Which Classification System is More Useful for Intertrochanteric Fractures? AO/ASIF or Jensen?[*]

İntertrokanterik Kırıklarda Hangi Sınıflandırma Sistemi Daha Kullanışlıdır? AO/ASIF ya da Jensen?

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Objectives: The aim of this study was to determine intra- and interobserver reliability of AO/ASIF and Jensen classification systems, and to compare reliability when applied by unexperienced and experienced orthopaedic surgeons.

Patients and Methods: The anteroposterior and lateral radiographs of 60 intertrochanteric hip fractures were reviewed and classified by two groups (G1, G2) of orthopaedic surgeons using the AO and Jensen classification systems on two separate occasions three months apart. Each group consisted of five orthopaedic surgeons. Group 1 had less than five years, and group 2 had more than 10 years of experience. Kappa statistical analysis was used for determination of intra- and interobserver variation.

Results: For the AO classification system without subgroups, the mean kappa value was 0.67 (range 0.47-0.90) for intraobserver variation and 0.42 (range 0.10-0.73) for interobserver variation. For the Jensen classification, the mean kappa value was 0.57 (range 0.35-0.80) for intraobserver variation and 0.30 (range 0.10-0.60) for interobserver variation. For the AO classification system with subgroups, the mean kappa value was 0.49 (range 0.21-0.81) for intraobserver variation and 0.23 (range 0.09-0.51) for interobserver variation.

Conclusion: Although these classification systems have disadvantages, this study suggests that AO system without subgroups is more useful than Jensen and AO system with subgroups to classify intertrochanteric fractures of the proximal femur.

Key Words: Intertrochanteric femur fractures; classification; observer.

Amaç: Bu çalışmanın amacı AO/ASIF and Jensen sınıflama sistemlerinin gözlemcilerin kendi içindeki (intraobserver) ve gözlemciler arası (interobserver) uyumunu saptamak ve deneyimli ve deneyimsiz ortopedik cerrahlar tarafından uygulandığındaki uyumu kıyaslamaktı.

Hastalar ve Yöntemler: Altmış intertrokanterik femur kırığına ait ön-arka ve yan radyografiler, iki gruba (G1, G2) ayrılmış 10 ortopedik cerrah tarafından üçer ay ara ile AO ve Jensen sınıflamaları kullanılarak incelendi ve sınıflandırıldı. Her grupta beş cerrah vardı. Grup 1'dekiler beş yıldan daha az, Grup 2'dekiler 10 yıldan daha fazla deneyimli idiler. İntraobserver ve interobserver varyasyonların belirlenmesinde Kappa istatistiksel analizi kullanıldı.

Bulgular: Alt grupları kullanılmadan yapılan AO sınıflaması için intraobserver uyum kappa değeri 0.67 (0.47-0.90), interobserver uyum kappa değeri 0.42 (0.10-0.73) olarak bulundu. Jensen sınıflaması için intraobserver uyum kappa değeri 0.57 (0.35-0.80), interobserver uyum kappa değeri 0.30 (0.10-0.60) olarak bulundu. Altgruplar kullanılarak yapılan AO sınıflama sistemi için intraobserver uyum kappa değeri 0.49 (0.21-0.81) ve interobserver uyum kappa değeri 0.23 (0.09-0.51) olarak bulundu.

Sonuç: Bu çalışmada, kullanılan sınıflama sistemlerinin dezavantajlarının olmasına karşın, intertrokanterik kırıklarda alt gruplar kullanılmadan yapılan AO sınıflamasının, Jensen ve alt gruplar kullanılarak yapılan AO sınıflamasına göre daha kullanılabilir olduğu gösterilmiştir.

Anahtar sözcükler: İntertrokanterik femur kırıkları; sınıflama; gözlemci.

Many classification systems for intertrochanteric fractures of the proximal femur have been described. In 1949, Evans[1] developed a classification system based on direction of the fracture line, stability of the fracture pattern and the potential convert an unstable fracture pattern to a stable reduction. In 1980, Jensen[2] described classification system based on Evans classification. In 1990, AO classification system[3] was introduced. These classification systems have been used for planning treatment and predicting the outcome of intertrochanteric femoral fractures.

The goal of classification systems are to classify fractures with similar patterns, predicting prognoses and planning treatments. It should be appropriate for clinical practice, audit and research. An ideal classification system should produce the same result each time the same patient data is reviewed by one observer (intraobserver reliability) or by different observers (interobserver reliability).

