# Comparison of the Static and Dynamic Balance Performance in Young, Middle-aged, and Elderly Healthy People

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**Background:** Body sway increases with age. The purpose of this study was to obtain baseline data and the characteristics of balance performance in different age groups for balance strategy management.

**Methods:** Healthy individuals (n = 107) were divided into young, middle-aged, and elderly groups, and assessed by computerized dynamic posturography (CDP) on a Smart Balance Master. The 6 subtests in the sensory organization tests (SOT) for the CDP were as follows: subtest 1, eyes open, fixed support platform; subtest 2, eyes closed, fixed platform; subtest 3, eyes open, fixed platform; subtest 4, eyes open, swaying platform; subtest 5, eyes closed, swaying platform; subtest 6, swaying visual surround, swaying platform. Motor balance control tests included the limit of stability (LOS) test at 75% of LOS in 8 directions and the left/right and forward/backward rhythmic weight shift (RWS) test.

**Results:** In the SOT, the elderly group demonstrated significantly lower average stability and maximal stability scores in subtests 4-6. This group also demonstrated a relatively lower average percentage of ankle strategy in subtests 4-6. In the motor control tests, the elderly group demonstrated a significantly higher overall reactive time and lower overall directional control in the LOS test, lower on-axis velocity during the forward/backward and left/right motor control test and a lower average percentage of forward/backward directional control in the RWS test.

**Conclusion:** The elderly had a higher degree of postural imbalance and used hip strategy to a greater extent to maintain their balance, especially when standing on a swaying support surface in the absence of visual surround or with conflicted visual surround. The elderly required a longer reaction time and demonstrated lower directional control in balance performance.

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**Key words: computerized dynamic posturography, balance test, sensory organization test, motor control test**

Postural sway increases with age.[1-5] Hence, it is important to study the changes in postural balance that occur with aging. In 1963, Sheldon studied the changing pattern of unsteadiness with age and

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reported that optimal control of postural sway is achieved during late adolescence and maintained until about the age of 60 years.[1] Rubenstein et al also reported that the risk of falls increases beyond 60 years of age.[2] In 2006, Era et al measured the postural balance of 7979 subjects who were 30 years old and over using a force platform and found that deterioration in balance function clearly started at a relatively young age and was accelerated from about 60 years onward.[3] Deterioration in postural control in elderly populations can be proved or explained by impaired cognitive function,[4-7] decline in sensory input such as visual, vestibular, and somatosensory input, decline in motor responses, and deterioration in sensory integration systems and other musculoskeletal and neuromuscular systems, resulting in decreased muscle strength, impaired knee or plantar reflexes, slow reaction time, and decreased efficacy of protective movement.[4,6-13]

Computerized dynamic posturography (CDP) can quantify an individual's change in body position and movement control when maintaining static and dynamic balance by eliminating or sway-referencing one's visual surround, or conflicting somatosensory input by using a swaying support surface to evaluate the ability to maintain an upright posture. In the present study, we used the sensory organization tests (SOT) of CDP to quantify subjects' motor response under 6 different sensory conditions. Motor response was also assessed based on 2 dynamic standing balance tests, the limits of stability (LOS) test and the rhythmic weight shift (RWS) test, which showed how well an individual could lean or shift weight over a stable support surface.

The purpose of this study was to compare the balance characteristics among different age groups using CDP. These data could provide clinicians with normal references of stability for patients with balance disorders.

## METHODS

### Subjects

The study population was comprised of 107 healthy subjects between 16 and 80 years old. The exclusion criteria included neuromuscular and musculoskeletal diseases such as stroke, Parkinson's disease, symptoms of unsteadiness, dizziness or vertigo, impaired sensory function, arthritis, uncorrected visual problems, and postural hypotension. Those taking medication such as sedatives, hypnotics, anxiolytics, and antidepressants were also excluded. The study population was comprised of 27 males and 80 females and was divided into 3 groups, young (16-39 years old), middle-aged (40-59 years old), and elderly (60-80 years old).

### Instruments

Computerized dynamic posturography was used to measure the static and dynamic changes in balance performance using a Smart Balance Master (NeuroCom International, Inc., Clackamas, OR, U.S.A.)

