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Review

Postural Correction and Functional Gains in Adults with Kyphotic Progression

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Abstract

Adults often have thoracic hyperkyphosis, which tends to worsen with age and causes pain, poor gait and balance, pulmonary restriction, a decreased quality of life, and an increased risk of falls. Conservative methods of improving posture and function, such as technology-enabled rehabilitation yoga, bracing, taping, and three-dimensional postural exercises targeted at spinal extensor strengthening, have gained popularity. With a focus on adults with age-related or postural hyperkyphosis, as well as those whose kyphotic progression cannot be attributed to acute trauma or neoplasm, this narrative review summarizes data from systematic reviews, cohort studies, and randomized and controlled trials published mostly since 2010. Structured kyphosis-specific exercise and posture training over a period of three to six months shows the strongest and most consistent signal of benefit, with improvements noted in self-image, some functional outcomes, and radiographic and clinical kyphosis measures. While telerehabilitation holds promise for access and adherence, adjuncts like spinal orthoses and temporary taping may have immediate or short-term effects on alignment and balance. The longevity of correction, the best dosage and program content, and the degree to which postural modification results in clinically significant improvements in respiratory function, fall prevention, and long-term disability prevention are among the unanswered questions. Multicenter trials with standardized outcomes, extended follow-up, and implementation strategies across various care settings should be given priority in future research.

Keywords: *Hyperkyphosis, postural kyphosis, kyphosis exercise, spine extensor strengthening, orthosis, telerehabilitation, pulmonary function*

Introduction

Thoracic Hyperkyphosis is one of the most prevalent spinal abnormalities in adults, characterized by an excessive anterior curvature of the thoracic spine (1, 2). Whereas mild kyphosis represents a normal feature of spinal anatomy, progressive hyperkyphosis extends beyond physiological limits and attains clinical significance (3, 4). In older populations, prevalence estimates range from 20% to 50% with women more likely to be impacted because of higher rates of osteoporosis and vertebral fractures (5). However, kyphotic progression is not limited to older adults; sedentary lifestyles, repetitive forward-flexed activities, or underlying musculoskeletal conditions can cause posture-related thoracic deformity in adults of all ages (6). The effects are extensive, impacting not only spinal alignment but also respiratory health, balance, physical function, and general quality of life (2, 7-9). Kyphotic progression has a complex pathophysiology (10). In addition to weakening spinal extensor muscles and bad posture, age-related disc degeneration and vertebral wedging cause the trunk to gradually shift forward. In the worst cases, the progression of curvature is accelerated by osteoporosis and vertebral compression fractures (11, 12). Because the trunk is mechanically moved, sagittal balance is altered, and the lower extremity muscles are placed under greater strain to maintain postural stability. Increased double-limb support, shorter strides, slower gait speed, and a decreased capacity to recover from balance disturbances have all been connected to this (13). Therefore, adults with severe kyphosis are more likely to fall and sustain fractures from falls, which increases morbidity and medical expenses (14).

Hyperkyphosis has physiological effects on respiratory health (15). A larger thoracic curvature limits the expansion of the rib cage, impairs diaphragmatic function, and lowers pulmonary capacity (16). According to longitudinal cohort studies, individuals with a larger thoracic curvature experience an accelerated decline in vital capacity and forced expiratory volume (17). As functional limitations, dyspnea and exercise intolerance may manifest, highlighting the systemic effects of postural deformity (18). In addition to physical symptoms, psychosocial consequences are frequent. People often express dissatisfaction with their appearance, experience diminished self-esteem, and feel social disconnection, all of which negatively impact their quality of life (19, 20).

Treatment options for thoracic hyperkyphosis include conservative measures for progressive but adaptable postural conditions and surgical intervention for severe structural deformities (21). However, surgery is typically saved for cases involving rigid deformity, intractable pain, or neurologic compromise (22). The cornerstone of treatment for most adults, particularly those with gradual kyphotic progression, is conservative measures like exercise, postural re-education, and supportive orthoses (23, 24). Interest in focused therapies that enhance functional outcomes, such as gait balance and respiratory function, in addition to reducing the kyphosis angle, has increased recently (25). Research from randomized and controlled trials suggests that telerehabilitation yoga, three-dimensional postural exercises, and structured spine-extensor strengthening can lead to significant functional benefits and postural correction (26-29). It has been demonstrated that adjunctive techniques, such as dynamic orthoses and proprioceptive taping, improve awareness and offer instant alignment cues in hyperkyphosis (30).

This review summarizes the most recent research on postural correction for adults with kyphotic progression, focusing on functional improvements that go beyond alignment. It examines the pathophysiological basis for intervention, assesses the evidence from clinical trials supporting exercise and supplementary techniques, and considers issues related to generalizability, implementation, and durability. The review identifies gaps that require further research while highlighting how targeted postural correction can alleviate physical and psychological burdens by incorporating findings from recent literature.

