Evaluation of Bone Mineral Density in Children with Hemophilia

N Abdelrazik, M Reda, M El-Ziny, H Rabea

Citation


Abstract

Background: Patients with hemophilia may be at risk for developing reduced bone mineral density for a number of reasons such as recurrent hemoarthrosis and immobilization.

Aim of the Work: To assess the bone mineral density (BMD) in children with hemophilia and, to correlate bone mineral density with findings regarding the joint disease (hemophilic arthropathy).

Patients and Methods: Thirty hemophilic patients aged 4.97±3.64 years and 30 control healthy individuals (had no joint disease) aged 5.09±3.64 years were selected from the hematology unit and outpatient clinic of MUCH respectively. Anthropometric measurements were done to all cases. Z score was used for weight, height, and Body Mass Index (BMI). Joint evaluation for hemophilic patients and control was done using Colorado PE-0.5: Half Point Instrument before using Dual Energy X-ray Absorptiometry (DEXA). DEXA scanning was performed to all hemophilic patients and controls focusing on L2–L4.

Results: There was no significant difference between hemophilic patients and controls as regard anthropometric measurements and their z-score. There was a significant difference between hemophilic patients and controls as regard BMD and BMD z-score (mean ± SD) (BMD: 0.48 ± 0.13 gm/m² for hemophilic patients versus 0.55 ± 0.14 gm/m² for control, p= 0.05, BMD z-score: -0.68±0.44 for hemophilic patients versus 0.19±0.14 for controls p=0.003). There was a significant difference between severe hemophilic patients (factor level assay less than 1%) and controls as regard BMD and BMD z-score (BMD: 0.41±0.15 gm/m² for hemophilic patients versus 0.55±0.14 gm/m² for controls, p = 0.01, BND z-score: -1.49±0.12 for hemophilic patients versus 0.19±0.14 for controls p=0.001). Also, in hemophilic patients, there was an inverse significant correlation between total joint evaluation scores and BMD z-score (r = -0.365, p =0.04).

Conclusions: Children with hemophilia could have reduced bone mineral density compared with age and gender matched controls. This reduction in bone mineral density was independent on difference in age and body size. Children with more established hemophilic arthropathy exhibited the lowest BMD and BMD z-score.


INTRODUCTION

Osteoporosis is a common problem that occurs throughout the world. It has become a major public health concern. Adequate bone mass accumulation in early life is important in preventing osteoporosis. Persons with the greatest bone mass at the end of adolescence have the greatest protection against the gradual decline in bone mass that occurs with aging (Mora and Gilsanz, 2003). Weight-bearing exercise is critical to ensure adequate bone mass formation in childhood and may be even more important than dietary calcium intake.
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(Bradney et al, 1998). The exact mechanism by which weight loading increases bone mass is not known but is likely related to dynamic strains in bone tissue regulating bone formation and resorption (Lanyon, 1996). Immobilization is significant in the development of reduced bone density among children with cerebral palsy (King et al, 2003). Patients with hemophilia may be at risk for developing reduced bone density in childhood and adolescence for number of reasons such as recurrent hemoarthrosis and immobilization. Until recently, only few sports, such as golf and swimming, were recommended for patients with hemophilia. Despite liberalization of these recommendations, children with severe hemophilia may be less likely to participate in weight-bearing, high-impact exercise (Gilbert et al, 1984). Patients with established changes of hemophilic arthropathy, characterized by pain, swelling, and joint instability, are even less likely to participate in sporting activities and may be at particular risk for reduced bone density. Finally, patients with Hemophilia who have been exposed to hepatitis C through infusion of contaminated plasma, clotting factor concentrates, or other blood substitutes may develop liver impairment and abnormalities in vitamin D metabolism and may be at risk of low bone density (Tsuneoka et al, 1996). Patients with hemophilia and reduced bone mineral density (BMD) may be at increased risk of fractures and osteoporosis in later life. Dual Energy X-ray Absorptiometry (DEXA) system can measure the BMD of the lumbar spine, proximal femur, forearm improved image quality, allowing better visualization of the scan region as well as the ability to detect vertebral deformities (Faulkner, 2001). The aim of this study is to assess the bone mineral density in children with hemophilia and to correlate bone density with findings regarding the presence of joints disease.