### Assessment procedures

Basic data, including body height (BH) and body weight (BW), and the SOT scores on the CDP were obtained for all subjects. During the SOT, the subject first stood upright and as steadily as possible on a movable platform facing a visual surround. For subtest 1, the subjects stood on a fixed platform with their eyes open; for subtest 2, they stood on a fixed platform with their eyes closed; for subtest 3, the subjects' visual surround was swayed and they stood on a fixed plateform, and the subjects had to maintain vertical balance; for subtest 4, the subjects opened their eyes and the platform was swayed; for subtest 5, the subjects closed their eyes and the platform was swayed; and for subtest 6, the subjects' visual surround and the platform surface were swayed. Only 1 trial was performed for subtests 1 and 2, and 3 trials were performed for subtests 4-6; each trial lasted 20 seconds. During subtest 1, vision and somatosensory inputs were permitted; during subtest 2, visual inputs were absent. Subtests 1 and 2 measured the patients' baseline stability. In subtest 3, the visual surround was conflicted, while in subtest 4, only somatosensory input was conflicted. In subtest 5, the visual surround was eliminated and the somatosensory input was conflicted, and in subtest 6, the visual surround and somatosensory inputs were conflicted; in this subtest, the vestibular system was isolated.

### Data analysis

The indices of the SOT were average stability scores, maximal stability scores (expressed as percentages), and the percentage of ankle strategy (expressed as percentages). A maximal stability score of 100% implied the highest stability, while a score of 0 implied the least stability. The ankle strategy scores ranged from 0% to 100%. A score of 100% implied a predominance of ankle strategy and 0 implied a predominance of hip strategy.

The indices of the RWS test were on-axis velocity (degrees/second) and the percentage of directional control with both left/right and forward/backward rhythmic weight shifting at 50% of LOS. LOS was defined as the maximum distance that a person can lean in a certain direction without losing balance. On- axis velocity showed the speed of center of gravity (COG) movement in the intended direction. Directional control referred to all COG movement in the intended direction without extraneous movement. A perfect directional control score equaled 100%.

The indices of the LOS tests were reactive time (seconds) and the percentage of dynamic control balance at 75% LOS in 8 directions. The directional control scores were a comparison of the amount of movement in the intended direction to the amount of extraneous movement. They were expressed as percentages. High directional control scores close to 100% were good. Directional control scores were a reflection of a patient's movement coordination.[10,16-18] Body mass index (BMI) was also calculated.

**Statistical analysis**

Group differences for continuous patient data (age, BH, BW, and BMI) were compared by analysis of variance (ANOVA) with Dunnett's T3 post-hoc test for multiple comparisons. Repeated measures ANOVA was used to compare the within subject variations (among the three trials in each subtest) for subtests 3-6. The maximum values of the 3 trials in subtests 3-6 were selected for further data analysis due to significant variability between these 3 trials in each subtest. Group differences in the indices of the balance test were compared by analysis of co-variance (ANCOVA), adjusted by co-variance (BMI), with least significant differences for multiple comparisons. Gender differences among the groups were calculated by a chi-square test. A $p < 0.05$ was considered statistically significant.

## RESULTS

Subject data are listed in Table 1.

The elderly group had the lowest average scores for maximal and average stability in all SOT subtests. The average stability score of 67.6 ± 6.5 in the elderly group was statistically different from those of the other groups (vs. 76.3 ± 5.7 young group, $p < 0.01$; vs. 69.9 ± 5.8 middle-aged group, $p < 0.05$). The average maximal stability scores of the elderly group were also significantly different from those of the young group in subtests 4-6 (79.0 ± 9.0 vs. 87.6 ± 6.9, $p < 0.001$ in subtest 4; 64.7 ± 13.6 vs. 74.9 ± 8.0, $p < 0.001$ in subtest 5; 59.4 ± 14.5 vs. 72.0 ± 11.6, $p < 0.001$ in subtest 6, respectively). There were also statistical differences between the middle-

