



## Evaluation of Dynamic Hip Screw with Trochanteric Stabilization Plate in management of Unstable Inter-Trochanteric Fractures

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### Abstract:

The goal of this study is to gauge the radiological results and therefore the functional outcomes consistent with Parker mobility score of the patients after using of Dynamic hip screw with trochanteric stabilizing plate in fixation of unstable trochanteric fractures and assess the complication.

Twenty patients (ages ranged from 51 to 70 with an average age of  $64.20 \pm 6.338$  years, 12 of them (60%) were females and 8 (40%) were males) with unstable trochanteric fracture were treated with Dynamic Hip Screw with Trochanteric Stabilization Plate between first of September 2019 to end of March 2020 at Beni-Suef University Hospital. Most of the operations were done in the first week 16 (80%) and only 4 (20%) patients had intraoperative complication and the same percent had post-operative complications. Parkers score was higher in non-diabetic patients p value (p value 0.041). The ASIA score was higher in patients with good bone quality and without intraoperative complication and this difference was statistically significant significantly (p-value, 0.011). DHS with TSP fixation of unstable intertrochanteric fractures of femur is an effective technique and has excellent functional and radiological outcomes with minimal complications and early rehabilitations rates.

**Keywords:** Dynamic Hip Screw, Trochanteric Stabilization Plate, Inter-Trochanteric Fractures.

## **1. Introduction:**

Intertrochanteric fractures of the hip have increased with increasing mean population age and have become a public health issue. Though the incidence of these fractures has markedly decreased in the western world; the total growth of the elderly population has led to amplifying the number of these fractures over the past three decades and this trend is predictable to continue. [1]. Global incidence of hip fractures had been estimated as high as 2.6 million by 2025 and 4.5 million by 2050. [2]

In comparison to intra-capsular fractures, inter-trochanteric fractures tend to occur in more aged people. Due to the increased life expectancy of the elderly and the proportional loss of bone density, these fractures tend to be more comminuted with aging; therefore, they are becoming more challenging for the surgeon. [3]

The two primary options for treatment of such fractures are extramedullary fixation and intramedullary fixation. There is no consensus on whether extramedullary or intramedullary (IM) fixation is the best treatment. [4]

The dynamic hip screw (DHS), commonly used in extramedullary fixation, has come to be a standard implant in treatment of such

fractures. Addition of an angularly stable trochanter- stabilizing plate (TSP) with locking screws has been used to reinforce DHS fixation and reduce medicalization and shortening of the femoral shaft and improvement is noted in the functional outcome, it is regarded as a solution for treating unstable type fractures that use a more familiar approach and implant application. [5]

The aim of the current study was to evaluate the radiological results and the functional outcomes according to (Parker mobility score) of the patients after using of DHS with TSP in fixation of unstable trochanteric fractures and assess the complication.

## **2. Patients And Methodes:**

The study was approved by the ethical committee of the Faculty of Medicine, Beni-Suef University. Written informed consent was obtained from all participants before recruitment in the study, after explaining the objectives of the work. Confidentiality was guaranteed on handling the data base.

This study was a prospective cross-sectional study conducted on twenty patients (two patients were lost during the follow up. One of them died within the first three months, due to

unknown causes); with unstable trochanteric fracture that selected randomly from the orthopedic surgery department at Beni-Suef University Hospital during the period from first of September 2019 to end of March 2020. The selected participants were treated with DHS+TSP according to the following inclusion and exclusion criteria:

**Inclusion criteria:** adult with unstable trochanteric fracture (AO/OTA type 31.A2-2 and 31.A2-3 subtypes and 31.A3 fracture group. Fit for surgery. **Exclusion criteria:** (1) Stable trochanteric fracture, (2) Open fractures, (3) Trochanteric with subtrochanteric extension, and (4) Unfit for surgery. **The Follow up period was at least 6 months.**

### **2.1.The following was done for all studied participants:**

- **On admission;** careful history taking and clinical examination were done for all patients, pre fracture level of activity and mobility was assessed according to Parker mobility score. [6], radiological assessment (Plain x-ray: in the form of pelvis AP, affected hip with femur AP& Lateral), laboratory investigations; (routine pre-operative investigations in the form of CBC, PT, PC, INR, AST, ALT, RBS and Creatinine).