SUBJECTS AND METHODS

This is a case control study carried out on 30 haemophilic patients and 30 age-matched healthy controls. They were selected from the outpatient clinic of the Hematology unit of Mansoura University Children's Hospital after exclusion of any case with morbid obesity or cerebral palsy and exclusion of four hepatitis B & C-virus infected cases. All patients in the study were subjected to complete thorough history taking and physical examination. Virology markers was done to 34 cases of hemophilia and 4 cases showed positive hepatitis B-surface antigen and/ or hepatitis C-antibody and were excluded from the study. Anthropometric measurements were done to all cases. To facilitate interpretation of patient and control anthropometric data, the values for weight, height and BMI were converted to z-scores by using United States revised growth charts (Kuczmarski et al,2000).

Joint evaluation: Lower limb joints (knee and ankle) was evaluated by using Colorado PE-0.5 : Half Point Instrument, according to published guidelines for joint evaluation among patients with hemophilia (Manco-Johnson et al, 2000). Evaluations included assessment and grading of swelling, muscle atrophy, joint deformity, presence of crepitus, range of motion, presence of flexure contracture, strength and pain at rest and during activity. Each joint was ascribed a score. Normal joints were scored as 0, and the highest score possible for the knee or ankle was 25. The highest total joints evaluation scores (sum of scores for both ankles and both knees) was 100. The total joints evaluation scores and the maximal single joint evaluation scores were used in the analysis. The joint evaluator was blinded with respect to the bone density results (it was performed before doing DEXA scanning). All control subjects were healthy children so their joints suspected to be healthy, and consequently no joint evaluation was done to them.

DUAL ENERGY X-RAY ABSORPTIOMETRY (DEXA) SCANS:

Lunar DPX-IQ USA apparatus consists of scan arm, which includes X-ray source that provides a greater photon flux at two energies, its beam collimation is tight, and with a high spatial resolution. Also, it includes scan table and control panel supported by version 4.3 software. The scanning time is short, the radiation dose and the precision error is reduced.

DPX-IQ permits relatively rapid (10-20 minutes) and precise (1% error) determination of whole BMC and BMD. Skeletal areas of interest can be selected and measured with high precision (Mazess, 1990). DEXA scans were performed in endocrinology and diabetes unit of MUCH. All patients were clinically well at the study during DEXA scans performance and each case was studied on one occasion. All scans for the study were performed without sedation of the cases. BMD and BMC were done on lumbar spine region focusing on (L2- L4) to all patients. It is the most preferable site in the spine, as measurements in the thoracic spine are complicated by air in the lungs (which alters the soft tissue baseline) and the presence of the ribs and sternum overlying the scan field (Peel et al, 1993). All patients were compared to 30 healthy age and sex matched Egyptian controls taken from their data in endocrinology and diabetes unit of MUCH (El- Ziny et al, 2005).
HOW BMD OF AN INDIVIDUAL BE EXPRESSED?

The BMD of an individual patient can be expressed in different ways. Because normal values decrease with age, it is convenient to express data in terms of z-scores. The score represents the difference between actual and the age & sex adjusted theoretical normal mean, it is expressed as a fraction of standard deviation, which permits integration of both the variance of BMD among the normal population and the decrease in BMD. DEXA, unlike all other methods, provides regional information that is critical for many clinical and sport medicine application (Mazess, 1990). In our study BMD values were expressed both in gms/cm\(^2\) and as a z-score. A z score is defined as the number of SDs above or below the mean, determined using age- and gender-matched reference data. z-score was assessed by using the mean and SD of the 352 healthy Egyptian children and adolescents as follows: Z-score = (patient BMD – mean BMD) / SD , the mean and SD are derived form El-Ziny Egyptian growth charts 2003. The expected mean z score for a normal population is 0. Mild osteopenia is considered in patients with Z-score between (-1 to < -2 ) and severe osteopenia in patients with Z-score (-2 SD or more negative ) (Munoz Torres et al, 1996).

Grouping of patients according to the level of osteopenia:

Group with normal BMD (Z-score < ± 1 SD ), group with mild osteopenia ( Z-score -1 to < 2SD ), group with severe osteopeni (Z-score -2SD or more negative ) (Munoz Torres et al, 1996).