**Table 1.** Data of Healthy Subjects in Three Age Groups

| Group<br>Number of subjects (n) | Group A<br>Young (n = 45) | Group B<br>Middle-aged (n = 27) | Group C<br>Elderly (n = 35) | Total<br>(n = 107) | *p*-value |
|---|---|---|---|---|---|
| Age (years) | 16-39 | 40-59 | 60-80 | 16-80 | AB, AC, BC |
| Mean ± SD | 25.2 ± 5.6 | 50.9 ± 5.7 | 67.4 ± 5.3 | 45.5 ± 19.3 | $p < 0.0001$ |
| Sex | 13: 32 | 7: 20 | 7: 28 | 27: 80 | 0.601 |
| (female) | (68.9%) | (74.1%) | (77.1%) | (72.9%) | |
| Body height (cm) | 162.1 ± 8.2 | 158.4 ± 6.8 | 156.2.0 ± 7.1 | 159.2.0 ± 7.9 | AC, $p < 0.005$ |
| Body weight (kg) | 55.0 ± 12.5 | 57.4 ± 8.4 | 56.9 ± 9.5 | 56.3 ± 10.5 | 0.605 |
| Body mass index | 20.9 ± 3.5 | 22.9 ± 3.3 | 23.3 ± 3.3 | 22.2 ± 3.5 | AC, $p < 0.01$ |

**Abbreviations:** AB: significant differences between groups A and B; BC: significant differences between groups B and C; AC: significant differences between groups A and C.
Values are expressed as mean ± SD or n (%); One-way ANOVA test with post hoc Dunnett's T3 multiple comparisons was performed.

aged and young groups (81.7 ± 8.9 vs. 87.6 ± 6.9 $p < 0.01$ in subtest 4; 65.0 ± 10.4 vs. 74.9 ± 8.0, $p < 0.01$ in subtest 5; 65.1 ± 11.0 vs. 72.0 ± 11.6, $p < 0.01$ in subtest 6, respectively) (Table 2). The elderly group had the lowest percentages of ankle strategy in subtests 4-6 (81.1 ± 8.5 vs. 86.4 ± 5.7 in the young group, $p < 0.001$, and vs. 84.6 ± 4.6 in the middle-aged group, $p < 0.01$ in subtest 5; 79.7 ± 9.2 vs. 86.4

**Table 2.** Maximal and Average Stability on the SOT in the Three Age Groups

| SOT condition Average % maximal stability scores | | No of trials | Group A Young | Group B Middle-aged | Group C Elderly | *p*-value |
|---|---|---|---|---|---|---|
| Vision | Support | | | | | |
| Eyes open | | 1 | 91.7 ± 05.4 | 92.8 ± 02.6 | 91.0 ± 04.8 | 0.440 |
| Eyes closed | | 1 | 91.4 ± 04.6 | 90.8 ± 03.4 | 89.5 ± 04.2 | 0.104 |
| Swayed vision | | 3 | 93.1 ± 03.3 | 90.5 ± 03.9 | 89.5 ± 05.1 | 0.161 |
| Eyes open | Swayed support | 3 | 87.6 ± 06.9 | 81.7 ± 08.9 | 79.0 ± 09.0 | AB, $p < 0.01$<br>AC, $p < 0.001$ |
| Eyes closed | Swayed support | 3 | 74.9 ± 08.0 | 65.0 ± 10.4 | 64.7 ± 13.6 | AB, $p < 0.01$<br>AC, $p < 0.001$ |
| Swayed vision | Swayed support | 3 | 72.0 ± 11.6 | 65.1 ± 11.0 | 59.4 ± 14.5 | AB, $p < 0.01$<br>AC, $p < 0.001$ |
| | Average stability | | 76.3 ± 05.7 | 69.9 ± 05.8 | 67.6 ± 06.5 | AC, $p < 0.01$<br>BC, $p < 0.05$ |

**Abbreviations:** SOT: sensory organization test; AB: significant differences between groups A and B; BC: significant differences between groups B and C; AC: significant differences between groups A and C.
Values are expressed as mean ± SD or n (%); One-way ANCOVA test, adjusted for body mass index, with least significant difference multiple comparisons was performed.

**Table 3.** Ankle Strategy Scores on the SOT in the Three Age Groups

| Average % of ankle strategy | | No of trials | Group A Young | Group B Middle-aged | Group C Elderly | *p*-value |
|---|---|---|---|---|---|---|
| Vision | Support | | | | | |
| Eyes open | | 1 | 96.7 ± 1.9 | 97.5 ± 1.2 | 97.3 ± 1.4 | AB, $p < 0.01$<br>AC, $p < 0.05$ |
| Eyes closed | | 1 | 96.3 ± 1.8 | 96.7 ± 1.8 | 97.1 ± 1.7 | AC, $p < 0.05$ |
| Swayed vision | | 3 | 97.0 ± 1.4 | 97.2 ± 1.5 | 97.1 ± 1.5 | 0.033 |
| Eyes open | Swayed support | 3 | 92.0 ± 3.5 | 90.5 ± 3.8 | 88.3 ± 3.7 | $p < 0.001$ |
| Eyes closed | Swayed support | 3 | 86.4 ± 5.7 | 84.6 ± 4.6 | 81.1 ± 8.5 | AC, $p < 0.001$<br>BC, $p < 0.010$ |
| Swayed vision | Swayed support | 3 | 86.4 ± 4.2 | 83.7 ± 4.7 | 79.7 ± 9.2 | AC, $p < 0.001$ |

