Hong Kong Journal of Orthopaedic Research
(An Open Access Journal for Orthopedics and Trauma Research)

Research Article

Hong Kong J Orthop Res
ISSN (e): 2663-8231
ISSN (p): 2663-8223
2020; 3(1): 21-26

www.hkorthopaedicjournal.com

Pertrochanteric Fractures in the Elderly: Is the Severity of Fracture Pattern associated with age and an increased rate of mortality?

Kirstine Husum Hoyem[1], Amir Oron[1], Philip Rozinsky[1], Yona Kosashvili[1]

1 *Orthopedic Surgery Department, Kaplan Medical center, Rehovot, Israel affiliated to the Faculty of Medicine the Herbrew University, Jerusalem, Israel*

Abstract

Purpose: This study was aimed at assessing whether there is a correlation between age and pertrochanteric femur fracture severity and if this may be tied to mortality at a 1-year interval. **Background:** Pertrochanteric hip fractures are a common low energy fractures and represent a major cause of morbidity and mortality in the elderly population. To date, association of a worse fracture pattern to loss of Bone Mineral Density has not been proven. We set out to assess whether fracture severity may be tied to age in this specific patient population. **Methods:** From May 2010 to January 2013, we retrospectively collected the data of all patients (>60 years old) sustaining a low energy pertrochanteric fracture which were admitted at the Kaplan Medical Center. The following parameters were collected and evaluated: (1) demographics, (2) fracture pattern, (3) time from admission to surgery, (4) time from surgery to mortality. **Results:** We included 578 fractures in the study. These were divided into 4 groups according to age. We analyzed the data using a Spearman's rho correlation and Pearson Chi-Square Test but found no significant difference in fracture stability with increase in age. For the 544 fractures that were operated on at Kaplan Medical Center we found that 1-year mortality was significantly higher with increasing age (p=0.000) and male sex (p=0.001). With every additional patient year, the mortality risk rose by 8.3%. Moreover, the relative mortality risk in the male patients of our cohort was 1.93 as compared to the female ones. Fracture severity and time from admission to surgery were not found to have a significant effect on mortality. **Conclusions:** Statistically the pertrocanteric fracture severity classified after the AO does not correlate with the age or one-year mortality of the patient. The one-year mortality rate was significant higher with increased age and male sex.

Keywords: Pertrochanteric femur fracture, Age, Fracture severity, AO classification, Mortality.

INTRODUCTION

By the third decade of life bone reaches peak mass, followed by gradual bone loss [1], which is more pronounced in women after menopause. This decrease in bone density leads to an increased incidence of osteoporosis. The prevalence of osteoporosis in women rises from 2% at 50 years to more than 25% at 80 years [2].

A serious consequence of osteoporosis in the elderly population is the occurrence of low energy fractures. Osteoporotic fractures are a significant cause of morbidity and mortality, particularly in the developed countries. In 2000 there were an estimated 9.0 million osteoporotic fractures world wide- of which 1.6 million where hip fractures [3]. An osteoporotic hip fracture represents a major cause of morbidity and mortality in the elderly population. The overall mortality is as high as 30% at 1-year post-fracture [4- 6]. As the age of the population increases, the prevalence of osteoporosis and its associated fractures such as hip fractures are expected to increase. Worldwide, the total number of hip fractures is expected to surpass 6 million by the year 2050[7].

Hip fractures can be roughly classified by anatomic location and by fracture type. The general categories include intracapsular (femoral neck and head) and extracapsular (pertrochanteric and subtrochanteric). Femoral neck fractures are commonly treated by hip replacement or fracture fixation, and pertrochanteric/ subtrochanteric fracture are usually treated by fracture fixation [8]. The non-surgical treatment for these fractures is rarely indicated and reserved only for the severely debilitated patient who would not withstand surgery.

