

Bone Mineral Density in Children with Juvenile Idiopathic Arthritis: A Hospital Based Study

MUHAMMAD FUADUL ISLAM¹, MOHAMMAD IMNUL ISLAM², MANIK KUMAR TALUKDAR²
SHAHANA A RAHMAN³

Abstract:

Background: Failure to develop adequate bone mineralization is common in children with Juvenile Idiopathic Arthritis (JIA). Osteopenia or osteoporosis occurs in all the JIA subtype but particularly common in systemic onset and polyarticular JIA. There is an association of increased demineralization of bones with duration of joint disease.

Objective: To determine the extent of osteoporosis in Juvenile Idiopathic Arthritis (JIA).

Methodology: Cross sectional study conducted from July 2011 to December 2011 in Department of Paediatrics and Institute for Nuclear Medicine and Ultrasound (INMU), Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka.

Participants: Total 30 patients were enrolled in this study.

Results: Significant osteopenia among 53.33% and 70% JIA patients and osteoporosis among 26.67% and 23.33% JIA patients were found at femur neck and lumber region respectively. In polyarticular cases majority of the cases had osteopenia (81.25% and 75%) and in systemic onset JIA cases majority had osteoporosis (55.56% and 33.37%) at femur neck and lumber region respectively. Longer duration cases at diagnosis had more osteopenia (58.33% and 66.67%) and osteoporosis (41.67% and 33.33%) than the shorter duration cases at femur neck and lumber region respectively.

Conclusion: From this small pilot study it may be concluded that JIA Patients are likely to have low BMD. Among them polyarticular and systemic onset JIA patients are even more susceptible to low BMD. There is also positive relationship between the duration of arthritis and low BMD.

Introduction:

Failure to develop adequate bone mineralization is common in children with JIA¹. Osteopenia is a condition where bone mineral is lower than normal. Osteoporosis is characterized by loss of both bone mass and micro architectural integrity resulting in an increased risk of fracture, growth retardation with associated morbidity and mortality². Osteopenia and or osteoporosis occur in all of the JIA subtype and most commonly found in systemic and polyarticular disease³. Osteopenia is a bone condition characterized by a decreased density of bone, which leads to bone weakening and an increased risk of fracture³.

Pathophysiology of bone loss is multifactorial and involves excessive activation of osteoclastogenesis and reduction of bone formation. Decreased physical activity, nutritional insufficiency, increased cytokines and drugs such as steroids and MTX negatively affect the skeletal maturation⁴⁻⁵. In a cross-sectional study, low bone mineral density (BMD) was found in 40-52% of JIA patient⁶.

A bone mineral density (BMD) measurement is the best way to determine osteopenia and osteoporosis⁷. BMD test can identify osteopenia and osteoporosis, determine the risk of fracture, assess growth retardation and measure the response to treatment. There is an association of increased demineralization of bones with duration of joint disease⁸.

In Bangladesh majority of JIA patients are diagnosed with long duration of disease⁹. No study regarding BMD in JIA so far has been done to assess the bone mineral density in the JIA patients.

1. FCPS Student, BSMMU

2. Assistant Professor, Paediatric Department, BSMMU.

3. Professor, Paediatrics, BSMMU.

Correspondence: Dr. Muhammad Fuadul Islam, FCPS student, BSMMU, Email- fuadislam96@yahoo.com

This study was conducted with the objective of determining the bone mineral density (BMD) in JIA patients. The study also assessed the extent of BMD in different types of JIA and to assess the relationship of BMD with duration of illness.

Methodology:

This was a cross sectional study done in the department of Paediatrics and Institute for Nuclear Medicine and Ultrasound (INMU), Bangabandhu Sheikh Mujib Medical University, Dhaka from July 2011 to December 2011. Thirty newly diagnosed cases of JIA according to International League against Rheumatism (ILAR) classification, whose age group between 4- 16 years, were included in the study. Consent was taken from the parents/attendance before enrolling their child in the study. Ten healthy children without any chronic disease or bone disease of similar age group were taken as control. Control was taken as no data was available in the Institute for Nuclear Medicine and Ultrasound, BSMMU for reference population below 20 years which can be compared with study population. Patients previously treated with DMARD'S or steroids were excluded from the study. Age group below 4 years was excluded from study as measurement of BMD was not possible with the existing BMD machine.