The aim of this study was to determine intra- and interobserver reliability of AO/ASIF and Jensen classification systems, and to compare reliability when applied by unexperienced and experienced orthopaedic surgeons.

PATIENTS AND METHODS

The anteroposterior and lateral radiographs of 60 patients with intertrochanteric femoral fractures who admitted to the Department of Orthopaedic Surgery in Trakya University between 1998 and 2003 were selected from a trauma database.

These radiographs were reviewed and classified by two groups of orthopaedic surgeons (G1, G2) which had less than five years and more than 10 years of experience, respectively. Each group consisted of five orthopaedic surgeons. A brief note including knowledge of AO and Jensen classification systems was given to each group. Observers classified these radiographs in 60 minutes according to AO classification without subgroups, Jensen and AO classification with subgroups, respectively (Fig. 1, 2). Observers reclassified the radiographs in a different order after three months of the initial assessment. They were not allowed to see how the fractures were treated or to discuss their observations with other investigators. During three months, the 60 sets of radiographs were kept without being touched.
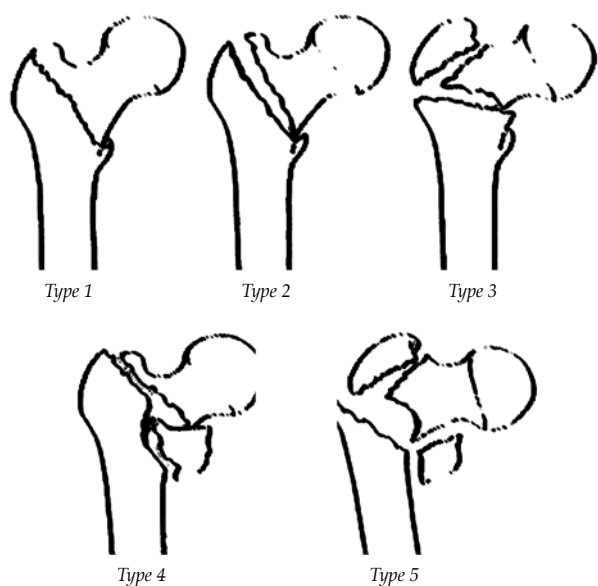

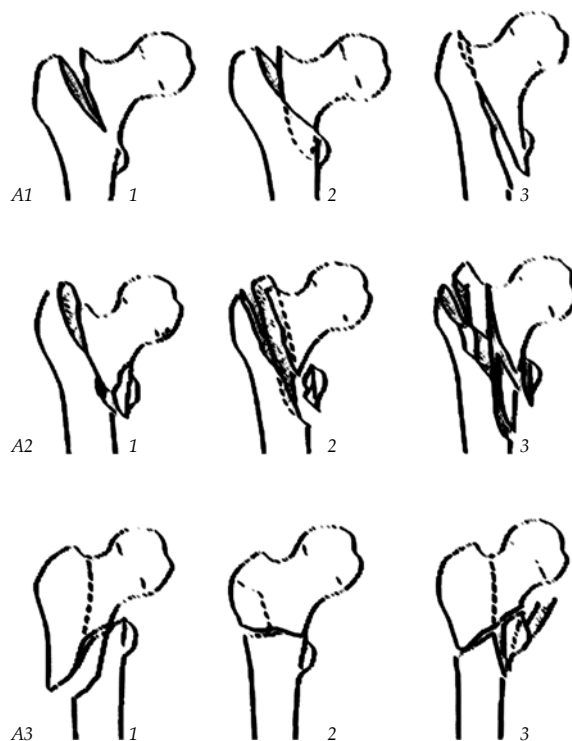**Fig. 1-** *The Jensen classification of intertrochanteric femur fractures.*

Fig. 2- *The AO/ASIF classification of intertrochanteric femur fractures.*

Table 1. Inter- and intraobserver kappa values for the AO classification without subgroups