Methods

This narrative review highlights recent research on postural correction and functional outcomes in

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adults with kyphotic progression. For studies published mainly between 2010 and 2025 a literature search was carried out in PubMed, Cochrane Library and Scopus using keyword and MeSH terms used such as “hyperkyphosis” “thoracic kyphosis” “postural kyphosis” “kyphosis exercise” “spine extensor strengthening” “Schroth” “orthosis” “taping” “telerehabilitation” “gait” “balance” “falls” and “pulmonary function. To find more pertinent reports, the reference lists of important studies and reviews were manually searched. Randomized controlled trials, controlled clinical trials, cohort studies, and systematic or narrative reviews that documented adult populations with age-related or postural hyperkyphosis, Scheuermann-related deformity that persisted into adulthood, or non-operative kyphotic progression were all considered eligible publications. Targeted exercise and posture training, Schroth-based, or other three-dimensional corrective exercises, yoga, orthoses, or external taping, and remote or technologically assisted rehabilitation were among the interventions of interest.

Discussion

Kyphotic Progression, Physiologic Burden, and the Justification for Postural Adjustment

A structural and functional alteration of the thoracic spine, such as hyperkyphosis, has a cascading effect on respiratory, musculoskeletal, and functional health. It is not just a matter of appearance or posture. Although kyphosis usually develops gradually in adulthood, it can worsen in the presence of osteoporosis, vertebral compression fractures, degenerative disc changes, and weakness in the spinal extensor muscles (31). Significantly habitual forward-flexed postures and mild anterior vertebral wedging contribute to cumulative deformity even in the absence of a fracture. The body's center of gravity is moved anteriorly by excessive thoracic curvature, which also pushes the trunk mass forward of the pelvis (32). The mechanical demands placed on the hip extensors, knee extensors, and ankle plantar flexors during standing and walking are increased by this changed sagittal alignment. Hyperkyphotic adults have been shown in clinical studies to have slower walking speeds, shorter strides, and greater double-limb support, markers that are highly predictive of fall risk and functional decline (13, 33). In addition to making it more difficult to use balance-recovery techniques, forward trunk inclination increases the risk of falls and the severity of injuries (2). Kyphotic progression also affects respiratory function. The diaphragm's mechanics are changed, the thoracic cavity is compressed, and rib cage expansion is limited by greater thoracic curvature (34). Longitudinal cohort analyses verify that adults with more severe kyphosis, especially women, suffer steeper declines in vital capacity and forced expiratory volume (FEV1) (35). This implies that there is a biologically tenable connection between pulmonary morbidity and spinal posture. Even though dyspnea is frequently multifactorial, kyphotic progression may be a neglected factor in older adults who experience exertional dyspnea for other reasons (36). Psychosocially speaking, kyphotic posture is linked to a negative body image, social disengagement, and a decreased sense of confidence in one's ability to move around daily (37, 38). In addition to affecting comfort and function, hyperkyphosis also affects identity as patients perceive themselves as frail or prematurely aged(39, 40). Therefore, posture-focused interventions have the potential to increase quality of life, lower the risk of falls, and improve functional independence (41).

Support for Multimodal and Exercise-Based Postural Correction

The most reliable and clinically significant research on kyphotic progression is focused on organized exercise-based therapies. Randomized controlled trials (RCTs) have shown that specific postural training and spine strengthening regimens can lessen the severity of kyphosis and enhance associated functional outcomes. The SHEAF trial (Study of Hyperkyphosis Exercise and Function) is still regarded as a seminal RCT (42). The six-month program, which involved posture-focused functional tasks, scapular stabilizer training, and spinal extensor strengthening, was implemented with older adults living in the community. The findings showed improvements in self-image and physical performance metrics as well as significant

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decreases in clinical kyphometer and radiographic Cobb angle measures of kyphosis (42). Even in older populations, progressive overload plays a role in musculoskeletal adaptation, as evidenced by follow-up analyses that indicated adherence and exercise intensity were important factors influencing benefit. Interventions based on yoga have also been investigated with varying degrees of success (43, 44). In an RCT, after a 6-month yoga program, participants flexicurve-measured kyphosis decreased somewhat, and they also experienced improvements in their physical performance and posture awareness (43). In addition to alignment-focused benefits, yoga may also help with respiratory mechanics, balance, confidence, and spinal mobility (45). Three-dimensional corrective exercise methods are becoming increasingly popular, such as kyphosis-adapted Schroth-based protocols (46). These prioritize rotational breathing, postural derotation, and active spinal elongation. Schroth treatment has been linked to quantifiable decreases in thoracic angle as well as improvements in pain and body image in adults with Scheuermann's kyphosis (46). Although sample sizes are still small, more recent trials in adults with postural hyperkyphosis indicate significant effects on kyphotic angle reduction and improved quality of life (46). When compared to generic exercise prescriptions, Schroth-based therapy's superior results may be explained by its intensity and customized instruction. The postural correction toolkit is expanded by adjunctive modalities. Spinal orthoses, especially dynamic active models like Spinomed, stimulate the activation of spinal extensors during daily activities by providing resistive feedback (47). In the short term, trials show gains in balance and gait speed as well as instantaneous improvements in upright posture (48, 49). However, there are still concerns regarding comfort, sustainability, and long-term adherence after the device is taken off. Orthoses might be the most effective transitional aids, enhancing exercise in the initial stages of recovery. Techniques for elastic taping are also effective in the long term in the elderly (50). According to studies, applying the device immediately reduces thoracic kyphosis and improves balance, most likely as a result of improved proprioceptive feedback. It could be a cheap supplement to exercise, especially for people who have trouble paying attention to their posture. One new area is rehabilitation made possible by technology. Trials of telerehabilitation that include respiratory and corrective exercises that are administered remotely have shown improvements in chest expansion, kyphosis, craniovertebral angle, and health-related quality of life (51, 52). For elderly individuals who have limited access to in-person therapy, these findings are particularly pertinent. Though their clinical validation is still being developed, digital tools like posture sensors and app-based feedback systems may improve self-monitoring and adherence even more (53, 54). The body of research backs up the idea that structured multimodal programs can result in function improvements and small but clinically significant kyphotic angle reductions. Evidence from exercise orthoses, taping, and technology has come together to highlight the importance of a holistic strategy that concurrently addresses muscle strength, proprioception, mobility, and behavioral adherence.