RADIATION SAFETY

X-RAY RADIATION EXPOSURE

The system makes radiation when electric voltage is supplied to, and current flows through, the X-ray tube. During a scan, the shutter opens to let a narrow beam of radiation pass through the scan table and patient. The size of radiation field at the table top is less than 4.00mm in diameter. Lead oxide shielding surrounds the X-ray tube insert inside the tube housing assembly and reduces radiation levels around the scan table (http://www.Lunercorp.com).

SKIN ENTRANCE EXPOSURE

Operator exposure at one meter from the X-ray tube is less than 1 µGy/hr. The average per capita background exposure in the U. S. is 1.400-3.000 µGy/hr. Currently, most areas require sufficient shielding to reduce exposure to the general population to less than 5.000 µGy/ year. Several areas have recently adopted a more conservative limit of 1.000 µGy/year. The typical radiation exposure from an AP chest film is 3000 µGy. Use these values to compare the relative risk of the bone densitometer (http://www.Lunercorp.com)

STATISTICAL ANALYSIS

Statistical analysis of data was performed using Statistical Package for Social Science (SPSS) program version 10, 1999 (SPSS,1999). Kolmogrov Smirnov test was used to evaluate the distribution of data. The quantitative data were presented as mean + SD. Kruskal–Walis one way ANOVA test was used to compare the means of more than two groups. Mann–Whitney U test was used to compare the means of two groups. Spearman rank correlation coefficient was used to study the linear relationship between two variables. The difference between means was considered significant when the P< 0.05; and highly significant when P< 0.001(Armitage and Berry, 1994)

RESULTS

Both groups of hemophilics (30 cases) and control (30 cases) were comparable as regard age and anthropometric measurement (Height z-score, Weight z-score, and BMI z-score). Of importance here, is the young age of hemophilics and controls (4.97+3.64 versus 5.09+3.64 years, p=0.9). BMD and BMD z-score were significantly reduced in hemophilics compared to controls (BMD: 0.48+0.13 for hemophilics versus 0.55+0.14 for control, p=0.05, BMD z-score: -0.68+1.44 for hemophilics versus 0.19+0.64 for control, p=0.003). Also, the subgroup of severe hemophilia (factor level assay less than 1%, 9 cases) has a reduced BMD and BMD z-score in comparison with controls (BMD: 0.41+0.15 gm/m\(^2\) for severe hemophilic patients versus 0.55+0.14 gm/m\(^2\) for controls, p = 0.01, BND z-score: -1.49+0.12 for severe hemophilic patients versus 0.19+0.14 for controls p=0.001). Hemophilia A (21 cases) has a more reduced BMD than Hemophilia B (9 cases) and controls (BMD z-score: -0.82 for hemophilia A, -0.37 for hemophilia B, and 0.19 for control, p=0.008). From the joint evaluation and scoring we found that the mean of maximum single joint score was (2.47± 3.03) of a possible 25 (range 0.0 - 11.0) and the mean total joint score was (4.0± 5.22) of a possible 100 (range 0.0 - 18.0). In the current study, there was significant inverse correlation between BMD z-score and total joint scores (r= -0.365 & P=0.048), and insignificant inverse correlation between BMD z-score and single joint scores (r= -0.298 & P=0.11). In other words, the more increase in joint scores, the more decrease in BMD z-scores and so the more appearance of osteopenia.
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Figure 1
Table 1: Comparison of hemophilic patients & controls as regard the age and anthropometric measurements

<table>
<thead>
<tr>
<th></th>
<th>Hemophilia (N=30)</th>
<th>Control (N=30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean 4.97 SD 3.64</td>
<td>Mean 5.09 SD 3.64</td>
<td>0.904</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>Mean 106.10 SD 25.06</td>
<td>Mean 105.03 SD 23.63</td>
<td>0.866</td>
</tr>
<tr>
<td>Height z-score</td>
<td>Mean 0.20 SD 1.57</td>
<td>Mean -0.10 SD 0.94</td>
<td>0.365</td>
</tr>
<tr>
<td>Weight (kgs)</td>
<td>Mean 20.48 SD 11.53</td>
<td>Mean 20.92 SD 11.87</td>
<td>0.886</td>
</tr>
<tr>
<td>Weight z-score</td>
<td>Mean 0.16 SD 1.23</td>
<td>Mean 0.15 SD 0.75</td>
<td>0.964</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>Mean 16.76 SD 2.08</td>
<td>Mean 17.33 SD 2.19</td>
<td>0.307</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>Mean 0.08 SD 0.89</td>
<td>Mean 0.30 SD 0.80</td>
<td>0.318</td>
</tr>
</tbody>
</table>