Demographic data and clinical characteristics were recorded. Necessary investigations were done. Bone mineral density (BMD) of the patients was measured at femur neck and lumbar spine by dual energy x-ray absorptiometry (DXA) manufactured by NORLAND, a cooper surgical company, model no 4/00. Result was reported as T-scores which represent the number of standard deviations (SD) from the mean bone density values of the controls. Normal reference was calculated from the bone mineral density in gm/cm² of the control group (Table-I).

From Table-I, average reference bone mineral density of control group at femur neck was calculated as 0.7652 gm/cm² and reference at L1-L4 was calculated as 0.7827 gm/cm² respectively.

T – Score was calculated by using the following formula:

T-score= (BMD – reference BMD)/SD

BMD of different types of JIA patients were observed. Any relationship with duration of illness and BMD was also observed. According to WHO guidelines T score of 0 to -1 indicated normal, -1 to -2.5 indicated osteopenia and less than -2.5 indicated osteoporosis.

Analysis of data including calculation of T-score, percentage and comparison was done manually.

Results:

30 newly diagnosed cases of JIA whose age group in between 4-16 years were enrolled in this study. Among them male were 20, and female were 10, Male: Female 2:1. When JIA patients were classified according to ILAR criteria it was found that oligoarticular 05 (16.7%), Poly articular 16 (53%) and systemic onset 09 (30.3%).

Table- I shows that average reference bone mineral density of control group at femur neck was calculated as 0.7652 gm/cm² and reference at L1-L4 was calculated as 0.7827 gm/cm².

Table-I
Bone mineral density of control group. (n-10)

Sl. No.	Bone Mineral Density gm/cm ²	
	Femur Neck region	L ₁ -L ₄ region
01	0.7837	0.8165
02	0.6758	0.7904
03	0.7974	0.8375
04	0.7782	0.6955
05	0.7737	0.8265
06	0.6857	0.7804
07	0.7994	0.8575
08	0.7789	0.6855
09	0.8037	0.7565
10	0.7758	0.7804
Average	0.7652	0.7827

Table-II shows the duration of illness at diagnosis. Duration of illness was more than 1 year in the majority (40%) of the cases followed by 6 months to 1 year (33.33%) and 6wks to 6 month (26.67%).

Table-II
Duration of illness at diagnosis (n-30)

Duration of illness	Number	Percentage %
6wk to 6month	08	26.67
6 Month to 1yr	10	33.33
> 1yr	12	40.00
Total	30	100

Table-III
BMD Score of study cases at neck of the femur and lumber region: (n=30)

BMD score at femur neck	Number (%)	BMD score at lumber spine	Number %
0 to -1	06(20)	0 to -1	02(6.67)
-1 to -2.5	16(53.33)	-1 to -2.5	21(70%)
> -2.5	08(26.67)	> -2.5	07(23.33)

Table-IV
Extent of BMD in different types of JIA (n=30)

Clinical type	BMD at Femur Neck			BMD at lumbar Spine		
	0 to -1	-1 to -2.5	< -2.5	0 to -1	-1 to -2.5	< -2.5
Oligoarticular (n=5)	04 (80%)	00	01 (20%)	02(40%)	03 (60%)	00
Polyarticular (n=16)	01 (6.25%)	13 (81.25%)	02 (12.5%)	00	12 (75%)	04(20%)
Systemic Onset (n=9)	01 (6.25%)	03 (33.33%)	05 (55.56%)	00	06(66.67%)	03(33.37%)

Table-V
Relationship of BMD with duration of illness (n=30)

Duration of illness	BMD at Femur Neck			BMD at lumbar Spine		
	0 to -1	-1 to -2.5	< -2.5	0 to -1	-1 to -2.5	< -2.5
6 weeks to 6 months (n=08)	04 (80%)	04(50%)	0	01(16.7%)	06 (75%)	01 (16.7%)
6 months to 1 year (n=10)	02 (20%)	05 (50%)	03 (30%)	01 (10%)	07 (77%)	02(20%)
>1 year (n=12)	0	07 (58.3%)	07 (58.3%)	0	08 (66.7%)	04 (33.3%)

Table- III shows that most of the patients had osteopenia at lumbar spine and femur neck region (70% and 53.33%). Osteoporosis was found in 23.33% and 26.67% patients in lumbar spine and femur neck respectively.

