



## A significant diagnostic method in torture investigation: Bone scintigraphy

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### ABSTRACT

Torture appears to be a permanent feature in countries, which have experienced military coups or ruled by oppressive governments in the past, such as Turkey. The Human Rights Foundation of Turkey (HRFT) was established in 1990 to serve torture victims, mainly those who were the victims of the 1980 military regime. Since then the HRFT has been providing rehabilitation and documentation for torture survivors. Bone scintigraphy can be one of the diagnostic methods to reveal trauma, particularly after several years when it is challenging to find any physical or radiological evidence. The HRFT's Istanbul Branch referred 97 of their applicants for bone scintigraphy between 1992 and 2010. In this retrospective survey of 97 cases, 17 of them were female and 80 of them were male. Several aspects were evaluated, including working conditions, change of torture methods practiced in certain time periods, time since torture and duration of exposure to torture in comparison with findings of bone scintigraphies. The torture methods varied from beating to falanga, electric shock, suspension and several other types of torture within the period of practice, although beating was a common denominator among all. The findings were classified according to time since torture and duration of exposure to torture. More than half of the cases (59%) had a detectable bone lesion on bone scintigraphy, and the detectable bone lesion on scintigraphy increased significantly with the duration of exposure to torture, particularly among cases who had been subjected to torture for a longer period (8 days and more). Bone scintigraphy should be considered as a valuable non-invasive diagnostic method to assess and document long term torture practices and/or cases with no detectable marks upon physical examination.

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### 1. Introduction

Torture appears to be a permanent feature in countries, which have experienced military coups or ruled by oppressive governments, such as Turkey. Since 1980 military coup there have been approximately 1 million torture survivors in Turkey. Unfortunately torture still persists in many aspects of public life [1].

The Human Rights Foundation of Turkey (HRFT) was established in 1990 to serve torture survivors, mainly those who were victims of the 1980 military regime. Since then HRFT has been providing rehabilitation and documentation for torture survivors.

Medical proof of torture is usually difficult to obtain, especially with the torture methods, which keep external signs of injury to a minimum or none [2]. Many forms of physical torture result in bone damage, which can to some extent be detected by

radiography as the primary diagnostic tool for the detection of skeletal trauma. However, radiography sometimes fails to detect injuries such as occult fractures and periosteal damages [3,4]. Bone scintigraphy can be used as a diagnostic method to reveal trauma, particularly after several years when it is challenging to find any physical or radiological evidence [3–6].

Bone scans performed with Technetium 99m Phosphate compounds and any hyperactivity on bones is accepted to be positive [4–7]. Scintigraphy is a sensitive method of detection of primary and metastatic skeletal neoplasms, metabolic bone disease and various joint abnormalities [8–12]. The procedure is also helpful for assessment of skeletal trauma caused by torture (falanga and beatings that cause bone lesions) [4–6]; or electrical burns that generally cause deeply invasive soft tissue injuries [13,14]; child abuse [15–17] and other traumatic injuries [18,19].

Bone scintigraphy might be a valuable tool for assessment and corroboration of alleged torture after many years since the data results of the HRFT, Istanbul Branch indicate significant correlation of trauma and focal bone lesions. Whilst the evidence of trauma related with alleged torture can be revealed and thus documented with this method even several years after the event, this

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documentation can later serve as valid evidence in court and also be used in international monitoring.

## 2. Materials and methods

From 1992 to 2010, a total of 4450 torture survivors applied to HRFT's Istanbul Branch for treatment, rehabilitation and documentation. All files were reviewed retrospectively and only the patients' files that included bone scintigraphy scans were enclosed in this study. Scintigraphy was carried out for patients where, despite a history of trauma, absence of physical and radiological findings, and wherever physical evidence was essential for documentation. Bone scans were performed on 107 torture victims. Ten patients with systemic disease such as osteomyelitis, tuberculosis, and cancer were excluded from the study. This study included 97 patients, and 57 of them had a traumatic hyperactivity on scintigraphy reports. Bone scintigraphy was performed 2.5 h after i.v. injection of  $^{99m}\text{Tc}$  diphosphonates on a gamma camera. The bone scans were performed in three different centers and evaluated by experienced nuclear medicine physicians.