The Pertrochanteric hip fracture count for a proximally 50% of the hip fractures [9 and 6] and can be

***Corresponding author:**
Dr. Amir Oron
Department of Orthopedic Surgery, Kaplan Medical Center, Rehovot, Israel
Email: amiroronmd@gmail.com

sub-classified. A number of classifications (Evan, Kyle, Boyd and Griffen, Ramadier, Jensens modifications of Evan, Ender, Tronzo, Kulkarni et al and AO) have been proposed for pertrochanteric fractures and are more or less successfully used in clinical settings [10-12]. At present one of the most common used and worldwide recognized is the AO classification [13] that subdivide into 9 types whish the first 4 are consider stable and 5 the last is consider unstable [14-16].

Previous study has found statistic evidence that fracture severity can be correlated to early patient mortality and reoperation rate in pertrochanteric fractures [17].

A number of studies have attempted to prove that bone mass density (BMD) can be correlated to the severity of the fracture pattern. However, to date, none of the studies were able to reach firm conclusions based on data with statistical significance. [18 and 19] Furthermore, the ability of a clinician to draw conclusions based on BMD is lacking due to the fact that most patients presenting in the orthopedic practice with pertrochanteric fractures have not recently undergone a BMD testing.

One of the possible explanations for the inability to find significant correlation between BMD and fracture severity may be that there are other contributing factors in the elderly population that may have an effect on the fracture severity, such as muscle weakness, concomitant medications and other co-morbidities. As in osteoporosis and BMD, these other contributing factors are more prevalent as age increases fracture severity is probably multi-factorial; however it may be correlated with increasing age.

Aim:

The primary purpose of this study was to investigate the potential influence of patient age on the severity of fracture type (Table 1 – data set 1). The secondary purpose to investigate which parameter (sex, age, fracture severity and time from admission to surgery) has an influence the one year mortality rate (Table 1- data set 2).

PATIENTS AND METHODS

The study was designed to conform the Helsinki Declaration and was approved by the local ethics committee prior to data collection. Hospital records were used to identify all patients older than 60 years of age who was admitted to Kaplan Medical Center between the 1 of May 2010 to the 31 of December 2013 with pertrochanteric fractures. We identified 644 fractures (there was patients that fractured both side in the including period so the statistic was done on numbers of fractures not on numbers of patients). (Figure 1)

By examining the initial injury radiographs we excluded 44 fractures (25 subcapital fracture (AO 31B) 10 diaphyseal fracture (AO32), 4 periprosthetic fracture, 1 impending fracture, 2 greater trochanter fracture and 2 fracture in patients with leg amputations in the same leg as the fracture). (Figure 1)

We collected demographic characteristics (age, sex, fracture side, trauma mechanism, date of surgery and date of death) by chart review. We excluded 22 fractures with high/medium energy fracture mechanism (MVA, fall from high etc.) (Figure 1)