Table - IV shows the extent of BMD in different types of JIA. It was found that most of the oligoarticular cases (80% and 40%) had normal BMD scores at femur neck and lumber region. But the majority of the polyarticular cases (81.25% and 75%) had osteopenia at femur neck and lumber region. Most of the systemic onset patients had osteoporosis at femur neck (55.56%) and osteopenia at lumber region (66.67%).

Table-V represents the relationship of BMD with duration of illness. It was found that 50% and 70% of the patients in 6 month to 1 year duration group and 58.33% and 66.67% of more than 1yr duration group had osteopenia at femur neck and lumber region

respectably. Among the short duration cases (6weeks to 6 months) no patient at femur neck and only 16.67% at lumber region had osteoporosis but among the longer duration cases (>1 year) 58.3% and 33.33% had osteoporosis and no patient had normal BMD.

Discussion

The present study was carried out to assess the bone mineral density among the Juvenile idiopathic arthritis patients, attending the pediatric rheumatology clinic, Bangabundhu Sheikh Mujib Medical University (BSMMU).

Among the 30 study cases 66.67% were male and 33.4% were female, male female ratio being 2:1. Miller et al¹⁰ found that females are always predominant among the JIA patients but our study found the reverse result. This might be due to our socio-cultural background where male children are given more importance and care. Rahman et al¹¹ and Islam et al¹² also found male predominance in their study.

Among the 30 patient, most of them (40%) were suffering for longer duration (more than 1yr), 33.33% patients were suffering from 6 month to 1 yr and 26.67% were suffering from 6 wk to 6 month. Rahman et al also showed similar findings where duration of arthritis at diagnosis was more than 1 year in the majority of the cases.¹¹

It was found that, BMD score was in between -1 to -2.5 in 53.33% of all JIA cases at femur neck and in 70% of cases at L₁-L₄ region respectively. Similarly BMD score was less than -2.5 in 26.67% cases at femur neck and in 23.33% at L₁-L₄ region respectively. Pep Muller et al in their study found similar findings where there was decreased BMD at L₁ - L₄ region in JIA.¹³

The study also tried to find out the extent of osteoporosis in different types of JIA. It was found that among the 16 polyarticular patients 6.25% had normal BMD at femur neck. But 81.25% and 75% patient had osteopenia, and 2.5% and 18.75% patients had osteoporoses at femur neck & lumber region respectively. Zak et al found similar finding where there was low BMD in 40-52% JIA patient, where polyarticular type predominated.⁶ Among the 09 systemic onset JIA cases, 11.11% had normal BMD. But 33.33% and 66.67% had osteopenia and 55.56 and 33.35% had osteoporosis in femur neck& lumber region respectively. So, the present study found mostly osteopenia in polyarticular patients and mostly osteoporosis in systemic onset JIA patients. This finding was also consistent with reported results where systemic onset and polyarticular cases had more osteopenia and osteoporosis³.

In this study BMD results were also compared with the duration of illness at diagnosis. 50% of the patients in 6 month to 1 year duration group and 58.33% of more than 1yr duration group had osteopenia at femur neck. Among the short duration cases (6weeks to 6 months) no patients had osteoporosis but longer duration cases (>1 year) 41.67% had osteoporosis and no patient had normal BMD. Similarly at L₁ to L₄ region longer duration cases had more osteoporosis and none of them had normal BMD. This findings is consistent with the study done by Boman et al who found duration of arthritis to be positively correlated with low BMD.⁸

Conclusion:

From this small pilot study it may be concluded that JIA Patients are likely to have low BMD. Among them polyarticular and systemic onset JIA patients are more susceptible to low BMD. There is also positive relationship between the duration of arthritis and low BMD.

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