INTRODUCTION

With improved quality of life and improved health care system, the life expectancy of human beings has been increased. As a result there is gradual and global increase in elderly population(1). As the balance of the body decreases along with aging process, the risk of fall increases with advancing age. Balance is achieved by the complex integration and coordination of multiple body systems including the vestibular, visual, auditory, motor, and higher level premotor systems(2,3,4). Intact balance control is required not only to maintain postural stability but also to assure safe mobility and functional independence in relation to activities of daily living(2,3,4,5). One-third to one-half of the population over age 65 reports either some sort of difficulties pertaining to balance(2,4) or resulting difficult ambulation. Falls and immobility to avoid falls are associated with significant morbidity, trauma, inactivity and depression(1,4). So it is not only important to address the balance complaints and fall risks earlier but also to be predicted and prevented as well. There are wide range of clinical tools(6,7,8,9) to assess static and dynamic balance and their function, with various approaches – Functional assessment, Physiological/systemic assessment, Quantitative assessment and Subjective assessment. In countries like India, clinical assessment tools play major role as quantitative assessments using posturography(10,11,12,13) are not yet
widely available in addition to financial constraints.

**PURPOSE OF THE STUDY**

Despite the availability of wide range of clinical tools to assess static and dynamic balance and their function, it is still difficult to select one to be followed, especially during follow ups.

By analysing the correlation of various clinical tools of balance assessment with one another we can try to select one tool for consistent use.

**OBJECTIVE**

To analyse the correlation of Tinetti’s Performance Oriented Mobility Assessment (POMA)(14,15,16,17) and Horak’s Balance Evaluation System Test (BEST)(17,18,19) with other clinical tools of balance and functional assessment

**METHODOLOGY**

It was an observational study to analyse the correlation of different clinical assessment tools of balance and fall risk in elderly, conducted in a tertiary care centre, Government Institute of Rehabilitation Medicine, Madras Medical College, Chennai, with ethical clearance from Institutional Ethical Committee, Madras Medical College, Chennai. 46 elderly subjects who were attending physiatric OPD and special clinics with purely age related balance complaints were included in study group (S) after careful exclusion of other conditions which may cause or contribute to their balance complaints as per the criteria mentioned. 46 age group and sex matched asymptomatic subjects were selected as control group from those accompanying others to the institute, in the view that subclinical balance deficits and fall risk still exist in elderly population despite no clinical symptoms.

**Inclusion Criteria:**

Elderly subjects with purely age related balance complaints

**Exclusion Criteria:**

- Stroke or paralysis of any aetiology
- Neurological diseases
- Vestibular impairment
- Uncorrected visual impairment
- Orthopaedic alterations like amputation / fracture
- Spinal deformities
- Foot, ankle, knee, Hip, spinal complaints (major/ specific) in last 6 months
- Unable to stand without aids
- Poor scores in MMSE
- Systemic hypertension
- Unfit cardiopulmonary status

**Materials & Methods:**

After obtaining informed consent and routine physiatric & cognitive assessment, with due care to the safety of the individuals, subjects in the study group as well as control group were assessed for balance with following clinical tools - Performance Oriented Mobility Assessment (POMA), Balance Evaluation System Test (BEST), Berg Balance Scale (BBS)(20,21,22,23,24), Timed Up and Go (TUG) (25,26,27,28), Uni-pedal Stance (UPS)(1,4,5.7), Four square Step (FSS)(5,6,7,8), Timed Sit & stand (TSS)(5,6,7,8), Functional Reach Test(FRT)(29,30,31). And subjective assessment was done with Activity specific balance confidence (ABC)(32,33). In addition to adherence of constant sensitizing and assessment time, the assessor was blinded to know the group to which the subjects being assessed belong to.

Spearman’s rank correlation coefficient was used to analyse the data with significance level of 5%.

**OBSEVATIONS, RESULTS & DISCUSSION**

The Study group included 46 elderly subjects (27 males & 19 females, aged from 60 to 74 years), and the control group included 46 age group and sex matched asymptomatic subjects.

**Age Group distribution**

Majority of subjects (59%) belong to the age group of 60-64 years.

This could be because of the fact that as the age advances, ambulation is decreased and dependency is increased which together restricts their tendency to come out of their safer zone of home environment to seek medical care.

**Gender distribution**

Males out-weighed females. That is, 59% of the subjects were males.

This could be a reflection of societal advantage of male...
gender so that they seek medical care earlier or could be due to lesser incidence/severity of age related balance complaints, except that of psychogenic complaints, in female gender because of their gender related inherent nature of activities of day today life of Indian population.

ASSOCIATED FACTORS
1. Diabetes: 29 subjects (63%) of study group and 17 subjects (37%) of control group were known diabetics (Type 2 DM). Among the known diabetic subjects 11 out of 29 (S) & 5 out of 17 (C) presented with poor glycaemic control and all of them gave h/o poor compliance to diabetes control treatment. And 15 out of 29 (S) & 6 out of 17 (C) had symptoms suggestive of peripheral neuropathy(34).

2. Obesity: 7 subjects (15%) of study group and 3 subjects (6.5%) of control group were obese with BMI >/=30.

3. Adhesive capsulitis: 6 subjects (13%) of study group and 3 subjects (6.5%) of control group had either unilateral or bilateral adhesive capsulitis with partial restriction of ROM which reflected on their functional reach during assessment.