Observer	AA	AB	AC	AD	AE	BA	BB	BC	BD	BE	Intra-observer
AA	–	–	–	–	–	–	–	–	–	–	0.64†
AB	0.46†	–	–	–	–	–	–	–	–	–	0.61†
AC	0.38†	0.52†	–	–	–	–	–	–	–	–	0.68†
AD	0.47†	0.67†	0.43†	–	–	–	–	–	–	–	0.90†
AE	0.24*	0.41†	0.29	0.50†	–	–	–	–	–	–	0.87†
BA	0.10	0.20	0.12	0.10	0.21	–	–	–	–	–	0.47†
BB	0.52†	0.73†	0.48†	0.72†	0.40†	0.29	–	–	–	–	0.65†
BC	0.53†	0.72†	0.52†	0.70†	0.41†	0.27	0.64†	–	–	–	0.67†
BD	0.21*	0.34†	0.23*	0.43†	0.31†	0.10	0.54†	0.41†	–	–	0.54*
BE	0.31†	0.57†	0.58†	0.66†	0.50†	0.28	0.57†	0.64†	0.35†	–	0.67†

Group 1: BA, BB, BC, BD, BE; Group 2: AA, AB, AC, AD, AE; *: p<0.05; †: p<0.001.

Kappa statistical analysis was used for determination of intra- and interobserver variation. Kappa is a coefficient of agreement corrected for the probability of agreement by chance, which ranges from +1, representing perfect agreement, through 0, representing chance agreement, to -1, representing absolute disagreement. Landis and Koch,[4] redefined the kappa values of 0 and +1 as follows: The value of 0.80 or more are considered almost perfect agreement; 0.61-0.80, substantial agreement; 0.41-0.60, moderate agreement; 0.21-0.40, fair agreement; 0-0.20, slight agreement; and 0, poor agreement.

RESULTS

The results of interobserver and intraobserver agreement were summarized in Tables 1-4. For the AO classification system without subgroups,

the mean kappa value was 0.67 (range 0.47-0.90) for intraobserver variation and 0.42 (range 0.10-0.73) for interobserver variation. For the Jensen classification, the mean kappa value was 0.57 (range 0.35-0.80) for intraobserver variation and 0.30 (range 0.10-0.60) for interobserver variation. For the AO classification system with subgroups, the mean kappa value was 0.49 (range 0.21-0.81) for intraobserver variation and 0.23 (range 0.09-0.51) for interobserver variation.

DISCUSSION

An ideal classification system should be simple, easy to remember, and should have acceptable interobserver and intraobserver reliability. In addition, the classification system should suggest treatment and/or outcome.[5] Previous studies have assessed the reliability of either the

Table 2. Inter- and intraobserver kappa values for the AO classification with subgroups

Observer	AA	AB	AC	AD	AE	BA	BB	BC	BD	BE	Intraobserver
AA	–	–	–	–	–	–	–	–	–	–	0.41†
AB	0.40†	–	–	–	–	–	–	–	–	–	0.43†
AC	0.21†	0.31†	–	–	–	–	–	–	–	–	0.46†
AD	0.41†	0.51†	0.27†	–	–	–	–	–	–	–	0.77†
AE	0.19	0.13*	0.17	0.21†	–	–	–	–	–	–	0.81†
BA	0.10	0.10	0.12	0.10	0.12	–	–	–	–	–	0.40†
BB	0.36†	0.42†	0.28†	0.34†	0.10*	0.16	–	–	–	–	0.52†
BC	0.27†	0.30†	0.17†	0.33†	0.23†	0.18	0.26†	–	–	–	0.38†
BD	0.10*	0.16†	0.14†	0.23†	0.09*	0.12	0.18†	0.20†	–	–	0.21†
BE	0.26†	0.44†	0.25†	0.41†	0.25†	0.10	0.32†	0.39†	0.20†	–	0.54†

*: p<0.05; †: p<0.001.

Table 3. Inter- and intraobserver kappa values for the Jensen classification

Observer	AA	AB	AC	AD	AE	BA	BB	BC	BD	BE	Intraobserver
AA	–	–	–	–	–	–	–	–	–	–	0.35†
AB	0.32†	–	–	–	–	–	–	–	–	–	0.55†
AC	0.23*	0.34†	–	–	–	–	–	–	–	–	0.41†
AD	0.23†	0.47†	0.20*	–	–	–	–	–	–	–	0.80†
AE	0.16	0.21	0.19	0.26†	–	–	–	–	–	–	0.69†
BA	0.16	0.15	0.10	0.15	0.12	–	–	–	–	–	0.75†
BB	0.33†	0.55†	0.40†	0.36†	0.18	0.16	–	–	–	–	0.76†
BC	0.33†	0.53†	0.39†	0.35†	0.10	0.14	0.60†	–	–	–	0.51†
BD	0.25†	0.43†	0.31†	0.44†	0.20*	0.13	0.45†	0.35†	–	–	0.42†
BE	0.30†	0.49†	0.40†	0.49†	0.13	0.10	0.55†	0.39†	0.47†	–	0.50†

*: $p < 0.05$; †: $p < 0.001$.