### - **Operative management**

All patients in the study were anesthetized by spinal anesthesia. Prophylactic broad spectrum antibiotic (cefotaxime 3<sup>rd</sup> generation cephalosporin) was taken with induction of anesthesia. Patient in the supine position on a traction table, closed reduction was done under the control of an image intensifier on both views and maintained by traction.

### - **Immediate Postoperative management protocol:**

- After the operation was finished, all patients were transmitted to the ward, intra venous broad spectrum antibiotic (cefotaxime third generation cephalosporine) was given to all patients for 3days and then shifted to oral one (amoxicillin-claviolenic acid), low molecular weight heparin (40 IU enoxaparine) was given to all patients and started 12-24 hours postoperative and continued for 14 days postoperative as prophylaxis against DVT & PE.
- **Mobilization:** patients started one day to three days after operation to actively move their hips and knees and were mobilized when tolerated.
- **Discharge from the hospital:** all patients were discharged from the hospital on oral broad spectrum antibiotic for 10 days and low molecular weight heparin for 14 days.

## 2.2. Clinical Follow-up:

All patients were followed up in the outpatient clinic as follow:

- After 2 weeks the wound was examined and the sutures were removed.
- After 6 weeks x-ray was done and mobilization was encouraged.
- After 3 months x-ray was done to check the union, weight bearing ability was assessed and range of motion was examined.
- After 6 months x-ray was done to check union and complications, Parker mobility score was calculated to all cases and any complications were assessed and analyzed.

## 2.3. Radiological evaluation:

X-ray was mandatory immediate postoperative, at 6 weeks, 3 months, 6 months and, by doing anteroposterior view of pelvis and lateral view of the operated hip. Fractures were judged to be healed if bridging callus was evident on three of four cortices as seen on two views.

The reduction was classified: good, acceptable, or poor using the criteria similar to those of Baumgaertner and his colleges. [7]

- (1) Good: normal or slight valgus alignment (<5 degrees) on the A/P radiograph, less

than 10 degrees of angulation on the lateral radiograph, and no more than 5mm of displacement of any fragment.

- (2) Acceptable: one criterion of a good reduction with respect to either alignment or displacement, but not both.
- (3) Poor reduction met neither criterion.

## 2.4. Clinical evaluation

Walking, pain and hip function were evaluated at each visit, and the **Parker Mobility Score (PMS)** at 3, 6 & 12 month was recorded and compared with that recorded preoperative. The operated hip compared to the other hip, while the patient sleeping supine on the bed in most of cases and the degree of hip flexion, extension, abduction, and adduction, external and internal rotation were recorded at 6 and 12 months postoperatively. The muscle power evaluated according to **the muscle power grade (ASIA)**, with comparing to the other normal side. [8]

## 2.5. Statistical Analysis:

The collected data were coded then entered and analyzed using the SPSS version 22 (Statistical package for social science). Descriptive statistics was done for categorical variables by frequency and percentage, and for numerical variables in the form of mean and standard deviation

(mean  $\pm$  SD). Suitable statistical tests of significance were used for non-parametric analysis: (Mann-Whitney-test for two unrelated samples, Chi-Square ( $\chi^2$ ) test for categorical data). P-values equal to or less than 0.05 were considered statistically significant. Simple graphs were used to illustrate some information.

### 3. Results:

This study was conducted on 20 patients admitted to orthopedic department at Beni-Suef university hospital. The mean age of the studied patients was  $64.20 \pm 6.338$  years with a range of 19 and a minimum of 51 years and a maximum of 70 years old. About 12 (60%) of the patient-participants were females and 8 (40%) were males. About 8 (40%) had a diabetes mellitus and hypertension each and about 5 (25) had an HCV infection.

