

## Original Research Article

# Comparison of Singh's index in view of osteoporosis in patient within tertrochanteric fracture and intracapsular fracture

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## ABSTRACT

**Background:** Osteoporosis is a progressive, systemic, skeletal disease with low bone mass. Diagnosing osteoporosis in practice is a major challenge, where resources are limited and costly. Measurement of osteoporosis through Singh's index in proximal femur fracture patients is consistent with Bone Mineral Density estimation like DEXA scan. Singh's index is a reliable, reproducible and easily available investigation for osteoporosis. The aim of this study is to evaluate the Singh's index of the patients with inter-trochanteric and intra-capsular fracture.

**Methods:** A retrospective observational study of 20 IT and IC fracture each. Singh's index evaluated from the X-rays at time of fracture presentation. Other required information collected at presentation.

**Results:** Out of 40 Patients, 6 had Singh's Index Grade 1 (15%), 11 had Grade 2 (27.5%), 10 had Grade 3 (25%), 7 had Grade 4 (17.5%), 6 had Grade 5 (15%), 0 Patients had Singh's index Grade 6. There was nonnoticeable significant variation in relation of gender with the type of fracture. Patients with higher age tend to have a lower grade of Singh's index.

**Conclusions:** Singh's Index indeed represents bone quality and a fall in the grades predisposes to fractures. Inter trochanteric fractures are common in the older age group with poor Singh's index (<3) compared to the relatively younger age group with Singh's index around 3. Gender, exercise, history of hypertension and diabetes, sunlight exposure, etc. has no significant impact on Singh's Index. Age is deciding factor for Singh's Index.

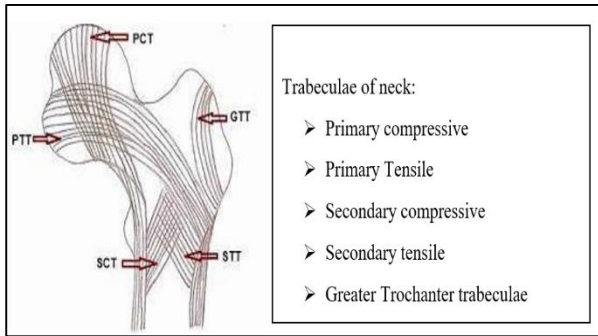
**Keywords:** Singh's index, Osteoporosis, Intra-Capsular, Intertrochanteric, Trabeculae

## INTRODUCTION

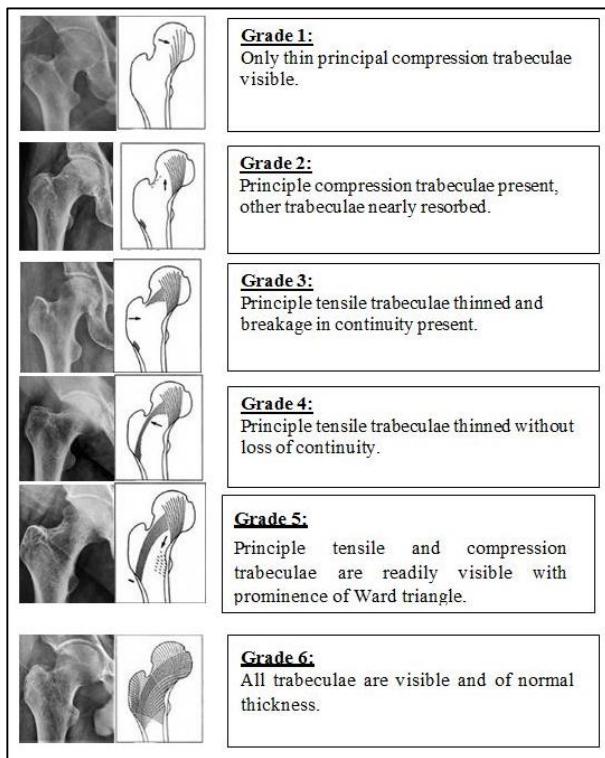
Osteoporosis is a progressive, systemic, skeletal disease with low bone mass and microarchitectural deterioration of bone tissues with a consequent increase in bone fragility and susceptibility to fracture.<sup>1</sup> A study in Delhi estimated the prevalence of osteoporosis as 24.6% in men and 42.5% in women above 50 years of age.<sup>2</sup> Osteoporosis can be divided into type 1 and 2; type 1: postmenopausal osteoporosis generally occurs before the age of 65