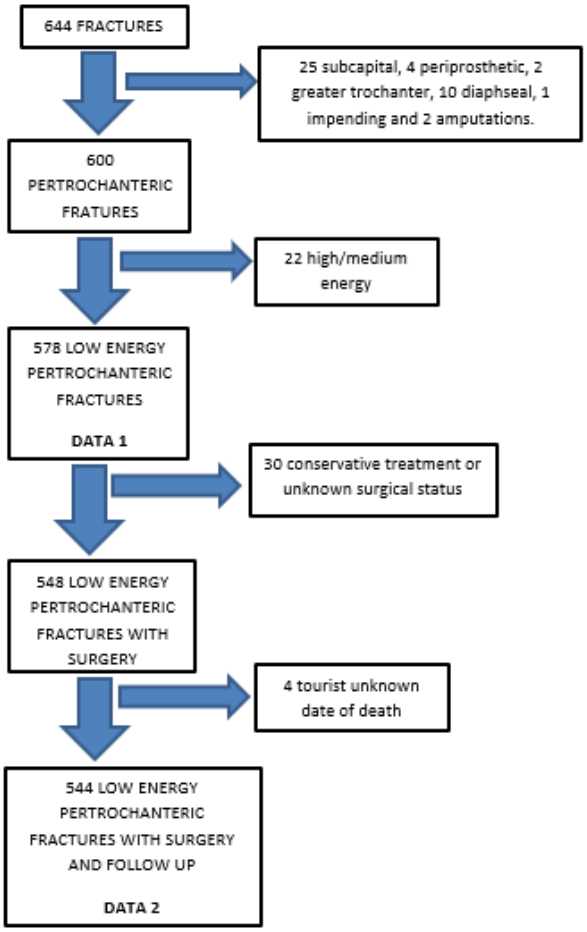


Figure 1: Flow Chart of Study

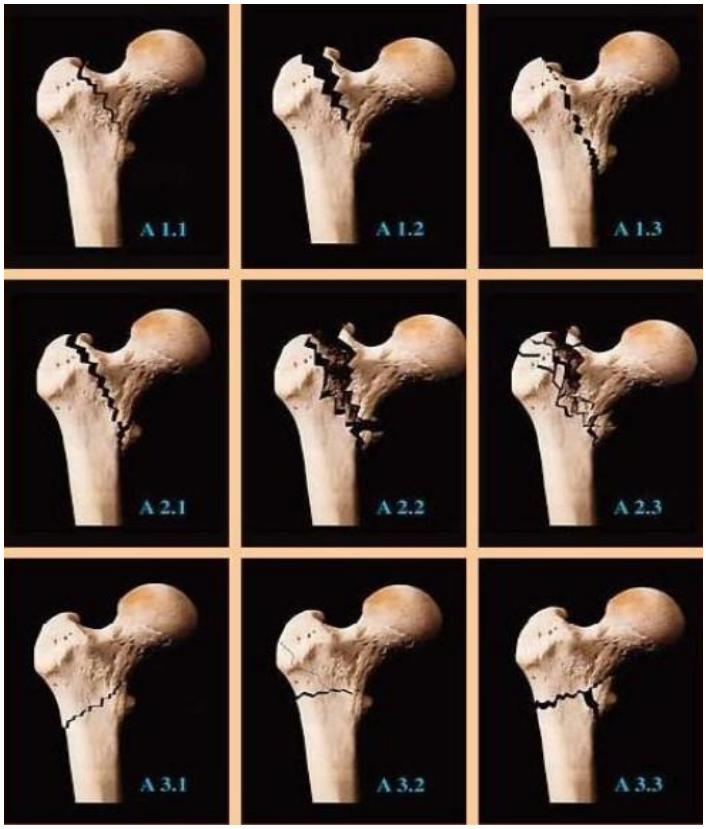
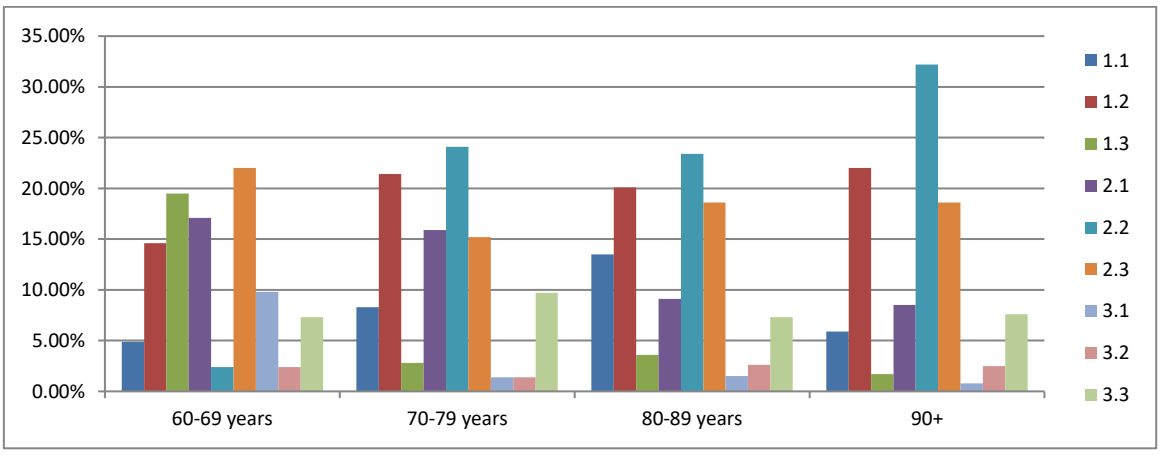