About 11 (55%) of the fractures were on the right side and 9 (45%) were on the left side. Most of the studied patients have an osteoporotic bone. Majority of the fractures were due to fall to the ground 13 (65%) and 7 (35%) of the fractures were due to road traffic accidents. And about 17 (85%) of the patients had multiple fractures. Majority of the operations were done in the first week 16 (80%) and only 4 (20%) patients had intraoperative

complication and the same percent had post-operative complications. **(Table-1)**

#### **Intraoperative Complications:**

**Intr-operative complications were detected in four cases (20%); those complications were inform of (inadequate reduction in two patients, incorrect position of the lag screw or screws in the femoral head in only one case and incorrect length of the lag screw in only one case). The remaining 80% of cases passed without intraoperative complications. (Table-2)**

#### **Post-operative Complications:**

**Post-operative complications were detected in four cases (20%); those complications were inform of (superficial wound infection in two cases, implant failure in one case after 1.5 months, screw extrusion in one case at 3 months without an obvious cause and secondary varus in one case at three months as a squally of excessive fracture collapse). (Table-2)**

The Parker's score ranged from 6 to 9 with a mean  $7.85 \pm 1.089$ . It was significantly higher in non-diabetic patients (p-value= 0.041), patients with good bone quality (p-value <0.001) and in patients without intraoperative complication (p-value= 0.019).

**Regarding the TAD (Tip-Apex Distance Index) in the present study; more than half**

**the studied vases** (55%) had TAD less than 25 mm and (45%) cases had TAD more than 25mm. It was noted that cases with TAD less than 25 mm had been allowed early partial weight bearing and early full weight bearing (p-value 0.001). Cases with TAD less than 25 mm had been showed full union within three months (p-value 0.002). **(Table-3).**

The ASIA score ranged from 3 to 5 with a mean of  $4.10 \pm 0.788$ . It score was significantly higher in patients with good bone quality and without intraoperative complication (p-value, 0.011). **(Figure-1).**

**Table (1): Basic Characteristics among the studied population; (N=20);**

Characteristics	Descriptive Statistics
<b>Age; (years)</b>	
Minimum	51
Maximum	70
Mean $\pm$ SD	$64.20 \pm 6.338$
<b>Gender; N (%)</b>	
Male	8 (40%)
Female	12 (60%)
<b>Co-morbidities; N (%)</b>	
DM	8 (40.0)
HTN	8 (40.0)
DM & HTN	5 (25.0)
HCV	5 (25.0)
<b>Side of Trauma; N (%)</b>	
Right side	11 (55%)
Left Side	9 (45%)
<b>Bone Quality</b>	
Good	8 (40%)
Osteoporotic	12 (60%)
<b>Mode of Trauma</b>	

RTA	7 (35%)
FTG	13 (65%)
<b>Associated Fractures</b>	
Yes	17 (85%)
No	3 (15%)

**Table (2): Operative and Post-Operative Details among Studied Population; (N= 20):**

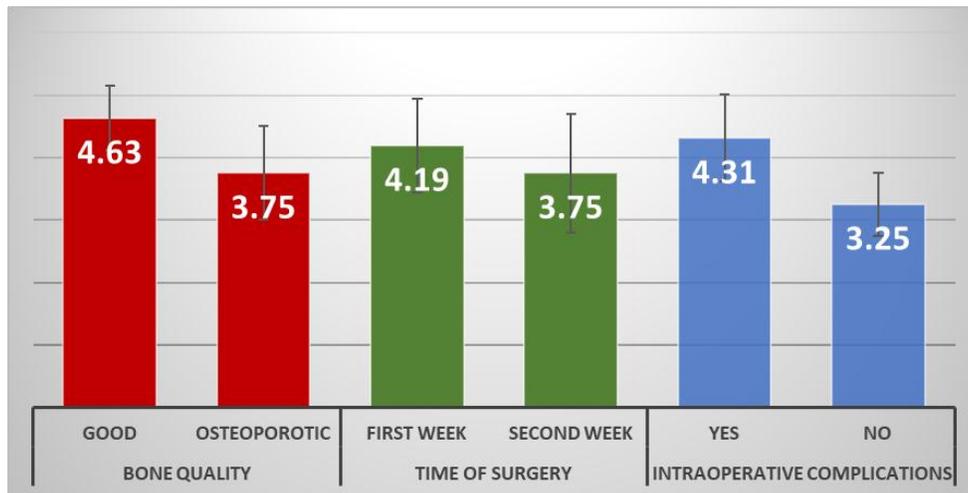
Characteristics	Descriptive Statistics
<b>Time of Surgery</b>	
First Week	16 (80%)
Second Week	4 (20%)
<b>Intraoperative complication</b>	
Yes	4 (20%)
No	16 (80%)
<b>Post-operative Complications</b>	
Yes	4 (20%)
No	16 (80%)
<b>Parker's Score;</b>	
Minimum	6
Maximum	9
Mean $\pm$ SD	7.85 $\pm$ 1.089
<b>ASIA score</b>	
Minimum	3
Maximum	5
Mean $\pm$ SD	4.10 $\pm$ 0.788
<b>TAD mm; N (%)</b>	
Less than 25mm	11 (55%)
25-30 mm	9 (45%)