years and affects women, type 2: osteoporosis is universal, after peak bone mass has been attained and is found in both men and women.<sup>3</sup> Most of the risk factors for the osteoporosis are non-modifiable. These factors are advanced age, genetic factors, female sex and estrogen deficiency. Modifiable risk factors include Body mass index, alcohol, smoking and nutrition. It is estimated that 1 in 3 women above the age of 50 will experience osteoporotic fractures, as well as 1 in 5 men. The patients who had osteoporotic fracture are two times more likely to

develop another osteoporotic fracture in their life time.<sup>4</sup> Diagnosing osteoporosis in practice is a major challenge, where resources are limited and costly. Measurements of osteoporosis through Singh's Index, calcar femorale, and femoral neck index in proximal femur fracture patients are consistent with Bone Mineral Density estimation like DEXA scan. Though DEXA scan is gold standard, it is costly and not easily available. Singh's index is reliable, reproducible and easily available investigation for osteoporosis.<sup>5</sup>



**Figure 1: Trabecular pattern-proximal femur.**



**Figure 2: Singh index-grades.**

The Singh index is a classification system for bone density of the femoral neck based on the visibility of the trabecular types that can be seen in the femoral neck. Five trabecular types can be present in the proximal part of the femur, as osteoporosis progresses, these trabeculae get thinner and eventually disappear.<sup>6</sup> X-rays are graded 1 through 6 according to the disappearance of the normal trabeculae

pattern. Studies have shown a link between a Singh index of less than three and fractures of the hip, wrist, and spine. Grade 3 and below indicates definite osteoporosis.<sup>7</sup> Singh index was used as an indicator in post-menopausal women, for the detection of osteoporosis.<sup>8</sup> Though some studies have even declared that this has very less precision in evaluating osteoporosis, compared to dual energy X-ray absorptiometry.<sup>9</sup> But, it was also used in determining the prevalence of osteoporosis in rural areas, as it's a cheaper assessment tool.<sup>10</sup>

**Aim and objectives**

Aim of current study was to evaluate the Singh's index of the patients with inter-trochanteric and intracapsular fracture. Objectives were to; Compare the Singh's index of fractured subjects with the normal control and to recommend prophylactic screening for the patients at risk of osteoporotic fractures.

**METHODS**

**Study design, location, duration and participants**

Retrospective observational Study was conducted at department of orthopedics, Deccan College of Medical Sciences, Hyderabad during 3 months (April 2020 to June 2020). There were 20 Patients in each group. (20 intra-capsular fractures and 20 inter-trochanteric fractures).

**Inclusion criteria**

Inclusion criteria were; all fractures involving neck of femur and intertrochanteric region and all fractures following trivial fall from standing height.

**Exclusion criteria**

Exclusion criteria were; Fractures following high grade trauma, RTA, Patients on medication which can affect bone density like anticoagulants and antiepileptic and Diseases which can cause limitation of mobilization and affect bonedensity like hemiplegia etc.

**Procedure**

After selecting the patient, the hip X-rays of patients with a history of fall from trivial height, with intra-capsular or intertrochanteric fracture are taken into account, Singh index is evaluated from the X-ray. A brief history is taken from the patient and a questionnaire is filled up. Particulars of the subjects like name, age, gender, etc. are recorded in case report form. Anthropometric parameters like height and weight are recorded using standard procedures. Body mass index (BMI) is also calculated.

**Statistical analysis**

Statistical analysis was done through Student's t-test, Chi-square test where ever applicable.

## RESULTS

Out of 40 Patients, 6 patients had Singh's Index Grade 1 (15%), 11 patients had Singh's index Grade 2 (27.5%), 10 Patients had Singh's index Grade 3 (25%), 7 Patients had Singh's index Grade 4 (17.5%), 6 Patients had Singh's index Grade 5 (15%), 0 Patients had Singh's index Grade 6. Majority among intertrochanteric fractures had grade 2 and intra-capsular had grade 3.

**Table 1: Distribution of Singh's index with type of fracture.**

Singh's index	Intertrochanteric fracture	Intracapsular fracture
Grade 1	2	4
Grade 2	7	4
Grade 3	4	6
Grade 4	5	2
Grade 5	2	4

**Table 2: Age distribution and its relation with fracture type and Singh's index.**

Singh's Index	Intertrochanteric Fracture (Mean age: 75.1 years)	Intra-capsular fracture (Mean age: 64.8 years)
Grade 1	74.5	65.7
Grade 2	80.4	70
Grade 3	71.2	63.1
Grade 4	71.8	67.5
Grade 5	73.5	60

Mean age of patients presenting with all Hip fractures 70 Years. Mean Age of patients with Grade 1 SI 68.6 years, Grade 2 SI 76.6 years, Grade 3 SI 66.4 years, Grade 4 SI 70.5 years, Grade 5 SI 64.5 years, Mean age and Singh's index related to intertrochanteric and intracapsular fracture shown in (Table 2). The value of Pearson's correlation coefficient = -0.487 suggesting a weak negative correlation. That is patients with a higher age tend to have a lower grade of Singh's index.

