# Reliability of Fracture Neck of Femur Classification Systems – A Retrospective Study

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## 1. Background

Neck of femur fractures (#NOF) are common (66,313 new cases in the UK during 2018)[1] and mainly occur in the elderly and frail . Classification systems are useful to help determine prognosis and management. The aim of the study was to compare the reliability of Garden[2] (Table 1) and Pauwel's[3] (Figure 1, 2 and Table 2) classification systems.
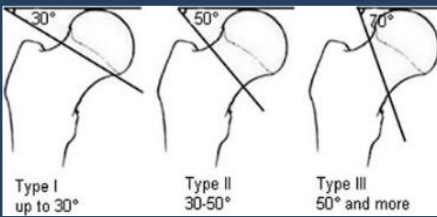


Figure 1 (Left): Pauwel's Classification Types[3]
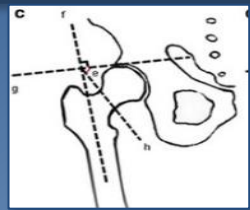Figure 2 (Below): Measuring Pauwel's Angle[3]

### Table 1: Garden Criteria [2]

| Type | Fracture | Displacement |
|------|----------|--------------|
| I | Valgus Impacted | None |
| II | Complete | None |
| III | Complete | Partially |
| IV | Complete | Complete |

### Table 2: Pauwel's Criteria[3]

| Type | Angle |
|------|-------|
| I | 0° - 30° |
| II | 30°-50° |
| III | >50° |

## 2. Methods

Two observers (A and B) both 4th year medical students, independently studied antero-posterior pelvis X-rays of patients (n=45) with intra-capsular #NOF and classified them according to both Garden and Pauwel's. This was done on two separate occasions, three weeks apart (Time 1 & 2). The reliability was assessed, producing kappa values, intra-class correlation coefficients and confidence intervals (k, ICC and CI respectively).

## 3. Results

| 11 Male | 34 Female |  | 25 Left Femur | 20 Right Femur |  | Mean Age 82 (55-96) |

### Table 3: Inter-observer Reliability

|  | Time 1 | Time 2 |
|--|--------|--------|
| **Garden Classification** | k=0.22 p=0.027 | k=0.33 p=0.002 |
| **Pauwel's Classification** | k=0.56 p<0.001 | k=0.46 p=0.001 |
| **Pauwel's Angle (ICC, 95% CI, p)** | 0.91 0.85 to 0.95 p<0.001 | 0.77 0.55 to 0.88 p<0.001 |

### Table 4: Intra-observer Reliability

|  | Observer A | Observer B |
|--|------------|------------|
| **Garden Classification** | k=0.71 p<0.001 | k=0.46 p<0.001 |
| **Pauwel's Classification** | k=0.81 p<0.001 | k=0.47 p=0.002 |
| **Pauwel's Angle (ICC, 95% CI, p)** | 0.91 0.82 to 0.95 p<0.001 | 0.79 0.62 to 0.89 p<0.001 |

## 4. Discussion

• Using validated grading systems[4,5], inter-observer agreement for Garden was rated *fair*, whilst Pauwel's was *moderate* on both occasions.
• Pauwel's uses measured angles, making it more *objective* than the *subjectivity of* determining if *partial* or *full* displacement has occurred. In theory less variable and thus more consistent, even with little observer experience, shown by *excellent* ICC values at Time 1.
• Intra-observer agreement was *substantial* and *almost perfect* for Observer A using Garden and Pauwel's respectively, whilst *moderate* for Observer B for both.
• Explanations are, A is more consistent, and thus has more agreeable results, or that B improved on the second attempt, whilst A did not, thus, less agreeable.

## 5. Limitations

This is a small study making the clinical applicability of any findings limited. Neither observer had a high level of orthopaedic knowledge at Time 1. Therefore, there was an additional variable of their learning curve between Time 1 and Time 2 which is independent of the classification systems. At Time 2, our results were comparable to those of Povilas et al. (k=0.33)[6.] A greater number of females reflects the nature of the injury and the prevalence in this particular patient demographic.

## 6. Conclusion

Pauwel's classification had greater inter-observer reliability than Garden and also greater intra-observer reliability for Observer A. Further studies are needed with a greater number of patients and observers to confirm the findings and appreciable clinical implications.

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