Mann–Whitney U test, P is significant ≤ 0.05.
BMI = Body mass index, SD = Standard deviation

Figure 2
Table 2: Comparison between hemophils and controls as regard BMC, BMD and BMD z-score

<table>
<thead>
<tr>
<th></th>
<th>Hemophilia (N=30)</th>
<th>Control (N=30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC gm</td>
<td>Mean 10.01 SD 5.61</td>
<td>Mean 11.91 SD 5.27</td>
<td>0.183</td>
</tr>
<tr>
<td>BMD Gm/m²</td>
<td>Mean 0.48 SD 0.13</td>
<td>Mean 0.55 SD 0.14</td>
<td>0.05</td>
</tr>
<tr>
<td>BMD z-score</td>
<td>Mean -0.68 SD 1.44</td>
<td>Mean 0.19 SD 0.64</td>
<td>0.003*</td>
</tr>
</tbody>
</table>

Mann–Whitney U test *P is significant < 0.05. BMC Bone Mineral Content
BMD Bone Mineral Density, BMD z-score Bone Mineral Density z-score

Figure 3
Table 3: Assessment of BMD, BMC and BMD z-score in severe hemophilic patients and controls

<table>
<thead>
<tr>
<th></th>
<th>Severe Hemophils N=9</th>
<th>Control N=30</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC gm</td>
<td>Mean 9.60 SD 6.19</td>
<td>Mean 11.91 SD 5.27</td>
<td>0.276</td>
</tr>
<tr>
<td>BMD Gm/m²</td>
<td>Mean 0.41 SD 0.15</td>
<td>Mean 0.55 SD 0.14</td>
<td>0.012*</td>
</tr>
<tr>
<td>BMD z-score</td>
<td>Mean -1.49 SD 1.12</td>
<td>Mean 0.19 SD 0.64</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

Mann–Whitney U test *P is significant < 0.05, **P is highly significant

Figure 4
Table 4: Comparison of the two types of hemophilia in relation to controls as regard BMC, BMD and BMD z-score

<table>
<thead>
<tr>
<th></th>
<th>H.A (N=21)</th>
<th>H.B (N=9)</th>
<th>Control (N=30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC gm</td>
<td>Mean 9.93</td>
<td>Mean 10.21</td>
<td>Mean 11.91</td>
<td>0.411</td>
</tr>
<tr>
<td>BMD Gm/m²</td>
<td>Mean 0.47</td>
<td>Mean 0.49</td>
<td>Mean 0.55</td>
<td>0.154</td>
</tr>
<tr>
<td>BMD z-score</td>
<td>Mean -0.82</td>
<td>Mean -0.37</td>
<td>Mean 0.19</td>
<td>0.008*</td>
</tr>
</tbody>
</table>

Kruskal–Wallis oneway ANOVA test, *P is significant < 0.05
H.A = Hemophilia A, H.B = Hemophilia B

Figure 5
Table 5: The values of single and total joint scores in hemophilic patients

<table>
<thead>
<tr>
<th>Joint score</th>
<th>Numbers</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single joint score</td>
<td>30 cases</td>
<td>11.0</td>
<td>0.0</td>
<td>2.47 ± 3.03</td>
</tr>
<tr>
<td>Maximal joint score</td>
<td>30 cases</td>
<td>18.0</td>
<td>0.0</td>
<td>4.00 ± 5.22</td>
</tr>
</tbody>
</table>

SD = Standard deviation
Table 6: Correlation between BMD z-scores in relation to single and total joint scores in hemophilic patients

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMD z-scores</td>
<td>0.283</td>
<td>0.365</td>
</tr>
<tr>
<td>r</td>
<td>0.110</td>
<td>0.048*</td>
</tr>
</tbody>
</table>

Spearman rank correlation, *P is significant < 0.05, r = Correlation Coefficient.

