably in the suboccipitals, pectoralis minor, scalenes, and hamstrings.

**Sensation:** not re-assessed.

**Gait:** SL increased to 54.87 cm, H-H BOS narrowed to 11.42, and velocity increased to 0.93 m/s.

**Figure 2. Photographs Showing Pre- to Post-Intervention Change in Usual Posture**



**Table 1. Changes in Outcome Measures Pre- to Post-Intervention**

	Pre-intervention	Post-intervention	Change
Height (cm)	166.3	168.4	+2.1
KI	12.16	10.99	-1.17*
Block (cm)	7.7	4.5	-3.2
Functional Reach (in)	6.6	8.9	+2.3
TUG (secs)	13.3	9.5	-3.8*
ROM Shoulder Flex (°)	170	157	-13
ROM Hip Ext (°)	Lacking 6 from neutral	5	+11
ROM Knee Ext (°)	5	0	+5
ROM Popliteal angle (°)	115	155	+40
MMT Shoulder Flex	5/5	5/5	0
MMT Scapular Prone Horizontal Adduction	4-/5	4/5	+5
MMT Hip Extension	4-/5	4-/5	0
MMT Knee Extension	4+/5	5/5	+5
MMT Knee Flexion	4-/5	5/5	+1.5
SL (cm)	38.65	54.87	+16.22*
H-H BOS (cm)	18.73	11.42	-7.43*
V (m/s)	.80	.93	+13*

\*change greater than MDC

## Summary/Discussion

This patient case illustrates that PT can make an improvement in impairments and function associated with age-related hyperkyphosis using manual therapy and exercise in a 4-week time frame. Observation of postural pictures demonstrates a dramatic change in this patient's forward head and lateral trunk lean. The lateral lean was not addressed during treatment other than ensuring that the patient lie in a straight position. Improvements occurred in most measures; reflected in the change scores in Table 1.

Height increased by nearly an inch which indicates an improvement in posture that is both observed and is evident in the improved KI and Block test that reflect change in thoracic kyphosis and forward head position. The flattening of the thoracic kyphosis as seen in the decrease in KI of 1.17 or 9.6% change is greater than the .73% MDC.<sup>13</sup> The improvement in Functional Reach and TUG may indicate better balance and a decrease in fall risk for Art. Shoulder flexion ROM showed a decrease

of 13°. There is not an obvious reason for the range to lessen. However, the treatment may have changed the position of the scapula on the trunk and rib cage and indirectly affected the ROM. Hip extension increased by 11° and may have allowed a more neutral pelvic position seen on photos. The hamstring length showed a big gain of 40°. Improved hip extension and hamstring length may be hypothesized to influence step length and gait speed and indeed, a clinically significant increase was seen in these parameters. TUG speed also improved by 3.8 secs which is greater than the MDC of 2.08 sec for community-dwelling older adults.<sup>14</sup> The hamstring strength also demonstrated a notable increase that would not be expected in only 4 weeks. The gain in MMT may be due to better muscle activation, with increased range, and better positioning. Gait parameters all improved more than the MDC. SL increased by 16.22 cm (MDC of 4.7 cm), H-H BOS decreased by 7.43 cm (MDC = 2.0 cm), and V increased by .13 m/s (MDC is 0.1 m/s).<sup>15,16</sup> Overall, Art showed improvement in alignment, function, gait, lower extremity strength (muscle activation) and range of motion.

There is a body of evidence that hyperkyphosis has a multidimensional impact seen through examining a diversity of outcome measures including spinal alignment, trunk strength, endurance, physical activity, function, mental health, quality of life, and mortality.<sup>9,17-22</sup> Subtle postural changes over time may be a barrier to older adults recognizing that hyperkyphosis affects their daily function and participation in activities. Patients typically seek PT treatment when pain becomes an issue rather than seeking help to prevent or improve posture.

Katzman et al has established that exercise and postural training are effective in reversing hyperkyphosis with long term (3-year) effects after a 12-week intervention; thus, building evidence that PT can reverse and maintain a difference in hyperkyphosis.<sup>23</sup> This evidence shows that PT should be treating patients with hyperkyphosis and perhaps even older individuals that are beginning to demonstrate postural changes to prevent the usual progression of kyphosis expected with ageing. In doing so, we may be able to prevent or slow the associated decline in physical function, health, and self-image. PT has an opportunity to make a significant impact on maintaining posture, physical function, and independence in an ageing population. Our profession should seek to promote physical therapy as a positive alternative to the bias of poor posture being a normal consequence of ageing.

Art's case illustrates the multifaceted relationship of age-related hyperkyphosis on alignment, joint and soft tissue mobility, function, and balance. The ICF model applied to this patient's interview clearly illustrates the influence of hyperkyphosis on different aspects of life that posture may influence. This patient case illustrates a novel approach of combining manual therapy with exercise for a short, 4-week clinically feasible timeframe.

There is a continued need for further randomized control trials to standardize effective treatments for hyperkyphosis and substantiate the impact that PT can make on alignment, function, gait, activities, and participation in life roles associated with posture that can be seen both in the short and long term.

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