### Demographics

In the total sample size of 40 patients, 18 were male and 22 were female. The Singh's index was more than 4 among 28% males (5/18) and 36% females (8/22). It was lower than 3 in 72% of males (13/18) and 63% of females (14/22). There was no statistical significance found with relation to gender and Singh's index.

Distribution of fracture type was 55% (10/18) IT and 44% (8/18) IC among males and 45% (10/22) IT fracture and 55% (12/22) IC fracture among females.

There is no noticeable significant variation in relation of gender with the type of fracture (Table 3).

### Correlation of Singh's Index with various conditions

When the value of Singh's Index correlated with Diabetes (p value=0.85), Hypertension (p value=0.29), sunlight exposure (p value=0.94) and regular exercise (p value=0.61), there was no statistically significant difference found. The noted p value in all is more than 0.05.

**Table 3: Gender and Singh's Index.**

Gender	Grade 4 and above	Grade 3 and below
Male	5	13
Female	8	14

P value=0.56

### IC versus IT fracture

Mean age of patients with IC vs IT fracture: 64.85±15.3 year vs. 75.15±12.77; p value=0.0265 (Student's t-test, significantly lesser age in patients with IC when compared to those with IT).

The results obtained after compilation showed patients with IT tend to have a significantly higher age when compared to those with IC fractures. Patients with higher age tend to have a lower grade of Singh's index. Higher proportion of patients with IC and IT fractures were noted to have a lower grade of Singh's index, the ratio was 27:13 for grade 3 and below: grade 4 and above (67.5% vs. 32.5%).

**Table 4: Correlation of Singh's Index with various conditions**

Variable	IC (n=20)	IT (n=20)	P value*	Inference
Exercise	8	2	0.28	Significantly higher in IC group
Sunlight	14	14	1	Non-significant
HTN	9	8	0.74	Non-significant
Diabetes	6	4	0.46	Non-significant
Grade 3 and below	14	13	0.74	Non-significant
Grade 4 and above	6	7	0.74	Non-significant

\*Chi-squared test

## DISCUSSION

Ramanujam et al in their study found 95% of patients had Singh's index 3 or less for any hip fracture, which resembles the findings in our study where 67.5% of patients with any hip fracture had SI less than or equal to 3.<sup>11</sup> Singh's index with poor grading increases the risk of

any hip fracture, any strategy to improve Singh's index will definitely reduce the morbidity due to Hip fractures in elderly population.

The average age of patients in the study by Sandeep et al was 69.33 years in IT fracture and 66.33 years in IC fracture.<sup>12</sup> In our study IT fracture was common in higher age group with average age of 75 years and IC with average age of 64.8 years. The minimal variation may be due to low sample size. The Intertrochanteric fracture occurs in much older population with more possibility of associated diseases, will be challenging in managing associated complication and rehabilitation.

Average Singh's Index was 2.42/6 in study by Sandeep et al with lesser difference between male (2.2/6) and female (2.6/6) populations, this is same with our study where there is no significant variation in SI of male and female (p value=0.56).<sup>12</sup> This shows, once osteoporosis starts it progress similarly in males and females. Both genders need special attention when evaluating and treating osteoporosis.

Correlation of exercise and Singh's index is controversial as many studies conclude that there is positive correlation of Singh's index with one hour of daily exercise. There is equal number of studies against it. In our study we found no any added effect of exercise on determination of Singh's index, as p value was statistically not significant.<sup>13-15</sup>

Exercise, though helpful in normal body function, there is no any significant effect on osteoporosis prevention. Irrespective of patients personality and built, when needed the evaluation and treatment need to be done.

### **Limitations**

The sample size is less, need big sample size for more conclusive results. X-rays being the old method for grading osteoporosis, this sometimes is the only tool available when resources are limited in remote areas. Findings cannot be extrapolated to general population, as incidence of osteoporosis was diagnosed among morbid patients presenting with fractures.

### **CONCLUSION**

Through this research, we wish to know the correlation between osteoporosis and fractures, accessing it by Singh index. As mentioned, the patient with osteoporotic fracture has two times greater risk of re-fracture, there is a need to change modifiable risk factors and intervention to treat osteoporosis and improve bone density. Age is the deciding factor for Singh's Index, which indeed for possible hip fractures. There should be special strategies, education and policies to reduce the risk of fall in elderly population.

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