Figure 2: AO/OTA classification group 31-A

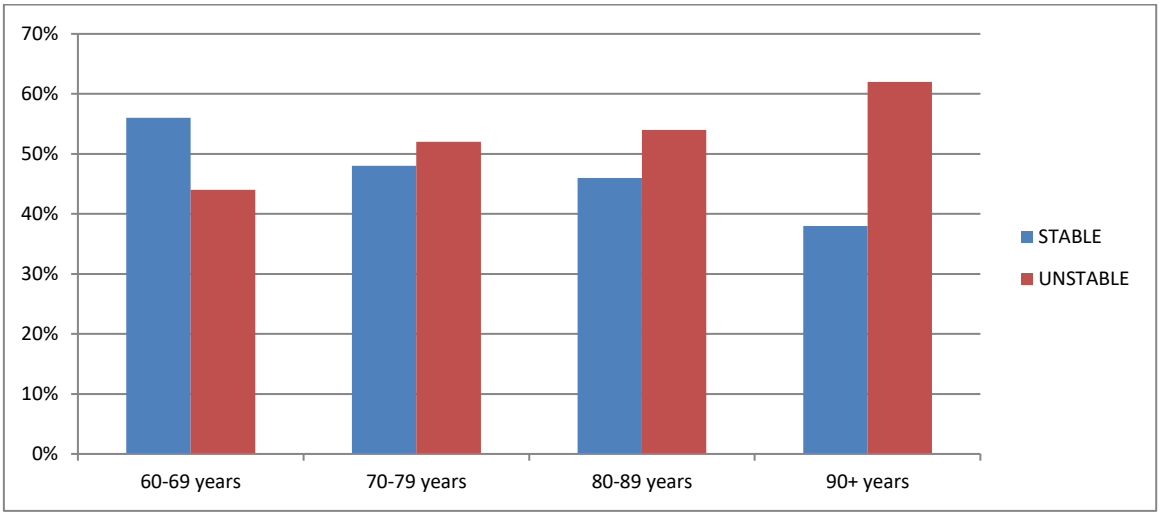
These 578 remaining fractures were classified according to the AO/OTA classification system by preoperative radiographs in anteroposterior (AP) and lateral views (if available) and categorized into 4 age groups (60-69, 70-79, 80-89 and 90-110). (Table 1)

Table 1: Patients Demografic

DATA2		DATA1		PATIENTS DEMOGRAFIC	
29.8%	162	29.6%	171	male	Sex
70.2%	382	70.4%	407	female	
100.0%	544	100.0%	578	Total	
7.2%	39	7.1%	41	60-69	Age groups
25.4%	138	25.1%	145	70-79	
47.2%	257	47.4%	274	80-89	
20.2%	110	20.4%	118	90+	
100.0%	544	100.0%	578	Total	
	83		83	Mean	Age
	8		8	Standard Deviation	
100.0%	544	100.0%	578	LT+RT	Side of fracture
52.8%	287	52.8%	305	LT	
47.2%	257	47.2%	273	RT	
	2.2			Mean	Time between admission and surgery (days)
	2.6			Standard Deviation	
9.7%	53	10.0%	58	1.1	Fracture type after AO classification
20.8%	113	20.4%	118	1.2	
3.7%	20	4.2%	24	1.3	
11.6%	63	11.2%	65	2.1	
23.9%	130	23.9%	138	2.2	
18.6%	101	18.2%	105	2.3	
2.0%	11	1.9%	11	3.1	
2.2%	12	2.2%	13	3.2	
7.5%	41	8.0%	46	3.3	
100.0%	544	100.0%	578	Total	
45.8%	249	45.8%	265	STABLE	Fracture stability
54.2%	295	54.2%	313	UNSTABLE	
100.0%	544	100.0%	578	Total	