Figure 6
Table 6: Correlation between BMD z-scores in relation to single and total joint scores in hemophilic patients

Figure 7
Figure 1: Correlation between maximum single joint score and BMD z-score r = -0.298, P = 0.110

Figure 8
Figure 2: Correlation between total joint score and BMD z-score r = -0.365, P = 0.048

Figure 9
Figure 3: Correlation between the degree of severity of hemophilia and BMD z-score : r = -0.404, P = 0.027

Figure 10
Figure 4: Comparison between hemophilics and controls as regard BMD z-score (p=0.003)
DISCUSSION

Generalized reduced bone mineral density and haemophilia are disorders of significant socioeconomic magnitude, both of which have a marked impact on the individuals' quality of life. The simultaneous occurrence of both illnesses and possible connections between the two has to our knowledge hardly been assessed in younger pediatric age. In this study, the comparison of haemophilic patients & controls as regard the age showed no significance difference (P= 0.9). We intended to select most of the cases of the young haemophilics because they are suspected to be less frequently exposed to recurrent joint trauma, haemarthrosis or established haemophilic arthropathy than the oldest cases to see if reduced bone mineral density in haemophiliacs is strictly associated with joint affection or not. To our knowledge, this is the first study assessing the generalized reduced bone mineral density in young haemophiliacs (age 4.97±3.64 years). Barnes et al, 2004 studied the bone mineral density in haemophilic patients by using the densitometry method. In their study, the mean age was (12.2± 3.5 years) for haemophiliacs versus (12.8± 2.1 years) for controls (P=0.4). So the old age of their cases than ours made them more exposed to recurrent trauma and joint affection which by turn elevated their joints scores and seems to be the aetiology of affection of bone mineral density in their study. In our study, we compared between all haemophilic cases and controls as regard BMC, BMD and BMD z-score. There was a significant difference between the both groups as regard BMD z-score (P=0.003). This proves that there is a reduced bone mineral density in haemophiliacs compared to controls. While Upelchurch et al, 1989 described regional loss of bone mass in close proximity to joints affected by haemarthropathy, our results suggest that haemophiliacs have a systemic loss of BMD. As physiologically observed in the normal population, haemophiliacs also loose bone mass with increasing age (Klibanski et al, 2000). Yet abnormally, average BMD is already pathological in young haemophiliacs when one would expect bone mass to reach its peak (Barnes et al, 2004). This data nourishes the hypothesis that young haemophiliacs may never reach the peak bone mass reached by a comparable healthy cohort (Wallny et al, 2007). Comparing a subgroup of haemophiliacs which are the severe group (factor assay levels were less than 1%) versus controls, we found that there was significant difference between both groups as regard BMD and BMDz-score (P=0.012 & 0.001 respectively). These results match with the results of only two studies done previously on the bone mineral density of haemophiliacs. The first study by Gallacher et al, 1994 who investigated the incidence of reduced bone mineral density (BMD) among adult patients with haemophilia by a densitometric and biochemical study. The study reported a reduction in bone mineral density among 19 adult patients with severe haemophilia (age range 18-69 years). There was no difference in markers of bone resorption between patients and control subjects, suggesting that the reduced bone density was not secondary to increased bone turnover. Barnes et al, 2004 also estimated the bone mineral density in 19 severe haemophilic children by using QDR 4500 Elite densitometer (Hologic, Bedford, MA, USA). The BMD for control subjects (215 ones) was measured by using a Hologic QDR 2000 densitometer and the results of the two Hologic densitometers were directly comparable. They studied the bone mineral density by focusing on the spine of the cases. They found no significant difference between patients and controls as regard BMC and BMD (P=0.38 & 0.07 respectively) but there was a significant difference as regard BMD z-score (P=0.001). This is nearly similar to our results. Although both groups of haemophilia (A,B) were affected as regard BMD z-score, but haemophilia A has more severe manifestation and affection of both joints and bone, so has a more severe affection of BMD (BMD z-score is -0.816 & -0.36 for haemophilia A, haemophilia B respectively) than haemophilia B (Mannucci, 2002). In Barnes et al, 2004 study, they selected the severe cases only and didn't classify haemophilia according to severity or its type. From the joint evaluation and scoring we found that the mean of maximum single joint score was (2.47) of a possible 25 (range 0.0 - 11.0) and the mean total joint score was (4.0) of a possible 100 (range 0.0 - 18.0).