**Table (3): Relation of Tip-Apex Distance Index and post-operative assessment among studied population; (N= 20):**

	Tip-Apex Distance Index (TAD)		<i>p-value</i>
	<25 mm N= 11	25 to 30 mm N= 9	
<b>Weight Bearing</b>			
Early; N= 12	11 (100.0%)	1 (11.1%)	<0.001*
Late; N= 8	0 (0.00%)	8 (88.9%)	
<b>Active hip knee exercises</b>			
Yes	11 (100.0%)	2 (22.2%)	<0.001*
No	0 (0.00%)	7 (77.8%)	

*\*p-value ≤0.05 considered statistically significant.*

*Statistically analyzed by Chi-Square test.*



**Figure (1): Relations between AISA score and Operative circumstances.**

#### **4. Discussion:**

The goal of any fracture fixation is to provide and maintain stable fixation while improving functional results. The DHS is currently the device most commonly used to stabilize intertrochanteric fractures. However, failure rates and complications were reported, to decrease these complications, the TSP and Gamma nail were developed. [9] According to the published biomechanical studies; TSP had the ability to resist femoral medialization which was comparable to the abilities of the intramedullary devices. [10]

The current study was designed to evaluate the radiological results and the functional outcomes according to Parker' mobility score of the patients after using of DHS+TSP in fixation of unstable trochanteric fractures and assess the complication.

In present study, 83.3% of the patients were over 50 years of age. These results were comparable to Ashok and colleagues who reported 94.2% of their patients were above 50 years of age. Further, 56.25% of patients in the present study were males and 43.75% were females. These results were comparable to Ashok and colleagues who reported 66.7% of their patients were males and 33.3% were females. [10]

Hsu et al., in their series concluded that the use of TSP reduced the reoperation rate after fixation of unstable intertrochanteric fractures with posterolateral wall fractures. They also concluded that the use of DHS and TSP for fixation of type A2 intertrochanteric fractures reduced incidence of postoperative lateral wall fractures, decreased lag screw sliding distances and re-operation rates. Babst et al., in their series concluded that addition of the TSP to the DHS construct provided additional stability with prevention of rotation of the head-neck fragment. They also concluded that the additional buttressing effect prevents lateralization of the greater trochanter. TSP provided a sound solution for fixation of these unstable intertrochanteric fractures. [11]

Babst et al reported that the use of long plate may not be better methods or provide more effective treatment for intertrochanteric fracture as it gives no advantages over the short plate but increases the operation time and more traumatizing. [12]

Intertrochanteric fracture fixation using a TSP with DHS and Anti-rotation screw through the TSP lead to prevent intra-operative rotation of the neck, and better function outcomes compared to using lag screw only. [13]

We imply that the anatomical reduction is the most important factor which determines the outcomes in

treatment of unstable trochanteric fracture using extramedullary fixation. Good Baumgartner grading was statistically significant in association with good Parker mobility score after 6 months (p-value 0.034), early full union before 10 week (p-value 0.030), and was the only statistically significant factor determines early full weight bearing (p-value 0.018) and early full union (p-value 0.033).

Parker et al recommended surgical treatment within 48 hours of admission. The incidence of age-related post-operative complications was significantly higher in those patients who underwent surgery on or after the third day compared with those who underwent surgery on the first or second days. The mortality rate for those patients treated within six hours was significantly lower than that for those treated after this time and it was highest for patients who were operated on after more than 36 hours. But in the study of José Cordero et al they conclude that surgical delay was not a statistically significant risk factor for short or long term mortality and surgical delay longer than 24hours has been a significant risk factor for wound infection. [14]

In our study all patients were operated within a week from trauma and there was no statistically significant difference on clinical outcomes or complications between cases treated in the first three days and others.

The mean operation time was 47 minutes in the study of Saucanye et al, this previous results was less than ours in the current study that was 57.8 minutes which decreases with increasing our learning curve from 40 to 90 minutes.