Graph 1



Graph 2

The AO (Arbeitsgemeinschaft für Osteosynthesefragen) classification [14 and 15] was initially created by Müller et al. [14] in the 1980s and has periodically undergone updates with the aim of standardizing the classification of fractures for worldwide coverage, through a system for locating the bone and the type of involvement (letter and number), such that an alphanumeric code would make it possible for professionals to promptly know what had happened, which would facilitate communication between orthopedic services. For this reason, this system is the one currently most used in studies. In this system, trochanteric fractures are represented by code 31-A. They are subdivided into three group's base on the obliquity of the fracture line and the degree of damage (bone fragmentation), [15] and each group is divides into three subgroups. (Figure 2)

Group 31-A1 presents a fracture line that starts in any region of the greater trochanter and extends as far as a point above or below the lesser trochanter. There are only two fragments and the medial cortex is fractured in only one locality. These fractures are stable after reduction and fixation, since there is good contact between the fragments, without bone loss. The lesser trochanter is intact [16].

Group 31-A2, the fractures are multifragmented and the fracture line starts laterally in the greater trochanter and continue to the medial cortical bone, as a two-part fracture. There is then a third fragment, which is the lesser trochanter. In this group, only fractures in subgroup 31-A2.1 are considered to be stable, given that this third fragment is small and the greater trochanter is intact, the 31-A2.2 and31-A2.3 is considered to be unstable [16].

Group 31-A3 presents a fracture line that crosses the intertrochanteric region, above the lesser trochanter medially and below the crest of the vastus lateralis in the lateral region. The line affects both cortices and has the characteristics of reverse obliquity [16].

These fractures were included in the statistical analysis (data 1) to investigate our hypothesis: increased patient's age leads to a higher incidence of severe fracture patterns.

For the statistical analysis (data 2) we excluded 30 patients who didn't undergo surgery in Kaplan Medical Center (because of conservative treatment or because of transferee to another hospital). We also excluded 4 patients (tourists) with unknown death date, the remaining patients we had a minimum of 3 years mortality follow up. It left us with 544 patients to confirm that fracture severity and time before surgery has influence the one-year mortality rate. (Figure 1 and Table 1)

Statistical analysis:

We analyzed the data using a Spearman's rho correlation for the 9 groups of the AO classification. Then we compared the stable fractures with unstable fracture with Pearson Chi-Square Test. To investigate if sex, age, fracture severity and time from admission to surgery was possible risk for increased one-year mortality rate we used Kaplan Meir and cox regression. The significance level was set at $P<0.05$.

RESULTS

We included 578 fractures (data 1) in the study. There were 407 female (70.4%) and 171 males (29.4%). The patients average age was 83 years (range from 60-101). These were divided into 4 groups according to age and were classified according to the AO classification. There were no significant differences in fracture stability with increasing age when we compared the incidence of the 9 groups of fracture types (1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, and 3.3) using a Spearman's rho correlation. (Graph 1)

Then we compared incidence of the stable fractures (1.1-2.1) with the unstable fractures (2.2-3.3) between the age groups with Pearson Chi-Square Test but again there was no significant difference in fracture stability with increase in age. (Graph 2)

For the 544 fractures (data set 2) that was operated in Kaplan Medical center with a at least 3 years follow up on mortality status we analyzed if sex, age, fracture severity and time from admission to surgery was possible risk for increased one-year mortality rate with Kaplan Meir and cox regression. We found that mortality at the 1-year interval was significantly higher with increasing age (p= 0.000) and male sex (p= 0.001). With every additional year the mortality risk rose by 8.3%. Moreover, the relative mortality risk in the male patients of our cohort was 1.93 as compared to the female ones. Fracture severity and time from admission to surgery were not shown to have a significant effect on 1-year mortality rate.

DISCUSSION

Fracture classification is fundamental for treatment, prognosis and communication in orthopedic surgery. During the time of this research (in January 2018) the AO changes their classification system of trochanteric fractures [20]. The new coding system separates the stable and the unstable pertrochanteric fractures according to the lateral wall height in millimeters with the leg in traction and neutral rotation-making an already complicated classification more complex (need for right position, traction and scale). This just confirms that the right

classification for pertrochanteric fracture is still to be found and even to divide pertrochanteric fractures into stable and unstable is complicated.