Durability, Functional Translation, and Issues with Implementation

Although there is encouraging evidence for short- to medium-term improvements, it is still unclear how long postural correction will last. Relatively few trials last longer than six months, with the majority lasting six to twelve weeks. The six-month results of the SHEAF trial indicate that longer-term supervised training produces more substantial and long-lasting effects; however, maintenance following program termination is rarely examined (42). The integration of posture awareness into daily routines and sustained spinal extensor strengthening is likely to be necessary for long-term correction. Gains may regress in the absence of reinforcement, which is similar to trends observed in other areas of musculoskeletal rehabilitation. One important clinical outcome is the functional translation of postural correction. Secondary analyses of short-term physical therapy programs show that even small posture adjustments can improve recovery strategies for balance, decrease the amount of time spent in double-limb support, and increase gait

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speed (55). These modifications fit the mechanisms that connect instability and forward trunk inclination. Although fall reduction is a crucial public health outcome, it hasn't been proven in interventional studies. Large-scale long-duration studies are necessary to detect changes in fall incidence, which are limited by comparatively small sample sizes and brief follow-ups. Relationship between Thoracic Kyphosis and Selected Cardiopulmonary Parameters and Respiratory Symptoms of Patients with Chronic Obstructive Pulmonary Disease and Asthma (56, 57).

Subjective breathing ease and chest expansion are improved by interventions that incorporate expansion breathing exercises with corrective postures such as Schroth or yoga-based programs. Trials of telerehabilitation that include respiratory exercises also show improvements in quality of life. There is currently insufficient proof, however, that postural correction slows the decline in FEV1 or avoids respiratory problems. Confirmation of these effects requires rigorous trials with spirometric results. Adherence, accessibility, and population customization are implementation challenges. Due to comorbidities, pain phobia, or restricted mobility, older adults may find it difficult to comply with exercise regimens (58). Although they can offer external cues, orthoses and taping cannot replace active conditioning. Scalability is a benefit of telerehabilitation, but safety and digital literacy issues are raised for unsupervised balance training. Additionally, the majority of the evidence is from women who live in the community, underrepresenting men, institutionalized elders, and working-age adults. In order to guarantee generalizability, future research must expand the inclusion criteria. Lastly, synthesis is hampered by inconsistent outcome measurement. The functional outcomes range from spirometry to gait speed to fear of falling, and radiographic Cobb angles, kyphometer measures, and flexicurve indices capture various facets of sagittal alignment. It would improve comparability across trials and fortify the evidence base to establish a standardized core outcome set that includes respiratory indices, key functional tests, one radiographic or validated clinical measure, and patient-reported outcomes.

Conclusion

Adults with kyphotic progression benefit clinically from exercise-based postural correction according to recent research. When incorporated into functional activities and administered over a minimum of three to six months, targeted spinal extensor strengthening and posture training can improve self-image, lessen the severity of kyphosis, and improve gait and balance, according to new research. While orthoses and taping offer short-term alignment and balance benefits, they are best used as conditioning adjuncts. Schroth-inspired three-dimensional exercises and yoga provide additional frameworks. The longevity of correcting the extent of functional translation, especially with regard to fall prevention and pulmonary outcomes, and the best dosage content and delivery method, is still unknown despite these developments. Multicenter randomized trials with extended follow-up and standardized clinically meaningful outcomes should be given priority in future research, as should implementation studies that focus on adherence, access, and personalization across a range of adult populations. Clinicians can provide patient-centered programs that aim to straighten the spine and restore function and confidence in daily life by judiciously combining progressive extensor strengthening, mobility and breathing exercises, sensorimotor retraining, and the intelligent use of cueing devices.

Disclosure

Conflict of interest

There is no conflict of interest.

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Ethical consideration

Non applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

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Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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