In the current study we didn't consider a comparison between intramedullary and extramedullary fixation although we found that the median fluoroscopic time in 40 patients was 96.8 sec. ranging from 60 to 180 sec, this result is almost the same that Sinan Zehir reported in his Study (it was 105 sec). [15]

One of the most important advantages regarding intramedullary fixation of intertrochanteric fractures is the lower estimated blood loss than other types of extramedullary fixation due to the minimally invasive technique here in current study the median value of blood loss was 150 ml ranging from 100 ml up to 200 ml. *Bhakat Ujjal* states in his study that the average blood loss was 100 ml in 30 patients treated by proximal femoral nail while it was 250 ml in 30 patients treated by extramedullary fixation method so that using intramedullary fixation type has lower rates of blood loss than other types of extramedullary fixation. [16]

The tip-apex distance (TAD) is originally described by Baumgaertner et al. regarding the use of fixed-angle sliding hip-screws. It is a clinically

useful concept that trochanteric screw cutout is more likely when the sum of the distance from the screw tip to the apex of the femoral head on AP and lateral images is  $>25$  mm. A more recent study demonstrated the appropriate translation of this concept to intramedullary nailing of pertrochanteric fractures. Geller et al. reported that no patients with a TAD  $<25$  mm had screw cut-out after intramedullary fixation of pertrochanteric fractures compared with a 44 % rate of screw cut-out in patients with a TAD  $>25$  mm. However, a study by Nikoloski et al. found that three patients had screw cut-out after intramedullary nailing of pertrochanteric fractures with a TAD of  $<20$  mm. This made D.G. Lorich et al. goes on to recommend an optimum TAD of 20–30 mm for intramedullary nailing, as TAD  $<20$  mm was associated with medial cut-out and TAD  $>30$  mm was associated with proximal cutout in their study. [17]

Several studies report good postoperative outcomes in pertrochanteric fractures treated with DHS and TSP and satisfactory functional outcomes.

The most important advantages in DHS and TSP are early active hip and knee exercises, early partial weight bearing and early union. In our study the mean time of active hip and knee exercises was 4 days ranging from 2 to 14 days and the mean time of weight bearing partial and complete was 5.9 weeks

and 9,3 week respectively , while full union was achieved from 8 to 14 weeks. [18]

According to meta-analysis by zhue et al comparing DHS and intramedullary nail in treatment of 909 patients of unstable intertrochanteric fractures from six randomized control studies. The results showed that the IMN group was associated with less blood loss, shortening of the limb, wound infections, hospital stay after operation and time of partial weight bearing with aids and also had Parker mobility score more than other group. In DHS with TSP there was no significant difference was seen in other parameter included fracture fixations complications, postoperative complications and one year mortality. On the other hand the meta-analysis of Li et al which published in the same year conclude that there was no obvious discrepancies were found regard adverse effect, operative time, blood loss, and hospital stay between intramedullary and extramedullary fixation of unstable trochanteric fracture. However there was increased body of evidence to indicate that unstable trochanteric fracture best treated by intramedullary nail. The review article by Kregor published in 2014 concludes that: “Failure rate of treatment of unstable trochanteric fracture with a DHS alone are too high to recommend its use”. [19]

The complicated cases represent 27.5% which was higher than reported. This may be explained by the wide range of our definition to

complications. The complicated cases ranging from superficial infections in 7.5 % to implant failure in one case (2.5%), while screw extrusion was encountered in 2 patients at 1.5 and 3 months, 4 cases (10%) had limping without an obvious cause and one case had secondary varus.

Our study had a number of limitations. The small number of cases, relative short time of follow up and the DHS with TSP was not compared to other internal fixation systems.

## 5. Conclusion and Recommendations:

DHS with TSP fixation of unstable intertrochanteric fractures of femur is an effective technique and has excellent functional and radiological outcomes with minimal complications and early rehabilitations rates. Anatomical reduction is mandatory in all cases to gain good results and avoid complications.

In order to improve results of using DHS with TSP for treatment of unstable trochanteric fractures we recommend to follows these tips:

- 1) Use the Tip-to-Apex distance.
- 2) Know the unstable trochanteric fracture patterns, and use TSP with DHS.
- 3) Avoid varus angulation of the proximal fragment, use the relationship between the tip

of the trochanter and the center of the femoral head.