Chehade MJ et al Studied the Influence of fracture stability on patient's mortality and found significant results in the one-year mortality rate (odds ratio: 1.37) between the stable and unstable fractures [17] however in ours study we could not reproduce this result and found no significant different in one-year mortality. The two studies showed a very similar patient demographic (number of patients 743 versus 544, female 71% versus 70% and median age 84 versus 83) but the fracture distribution is different (stable fracture 60% versus 46%) this could be caused by and inter-observant bias when classifying the fracture types.

As shown in the study of Behrendt C et al inter-observer agreement of the OA classification (with 9 subgroups) was poor (Kappa value 0.42) but for the simplified AO classification (with 3 subgroups) it was good (kappa value 0.7) [21], the problem is, that in the simple classification, one of the subgroups containing both stable and unstable fractures, and therefore irrelevant in clinical use.

CONCLUSION

We did not find a statistically significant correlation between the pertrochanteric fracture severity classified according to AO guidelines and increased age or one-year mortality in females. We believe a study with a larger number of patients may find a significant correlation. However, we did find that the one-year mortality rate was significantly higher with increased age and male sex.

Conflicts of interest

The authors declare no conflicts of interest.

Source of funding

None.

Trial registration: 0147-17-KMC

REFERENCES

1. Lu J, Shin Y, Yen MS, Sun SS, Peak bone mass and patterns of change in total bone mineral density and bone mineral contents from childhood into young adulthood. J Clin Densitom. 2016 Apr; 19(2): 180–191. [PubMed]
2. National Osteoporosis Guideline Group (NOGG). http://www.shef.ac.uk/NOGG/index.html (Accessed on June 29, 2011
3. Johnell O, Kanis JA, An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006 Dec;17(12):1726-33. [PubMed]
4. Omsland T K, Emaus N, Tell G S, et al. Mortality following the first hip fracture in Norwegian women and men (1999-2008) a norepos STUDY. Bone. 2014:63; 81-86.
5. Parker M, Johansen A. Hip fracture. BMJ. 2006;333(7557):27-30
6. Keene G S, Parker M J, Pryor G A. Mortality and morbidity after hip fractures. BMJ. 1993;307:1248-50
7. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M, Epidemiology of hip fracture, Bone. 1996;18(1 Suppl):57S. [PubMed]
8. Uptodate, Hip fractures in adults
9. Nydegger V, Rizzoli R, Rapin C H, et al. Epidemiology of the proximal femur in Geneva: Incidence, Clinical and Sosial Aspects. Osteoporosis int. 1991:2;42-47.
10. Bernstein J, Monaghan BA, Silber JS, DeLong WG. Taxonomy and treatment – a classification of fracture classifications. J Bone Joint Surg Br. 1997; 79:706–07. [PubMed]
11. Audige L, Bhandari M, Kellam J. How reliable are reliability studies of fracture classifications? A systematic review of their methodologies. Acta Orthop Scand.
12. Sonawane DV. Classifications of Intertrochanteric fractures and their Clinical Importance. Trauma International. 2015; 7-11.
13. Lamp J N, Panteli M, Pneumaticos S G, Giannoudis P V. Epidemiology og pertrochantic fracture:our institutional experience. Eur J Trauma Emerg Surg. DOI 10.1007/s00068-014-0375-x
14. Müller M.E., Nazarian S., Koch P., Schatzker J. Springer-Verlag; New York: 1990. The comprehensive classification of fractures of the long bones.
15. Jensen J.S. Classification of trochanteric fractures. Acta Orthop Scand. 1980;51(5):803–810. [PubMed]
16. DeLee J.C. Fractures and dislocations of the hip in fractures. In: Rockwood C.A. Jr., Green D.P., editors. Fractures in adults. 2nd ed. JB Lippincott; Philadelphia: 1984.