**Abbreviations:** SOT: sensory organization test; AB: significant differences between groups A and B; BC: significant differences between groups B and C; AC: significant differences between groups A and C.
Values are expressed as mean ± SD or n (%); One-way ANCOVA test, adjusted for body mass index, with least significant difference multiple comparisons was performed.

± 4.2 in the young, $p < 0.001$ in subtest 6) (Table 3). In addition, the motor control test at 75% of LOS tested in 8 directions revealed that there were significant differences in the overall reaction time between the elderly and young groups (0.9 ± 0.4 vs. 0.7 ± 0.2, $p < 0.001$), and in overall directional control (65.4 ± 14.7 vs. 78.4 ± 10.7, $p < 0.001$) (Table 4). The on-axis velocity during forward/backward movement was significantly different among the groups. The elderly group also had lower on-axis velocity during forward/backward and left/right dynamic balance control, and a lower average percentage of directional control in the forward/backward RWS test than the young group (Table 5). Five elderly subjects fell in subtest 5 and another 5 fell in subtest 6; only 5 persons from each of the young and middle-aged groups fell in the SOT.

## DISCUSSION

Dornan reviewed prior studies and reported that eye closure caused a greater increase in postural

**Table 4.** LOS Test at 75% LOS in 8 Movement Directions in the Three Age Groups

| Group | Reaction time (sec) | | | *p*-value | Directional control (%) | | | *p*- value |
|---|---|---|---|---|---|---|---|---|
| | Young | Middle-aged | Elderly | | Young | Middle-aged | Elderly | |
| F | 0.8 ± 0.7 | 1.1 ± 0.6 | 1.2 ± 0.6 | AC, $p < 0.05$ | 86.2 ± 12.6 | 81.2 ± 15.4 | 72.9 ± 26.7 | AC, $p < 0.05$ |
| RF | 0.6 ± 0.2 | 1.0 ± 0.5 | 1.1 ± 0.8 | AB, $p < 0.05$<br>AC, $p < 0.001$ | 80.2 ± 11.6 | 69.1 ± 18.7 | 64.3 ± 25.6 | AB, $p < 0.05$<br>AC, $p < 0.001$ |
| R | 0.5 ± 0.1 | 0.7 ± 0.4 | 0.9 ± 0.5 | AC, $p < 0.001$ | 85.1 ± 6.8 | 81.3 ± 10.3 | 82.7 ± 8.6 | AB, $p < 0.05$ |
| RB | 0.6 ± 0.3 | 0.9 ± 0.5 | 0.7 ± 0.4 | AB, $p < 0.01$<br>BC, $p < 0.05$ | 67.2 ± 18.7 | 62.2 ± 27.8 | 52.7 ± 46.3 | 0.051 |
| B | 0.6 ± 0.4 | 0.7 ± 0.4 | 0.7 ± 0.4 | 0.328 | 72.2 ± 28.9 | 68.5 ± 24.7 | 62.0 ± 35.1 | 0.380 |
| LB | 0.7 ± 0.4 | 0.7 ± 0.4 | 0.8 ± 0.4 | 0.936 | 67.4 ± 33.8 | 52.7 ± 29.8 | 48.9 ± 26.6 | < 0.001 |
| L | 0.7 ± 0.4 | 0.8 ± 0.4 | 0.9 ± 0.7 | 0.076 | 88.8 ± 5.4 | 87.0 ± 5.4 | 85.4 ± 9.2 | AC, $p < 0.05$ |
| LF | 0.8 ± 0.3 | 0.8 ± 0.4 | 0.9 ± 0.5 | 0.068 | 80.2 ± 10.5 | 70.2 ± 33.8 | 68.2 ± 22.6 | 0.133 |
| Average | 0.7 ± 0.2 | 0.8 ± 0.2 | 0.9 ± 0.4 | AC, $p < 0.001$ | 78.4 ± 10.7 | 70.8 ± 12.0 | 65.4 ± 14.7 | AC, $p < 0.001$ |

**Abbreviations:** LOS: limits of stability; F: forward; B: backward; R: right; L: left; AB: significant differences between groups A and B; BC: significant differences between groups B and C; AC: significant differences between groups A and C.
Values are expressed as mean ± SD or n (%); One-way ANCOVA test, adjusted for body mass index, with least significant difference multiple comparisons was performed.