STATISTICAL ANALYSIS
Spearman’s rank correlation coefficient (rho) was used to analyse the data with significance level of 5% and confidence level of 95%.

POMA vs BEST

<table>
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<tr>
<th>POMA VS BEST</th>
<th>Study Group</th>
<th>Control Group</th>
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<tbody>
<tr>
<td>rho</td>
<td>0.64</td>
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There was statistically significant positive correlation between Performance Oriented Mobility Assessment and Balance Evaluation System Test in Study group as well as Control group. This implies that higher the scores in POMA, higher the scores in BEST as well. In study group, in addition to statistically significant positive correlation between POMA & BEST (rho: 0.64), each individually showed statistically significant positive correlation with BBS, UPS, FRT, ABC but with varying strength (POMA: 0.72 to 0.96, BEST: 0.58 to 0.83) and statistically significant strong inverse correlation with TUG, FSS, TSS but with varying strength (POMA: -0.74 to -0.88, BEST:-0.82 to -0.97). The strength of correlation of POMA with FRT was the same as the strength of correlation of BEST with FRT.

In control group as well, in addition to statistically significant positive correlation between POMA & BEST (rho: 0.62), each individually showed statistically significant positive correlation with BBS, UPS, FRT, ABC but with varying strength (POMA: 0.74 to 0.92, BEST: 0.62 to 0.86) and similarly statistically significant strong inverse correla-
**Study Group – Correlation with other tools**

| STUDYGROUP  | POMA | | BEST |  |
|-------------|------|------------|------|  |
| rh\o        | Correlation | p value   | significance | rh\o        | Correlation | p value   | significance |
| BBS         | 0.96  | Positive   | <0.05     | significant  | 0.73  | Positive   | <0.05     | significant  |
| TUG         | -0.74 | Negative   | <0.05     | significant  | -0.84 | Negative   | <0.05     | significant  |
| TSS         | -0.82 | Negative   | <0.05     | significant  | -0.97 | Negative   | <0.05     | significant  |
| FSS         | -0.88 | Negative   | <0.05     | significant  | -0.82 | Negative   | <0.05     | significant  |
| UPS         | 0.72  | Positive   | <0.05     | significant  | 0.67  | Positive   | <0.05     | significant  |
| FRT         | 0.83  | Positive   | <0.05     | significant  | 0.83  | Positive   | <0.05     | significant  |
| ABC         | 0.91  | Positive   | <0.05     | significant  | 0.58  | Positive   | <0.05     | significant  |

**Control Group – Correlation with other tools**

| CONTROL GROUP  | POMA | | BEST |  |
|----------------|------|------------|------|  |
| rh\o         | Correlation | p value   | significance | rh\o         | Correlation | p value   | significance |
| BBS          | 0.92  | Positive   | <0.05     | significant  | 0.74  | Positive   | <0.05     | significant  |
| TUG          | -0.71 | Negative   | <0.05     | significant  | -0.80 | Negative   | <0.05     | significant  |
| TSS          | -0.78 | Negative   | <0.05     | significant  | -0.96 | Negative   | <0.05     | significant  |
| FSS          | -0.84 | Negative   | <0.05     | significant  | -0.82 | Negative   | <0.05     | significant  |
| UPS          | 0.74  | Positive   | <0.05     | significant  | 0.64  | Positive   | <0.05     | significant  |
| FRT          | 0.81  | Positive   | <0.05     | significant  | 0.86  | Positive   | <0.05     | significant  |
| ABC          | 0.88  | Positive   | <0.05     | significant  | 0.62  | Positive   | <0.05     | significant  |

Correlation with TUG, FSS, TSS but with varying strength (POMA: -0.71 to -0.84, BEST: -0.80 to -0.96).

**CONCLUSION**

- Both POMA & BEST correlated well with other tools and between themselves as well. All correlations were statistically significant.
- When compared to BES Test, POMA showed stronger correlation with most of other clinical tools (BBS, UPS, FSS, ABC) except with few clinical tools (TUG, TSS) which themselves were parameters of BEST.
- POMA showed superior level of strength of correlation especially with functional (BBS) and subjective assessments (ABC).
- Though BEST directs towards balance system to be targeted, it is yet to be validated.

Despite the fact that combinations of two or more clinical tools are complementary to each other during initial fall risk assessment, this study concludes that POMA could be used as a single best clinically available balance assessment tool in elderly, especially during follow up visits where time constraint is the limiting factor and also in but not limited to rehabilitation settings where the functional improvement with subjective wellbeing is the ultimate goal. However, large scale studies with representative samples from Community dwelling elderly population are needed to generalize the results.

**LIMITATIONS OF THE STUDY**

- Correlation among subgroups with different comorbidities is not studied.
- Correlation of the scales with quantitative assessment like posturo-graphy is not studied.
- Subgroups with subclinical balance disturbances are not studied in detail.
- Samples are not representative, and so the results could not be generalized to whole population.
FUTURE SCOPE OF THIS STUDY

- Large scale study with control groups and representative samples from Community dwelling elderly population could be next step to confirm or generalize the results
- Horak’s BES Test’s ability to identify the target neuro musculo skeletal system could be validated
- Correlation of the scales with quantitative assessment like posturo-graphy could be studied in Indian population

REFERENCES