17. Chehade MJ, Carbone T, Awward D, Taylor A, Wildenauer C, Ramasamy B, McGee M. Influence of fracture stability on early patient mortality and reoperations after pertrochanteric and intertrochanteric hip fractures. J Orthop Trauma. 2015;29/12:538-43.
18. Hoesel LM, Pausch M, Schnettler R, Heiss C. The impact of osteoporosis on the classification of hip and wrist fractures. Med Sci Monit. 2008;14(3):HY1–8. [PubMed]
19. Prabhnoor S H, Anit K S D, Atul A, Rajesh M, Anil J. A Study on the Correlation of Pertrochanteric Osteoporotic Fracture Severity with the Severity of Osteoporosis. J Clin Diagn Res. 2016 Apr; 10(4): RC09–RC11. [PubMed]
20. AO Foundation – AO/OTA Fracture and Dislocation Classification Compendium. Othop Trauma. Volume 32, Number 1 supplement, January 2018.
21. Behrendt C. Repruducibility of tronzo and ao/asif classifications for transtrochanteric fractures. Acta Ortop Bras. 2014; 22(5):275-277.
22. Johnell O, Kanis JA, An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006 Dec;17(12):1726-33. [PubMed]
23. Omsland T K, Emaus N, Tell G S, et al. Mortality following the first hip fracture in Norwegian women and men (1999-2008) a norepos STUDY. Bone. 2014:63; 81-86.
24. Parker M, Johansen A. Hip fracture. BMJ. 2006;333(7557):27-30
25. Keene G S, Parker M J, Pryor G A. Mortality and morbidity after hip fractures. BMJ. 1993;307:1248-50
26. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M, Epidemiology of hip fracture, Bone. 1996;18(1 Suppl):57S. [PubMed]
27. Uptodate, Hip fractures in adults
28. Nydegger V, Rizzoli R, Rapin C H, et al. Epidemiology of the proximal femur in Geneva: Incidence, Clinical and Sosial Aspects. Osteoporosis int. 1991:2;42-47.
29. Bernstein J, Monaghan BA, Silber JS, DeLong WG. Taxonomy and treatment – a classification of fracture classifications. J Bone Joint Surg Br. 1997; 79:706–07. [PubMed]
30. Audige L, Bhandari M, Kellam J. How reliable are reliability studies of fracture classifications? A systematic review of their methodologies. Acta Orthop Scand.
31. Sonawane DV. Classifications of Intertrochanteric fractures and their Clinical Importance. Trauma International. 2015; 7-11.
32. Lamp J N, Panteli M, Pneumaticos S G, Giannoudis P V. Epidemiology og pertrochantic fracture:our institutional experience. Eur J Trauma Emerg Surg. DOI 10.1007/s00068-014-0375-x
33. Müller M.E., Nazarian S., Koch P., Schatzker J. Springer-Verlag; New York: 1990. The comprehensive classification of fractures of the long bones.
34. Jensen J.S. Classification of trochanteric fractures. Acta Orthop Scand. 1980;51(5):803–810. [PubMed]
35. DeLee J.C. Fractures and dislocations of the hip in fractures. In: Rockwood C.A. Jr., Green D.P., editors. Fractures in adults. 2nd ed. JB Lippincott; Philadelphia: 1984.
36. Chehade MJ, Carbone T, Awward D, Taylor A, Wildenauer C, Ramasamy B, McGee M. Influence of fracture stability on early patient mortality and reoperations after pertrochanteric and intertrochanteric hip fractures. J Orthop Trauma. 2015;29/12:538-43.
37. Hoesel LM, Pausch M, Schnettler R, Heiss C. The impact of osteoporosis on the classification of hip and wrist fractures. Med Sci Monit. 2008;14(3):HY1–8. [PubMed]
38. Prabhnoor S H, Anit K S D, Atul A, Rajesh M, Anil J. A Study on the Correlation of Pertrochanteric Osteoporotic Fracture Severity with the

Severity of Osteoporosis. J Clin Diagn Res. 2016 Apr; 10(4): RC09–RC11. [PubMed]
39. AO Foundation – AO/OTA Fracture and Dislocation Classification Compendium. Othop Trauma. Volume 32, Number 1 supplement, January 2018.
40. Behrendt C et al. Repruducibility of tronzo and ao/asif classifications for transtrochanteric fractures. Acta Ortop Bras. 2014; 22(5):275-277.