**Table 5.** On-axis Velocity and Directional Control in Rhythmic Weight Shifting (LOS = 50%)

| Group | Forward/Backward | | | *p*-value | Left/Right | | | *p*-value |
|---|---|---|---|---|---|---|---|---|
| | Young | Middle-aged | Elderly | | Young | Middle-aged | Elderly | |
| On-axis velocity (deg/sec) | 3.4 ± 0.7 | 2.7 ± 0.9 | 2.0 ± 0.9 | AB, $p < 0.01$<br>AC, $p < 0.001$<br>BC, $p < 0.001$ | 5.1 ± 0.8 | 4.5 ± 1.2 | 4.2 ± 1.1 | AB, $p < 0.05$<br>AC, $p < 0.01$ |
| Directional control (%) | 74.1 ± 13.9 | 69.3 ± 16.0 | 61.7 ± 20.4 | AC, $p < 0.01$ | 81.8 ± 7.1 | 81.4 ± 6.1 | 81.8 ± 6.0 | 0.988 |

**Abbreviations:** LOS: limits of stability; AB: significant differences between groups A and B; BC: significant differences between groups B and C; AC: significant differences between groups A and C.
Values are expressed as mean ± SD or n (%); One-way ANCOVA test, adjusted for body mass index, with least significant difference multiple comparisons was performed.

sway velocity in elderly subjects than in young subjects.[19] In our present study, the elderly group had the lowest average maximal stability with eyes open and closed, and with swayed vision on a fixed support surface, but there was no statistically significant differences among groups. This finding was similar to that of Peterka and Black, who assessed 214 healthy subjects between 7 and 81 years old using posturography and found no age-related increase in the postural sway of subjects standing on a fixed support surface with their eyes open or closed.[20]

Age-related increases in sway have been reported under conditions involving altered visual or somatosensory cues.[11,15,20] Mirka et al reported that older subjects had a lower ability to maintain postural balance and needed to increase body sway in the absence of visual cues or with conflicting visual cues. Further, postural sway increased with additional movement of the support surface.[11] Wolfson tested 234 community-dwelling elderly subjects as well as 34 young controls using CDP and reported that elderly subjects demonstrated significantly greater sway under 5 of the 6 SOT conditions than young controls.[13] Baloh et al compared 82 community-dwelling subjects over 75 years old and 30 young controls and concluded that the difference in sway velocity between the young and elderly subjects was greater during dynamic posturography than static posturography.[14] Colledge et al investigated spontaneous sway in 74 healthy subjects using static posturography, with groups 20-40, 40-60, 60-70, and > 70 years old. In that study, all age groups depended more on proprioception than on vision to maintain balance. However, in the absence of reliable pressoreceptor information, dependence on vision increased.[8] In our study, the average maximal stability scores in the elderly were significantly different from those in the young in subtests 4-6, in which a subject's support surface was swayed. Those of the middle-aged group also differed significantly from those of the young group. Stelmach et al reported that the elderly demonstrated greater perturbation-induced sway and showed a slowing in the voluntary mechanism.[21]

Mirka and Black[11] investigated a normal population and reported that most falls during posturography occurred under conditions 3 and 6, suggesting a dependence on vision or sensitivity to altered visual cues. Our data showed that the majority of falls occurred under conditions 5 and 6. They suggested that since only vestibular input is available as an accurate orientation reference under conditions 5 and 6, there may be a deficit in vestibular function or possible central nervous system dysfunction when there is no adaptive response to simultaneously altered visual and somatosensory cues.[11]