However in Barnes et al, 2004 study, they made the joint evaluation and scoring using the same method of joints evaluation. They reported that the mean of maximum single joint score was (5.3) of a possible 25 (range 1.0 - 10.0) and the mean total joint score was (9.9) of a possible 100 (range 2.0 - 24.0). By comparing the two results, we found that our patients values were less than their patients values and this matches with the younger ages of our patients and less joints affection of them. In the current study, there was significant inverse correlation between BMD z-score and total joint scores ($r= -0.365$ & $P=0.048$), and insignificant inverse correlation between BMD z-score and single joint scores ($r= -0.298$ & $P=0.11$). In other words, the more increase in joint scores, the more decrease in BMD z-scores and so the more appearance of osteopenia. This results match with the results of Barnes et al, 2004 where they found a significant correlation between reduced bone density and joint evaluation scores in the severe haemophilic cases. Exception was that, some cases in our study with lower joint scores having osteopenia (patients number 11,19,23). This result proves that osteopenia in haemophilic patients are not only due to joints affection and immobilization but also may be due to other etiology, such as sport restriction of those patients for fear of trauma and bleeding. Another significant inverse correlation existed between BMD, BMD z-score and the degree of severity of haemophilia ($r= -0.45, P=0.012$ for BMD & $r= -0.404, P=0.027$ for BMD z-score). An insignificant inverse correlation between BMC and the degree of severity of haemophilia was seen. So, the more the degree of severity of haemophilia the more decrease in BMD, BMC and BMD z-scores so the more appearance of osteopenia. Our results are also indirectly supported by a study done by Wallny et al, 2007 and Dunn et al, 2004 who reported that degenerative joint disease due to recurrent haemarthrosis is a source of substantial morbidity for patients with moderate or severe haemophilia A or B. In most patients, the frequency of joint bleeding is inversely proportional to the circulating level of clotting factor and the joints which most commonly involved are the ankles, elbows, and knees. In our study we excluded the already infected cases with hepatitis viruses in order to avoid the secondary effects on the liver functions and the impairment of vitamin D metabolism. In Gallacher et al, 1994 study, they found that minor abnormalities in liver function tests and testosterone metabolism among the patients with hemophilia were suggested to be secondary to hepatitis C-associated liver disease and the likely cause of the reduced BMD in their study. Also Barnes et al, 2004 found eight patients in their study had been only exposed to hepatitis C and no one of them was receiving treatment of liver disease. They found that there was no significant difference in bone density between those patients and the patients who had not been exposed to hepatitis C. They also mentioned that if the hepatitis C-associated liver disease progressed, it might have significant effects on bone density among those patients. Tsuneoka et al, 1996 supported these results in their study done on BMD of the second to fourth lumbar vertebrae determined with a Lunar (Madison, WI, USA) DPX, a Dual-Energy X-ray Absorptiometry diagnostic system. BMD was significantly lowest in patients with liver cirrhosis, followed by patients with chronic hepatitis, and healthy subjects, in this order. There was a significantly positive but weak correlation between albumin and BMD. Also levels of 25(OH)D and 1,25(OH)2D were significantly lower in patients with liver cirrhosis than in those with chronic hepatitis. All these results complete our idea about the state of bone mineral density in haemophilic patients and the aetiologies which causes osteopenia in them like immobilization due to joint affection or arthropathy and may be also due to sport restriction which was supported by the study of Fuchs and Snow, 2002. They studied gaining in hip bone mass from high-impact training, where they found gains in BMC at the femoral neck from high-impact jumping and concluded that this simple exercise may be useful in promoting bone growth at the hip and, thus, enhance peak bone mass (Fuchs and Snow, 2002).

CONCLUSION

We concluded a reduced generalized bone mineral density in the young haemophiliacs due to painful haemophilic arthropathy with consecutive immobilization that lead to reduction of bone mass owing to lack of activity, which is known to be an important stimulus for physiological bone metabolism. Patients with haemophilia and reduced bone mineral density (BMD) may be at increased risk of fractures and osteoporosis in later life.

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References

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r-20. SPSS: Statistical Package for Social Science, standard version 10.0.1; (1999); SPSS Inc., Chicago, IL.


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