- 4) For proper placement of Anti-Rotational Screw it should be parallel and superior to the DHS lag screw and to achieve that you must drill the hole for lag screw more inferior than normal, which allows room for placement of Anti-Rotational screw superior to the DHS lag screw.

## 6. References:

- [1] Fu, Chun-Wei, et al. "Dynamic Hip Screw with Trochanter-Stabilizing Plate Compared with Proximal Femoral Nail Antirotation as a Treatment for Unstable AO/OTA 31-A2 and 31-A3 Intertrochanteric Fractures." *BioMed Research International* (2020).
- [2] Sinan Z., R. Zehir, Sultan Z., Azboy, and N. Haykir: Proximal femoral nail antirotation against dynamic hip screw for unstable trochanteric fractures; a prospective randomized comparison. *Eur J Trauma Emerg Surg.* (2015); 41:393–400.
- [3] Koun Y, Mitsuishi N, Hisashi S, Shoji F, and Hirohiko H. Comparison of morphological features in the femur between femoral neck fractures and femoral intertrochanteric fractures *Surg Radiol Anat* .DOI 10.1007/s00276-(2016)-1626-9.

- [4] Weiser, Lukas, et al. "Extra-vs. intramedullary treatment of pertrochanteric fractures: a biomechanical in vitro study comparing dynamic hip screw and intramedullary nail." *Archives of orthopaedic and trauma surgery* 135.8 (2015): 1101-1106.
- [5] Lakho, Muhammad T., et al. "Functional and Radiological Outcome of Unstable Intertrochanteric Fracture Post Dynamic Hip Screw Fixation." *Cureus* 11.4 (2019).
- [6] Parker, Martyn J., and CHRISTOPHER R. Palmer. "A new mobility score for predicting mortality after hip fracture." *The Journal of bone and joint surgery. British volume* 75.5 (1993): 797-798.
- [7] Baumgaertner, Michael R., and Brian D. Solberg. "Awareness of tip-apex distance reduces failure of fixation of trochanteric fractures of the hip." *The Journal of bone and joint surgery. British volume* 79.6 (1997): 969-971.
- [8] Gündüz, Berrin. "ASIA Update-ASIA Impairment Scale: level determination, classification, and case examples." *Turk J Phys Med Rehab* 61.suppl 1 (2015): 525-531.
- [9] Griffin JB: The calcar femorale redefined. *Clin Orthop* (1982); 164:211–214.
- [10] Singh M, Nagrath AR, Maini PS: Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. Quoted from Rockwood and Green's Fractures in Adults, 10th ed. Philadelphia, J.B. Lippincott, 2014.
- [11] Stephen K, Thomas RG: Manual of Human anatomy, 2010; [emedicine.medscape.com/article/1898964-overview](http://emedicine.medscape.com/article/1898964-overview)
- [12] Dieter M Lindskog, Michael R. Baumgaertner: Unstable Intertrochanteric Hip Fractures in the Elderly. *J Am Acad Orthop Surg* (2004); 12:179-190
- [13] Coleman AL, Stone K, Ewing SK, Nevitt M, Cummings S, Cauley JA, Ensrud KE, Harris EL, Hochberg MC, Mangione CM. Higher risk of multiple falls among elderly women who lose visual acuity. *Ophthalmology*(2004);111:857–862.
- [14] Kannus P, Parkkari J, Niemi S: Prevention of hip fracture in elderly people with use of a hip protector. *N Eng J Med* (2000); 343:1506-1513
- [15] Holick M. Resurrection of vitamin D deficiency and rickets. *J Clin Invest* (2006); 116(8): 2062-2072.
- [16] Capt Wendy L.Aronson, Ken Muller, Maura S.McAliffe. Variability in the ASA, PS

classification scale. ANNA Journal. August (2003), vol. 71, no.4: 265-74.

[17] Partanen: Etiopathology and treatment-related aspects of hip fracture. Acta Univ Oul D 742. 2003.

[18] Kubiak EN, Bong M, Park SS: Intramedullary fixation of unstable intertrochanteric hip fractures: one or two lag screws. J Orthop Trauma 6th ed. (2006); 1793-825

[19] Dell R, Greene D, Schelkun SR, Williams K: Osteoporosis disease management: the role of the orthopaedic surgeon. J Bone Joint Surg Am (2008); 90 (Suppl 4):188-194.