Our study may have recorded fewer falls because we recruited healthy subjects who had not reported dizziness or medical illness. All our subjects were considered to have normal balance control for their age, although they could have had subclinical or presymptomatic diseases. Other possible reasons for falls in our study include visual impairment, loss of contrast sensitivity for detail, loss of sensitivity to flickering objects, impaired pursuit eye movement, vestibular degeneration,[22] generalized degeneration of the neuromuscular and sensory systems, such as loss of sensitivity in the peripheral sensory system, and reduced somatosensory perception, vibration sense, and joint position sense.[4,6-13]

Three movement strategies are most commonly used in response to anterior-posterior postural sway. In the ankle strategy, an individual shifts the body's COG by rotating the body about the ankle joints with minimal movement of the hip and knee joints. This strategy is used to correct small amounts of postural sway that occur as a result of slow, small perturbations on a firm wide surface. In the hip strategy, an individual changes the COG by flexing or extending the hips and activating the proximal muscles about the hip opposite the side of postural sway. This strategy is usually used for quick postural adjustment needed to correct larger, more rapid perturbations or when the support surface is small. When the support surface is moved backward, an individual usually bends forward at the hip, activating the abdominal and quadriceps muscles. In the stepping or hop strategy, which is used when the ankle and hip strategies are inadequate, an individual realigns the base of support during rapid or large perturbations.[10,16]

In the present study, the elderly group had the lowest percentages of ankle strategy scores in subtests 4-6 and scores decreased with increases in the difficulty of the subtest. There was a significant difference in the average percentage of ankle strategy employed between the elderly and young groups in subtests 5 and 6 and between the elderly and middle-aged groups in subtest 5 (Table 3). This implied that subjects needed to use more hip strategies to a greater extent under variable visual conditions while the support platform was swayed. On average, elderly subjects used hip strategy, and hip motion to a greater extent to maintain their postural balance when visual cues were absent and the reference support swayed, and when visual surround was conflicted and the reference support swayed. The elderly group demonstrated a longer reaction time in the LOS test and worse directional control in the RWS test than the young group.

Overall, the present study proved that postural sway increases with age and that all age groups found it difficult to maintain their balance with increases in the complexity of visual or/and somatosensory cues. In particular, elderly subjects, who used hip strategy to a greater extent to maintain their postural balance, found balance maintenance difficult. In addition, compared with the young group, the elderly group demonstrated reduced directional control and increased reaction time during the motor control test. Visual cue is an important stabilizing factor in maintaining balance. Furthermore, altered somatosensory cues from the support surface had considerable adverse effects on postural control.

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# 健康年輕、中年、老年人靜態和動態平衡的比較

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**背 景**：身體晃動隨年齡增加而增加。本文目的是測量不同年齡群的平衡穩定度及其特徵，以作爲復健平衡訓練的參考。

**方 法**：共收集 107 位健康者，年齡自 16 至 80 歲，27 位男性、80 位女性，分爲年輕組、中年組、老年組共 3 組，以電腦化動力姿態分析儀 (computerized dynamic posturography)，Smart Balance Master 測試平衡穩定度，包括感覺統合測試 (sensory organization test) 及兩項動作控制平衡測試：8 個不同方向在穩定度 75% 內的穩定度測試 (limit of stability test)，及向前向後、向左向右節律性轉移測試 (rhythmic shifing test)。感覺統合測試又分 6 個分測試，測試 1：雙眼張開、固定支撐平台 (fixed support surface)，測試 2：雙眼閉上、固定支撐平台，測試 3：前面視覺晃動、固定支撐平台，測試 4：雙眼張開、晃動支撐平台，測試 5：雙眼閉上、晃動支撐平台，測試6：晃動前面視覺、晃動支撐平台。

**結 果**：在感覺統合測試方面，老人組在分測試 4,5,6，其平均穩定度、最大穩定度百分比有顯著地降低，平均踝部策略百分比亦相對地降低。動作控制測方面，老人組的平均反應時間增長，平均方向控制百分比較低。在節律性轉移測試方面，老人組在向前向後、向左向右動作控制的平均軸心速度及向前向後的方向控制的平均百分比較低。

**結 論**：本研究證實老年人身體姿態晃動多於年輕人且使用較少踝部策略維持姿態穩定度，尤其當他們站立在晃動的支撐平台且其眼睛閉著或前面視覺晃動時；老年人反應時間和身體控制方向的平衡能力也相對降低。

(長庚醫誌 2009;32:297-304)

**關鍵詞**：電腦化動力姿態分析儀，平衡測試，感覺統合測試，動作控制測試

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