AO or Jensen classification methods of intertrochanteric fractures. Schipper et al.[6] studied the AO classification system for intertrochanteric fractures for 20 X-rays reviewed by 15 observers. They reported a mean intra-observer kappa value of 0.48 and interobserver values of 0.33 and 0.34 for the classification with subgroups. For the AO system without subgroups, kappa values were 0.78 for intraobserver and 0.67 and 0.63 for interobserver. An earlier study[7] of intertrochanteric hip fractures also found the AO classification to be unreliable. Pervez at al.[8] studied Jensen and AO classification system for 88 X-rays reviewed by five observers. For the Jensen classification, the mean kappa value was 0.52 for intraobserver variation and 0.34 for interobserver variation. For the AO system with subgroups, the mean kappa value was 0.42 for intraobserver variation and 0.33 for interobserver variation. For the AO classification system without subgroups, the mean kappa value was 0.71 for intraobserver variation and 0.62 for interobserver variation.

The result of our study confirms the unreliability of both the AO/ASIF with subgroup and Jensen classification systems. But AO/ASIF without subgroup classification was found reliable.

AO group A1 fractures are two-part intertrochanteric fractures, which may be displaced or undisplaced and equivalent to Jensen classification types 1 and 2. AO group A2 fractures are comminuted, unstable and equivalent to Jensen types 3, 4 ,5. AO group A3 fractures are reverse oblique and fracture line runs distally in a medial to lateral direction. These reverse oblique fractures were incorporated within the other groups in Jensen classification. Clinical studies have indicated a marked increase in risk of fixation failure for these fracture patterns[9] and intramedullary fixation of these fractures

Table 4. The results of intra and interobserver agreement

	Group I (≤5 years experience)		Group II (>5 years experience)		*Total*	
	Intraobserver kappa value	Interobserver kappa value	Intraobserver kappa value	Interobserver kappa value	Intraobserver kappa value	Interobserver kappa value
AO With subgroups	0.41† (range 0.22-0.52)	0.21‡ (range 0.10-0.39)	0.59† (range 0.41-0.81)	0.28‡ (range 0.13-0.51)	0.49† (range 0.21-0.81)	0.23‡ (range 0.09-0.51)
AO Without subgroups	**0.60†** (range 0.47-0.67)	0.41† (range 0.10-0.64)	**0.74*** (range 0.61-0.90)	0.44† (range 0.24-0.67)	0.67* (range0.47-0.90)	0.42† (range 0.10-0.73)
Jensen	0.59† (range 0.42-0.76)	0.33‡ (range 0.10-0.60)	0.56† (range 0.35-0.80)	0.26‡ (range 0.16-0.47)	0.57† (range 0.35-0.80)	0.30‡ (range 0.10-0.60)

≥0.81: Perfect agreement; 0.61-0.80*: Substantial agreement; 0.41-0.60†: Moderate agreement; 0.21-0.40‡: Fair agreement; 0-0.20: Slight agreement.

has been suggested. Therefore, these reverse oblique fractures should be defined separately in Jensen classification.

Jin et al.[10] studied reliability of classification systems of intertrochanteric fractures, 40 X-rays reviewed by five experienced orthopaedic surgeons. They reported the experience of observers may be one of the important factors that substantially affect reliability. However, some authors.[6,11,12] found that reliability of the classification systems were not significantly affected by the level of expertise and experience. The only difference in our study is the higher intraobserver variation for AO/ASIF classification system without subgroups in group II (Table 4). In our opinion, observer experience should not affect inter- and intraobserver variation in an ideal classification system. Therefore this increased intraobserver variation which depends on observer experience for AO/ASIF classification system without subgroups is a disadvantage.

This study suggests that although these classification systems have disadvantages, AO system without subgroups is more useful than Jensen and AO system with subgroups to classify intertrochanteric fractures of the proximal femur.

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