A multidisciplinary team of physicians and specialists of different disciplines according to the individual needs examined every patient. Working conditions, change of torture methods practiced in certain time periods, time since the torture, duration of exposure to torture experiences, physical findings and bone scintigraphies on their files were evaluated. Unless otherwise stated, the values are presented as mean  $\pm$  standard deviation (SD) or percentage as appropriate. Descriptive statistics were made by standard methods. For comparison of the groups Chi-square tests were used in categorical variables. All statistical tests were two-tailed and a  $P$  value  $< 0.05$  was considered to be statistically significant. The statistical analysis was carried out by using Statistical Package of Social Science (SPSS), version 16.0 (Chicago, IL, USA). Ethic principles were complied.

## 3. Results

In this retrospective survey, 17 (18%) were female and 80 (82%) were male. Their mean age at the time of torture was  $30.63 \pm 8.2$  years (range 17–68). 57/97 patients were reported focal enhanced uptake on the bone scintigraphy. The mean age of patients with increased uptake on bone scan was  $31.01 \pm 8.3$  (range 18–56). 11 (19%) of them were female, 46 (81%) were male.

Thirty-four of them had applied between 1992 and 1999, while 11 patients had applied between 2000 and 2003, and 12 had applied between 2006 and 2010. There were no patients who had a bone scintigraphy in the years 2004 and 2005.

In total, 97 files of patients with a story of torture ranging from 5 days to 12 years ago were evaluated. All of them allegedly had been beaten, and 57 of them (59%) severely with hard objects such as gun butts, truncheon, clubs, or suffered punching, kicking. 12 (12%) of them suffered only beating, while remaining 85 (88%) declared that they had been subjected to multiple torture methods such as beating, pressurized cold water, cross suspension, Palestinian suspension, electric shocks, sexual abuse, rape, falanga, testicle torsion, asphyxiation, thermal torture, etc.

The time since torture was evaluated in three phases. The acute phase ranged from 5 to 30 days after the torture, the subacute phase ranged from 1 to 6 months and the chronic phase was 7 months or more after the torture. Table 1 demonstrates the time since torture phases on patients with enhanced uptake and without pathological uptake on scintigraphy.

**Table 1**  
Time since torture phases in patients with enhanced uptake and without pathological uptake on bone scan.

Time since torture	Enhanced uptake		Without pathological uptake		Total	
	n	(%)	n	(%)	n	(%)
Acute (5–30 days)	33	(62)	20	(38)	53	(54)
Subacute (1–6 months)	14	(56)	11	(44)	25	(26)
Chronic (7 mo and $\uparrow$ )	10	(53)	9	(47)	19	(20)
Total	57	(59)	40	(41)	97	(100)

**Table 2**

Time since torture and duration of exposure to torture in patients with enhanced uptake on bone scan.

Time since torture	Duration of torture n (%)		
	1–7 days	8 days and $\uparrow$	Total
Acute (5–30 days)	29 (88)	4 (12)	33 (58)
Subacute (1–6 months)	9 (64)	5 (36)	14 (24)
Chronic (7 mo and $\uparrow$ )	3 (30)	7 (70)	10 (18)
Total	41 (72)	16 (28)	57 (100)

Chi-square: 13.270,  $P$ : 0.0013.

When examining the duration of exposure to torture, we found that these periods were subject to changes over the years. In the 1992–1999 period (during these years the military regime in Turkey was still influential), duration of exposure to torture increased up to 183 days, and the mean time was 35 days. The mean time was 7 days, and it increased up to 14 days in the state of emergency during the years from 2000 to 2010.

The findings were classified according to the time since torture and the duration of exposure to torture. Table 2 demonstrates the number of patients with enhanced uptake on scans according to time since torture and of exposure to torture. It was highly significant that if the duration of exposure to torture period had been longer (8 days and more), the detectable bone lesion on bone scintigraphy rate increased significantly ( $P$ : 0.0013). Table 3 demonstrates the number of patients without pathological uptakes on scans according to time since torture and of exposure to torture. Results of this table are not significant statistically ( $P$ : 0.2572).

10 patients with enhanced uptake on bone scan were allocated to the chronic phase. Seven of them had exposure to torture for more than 8 days and their time since torture periods were as follows: 12 years, 8 years, 6 years, 1.5 years, 8 months, 8 months, 7 months. Three of the patients in chronic phase after torture had been exposed to torture for less than 8 days and the time period since the torture were 7 years, 5 years and 1 year. They were subjected to severe torture methods several times.

Patients with enhanced uptake on bone scan did not exhibit a correlation between the time since torture with age ( $P$ : 0.05) or gender ( $P$ : 0.22). Forty-six (81%) of patients with enhanced uptake were male (mean age was  $32.4 \pm 8.1$ , range 19–56), and 11 (19%) were female (mean age was  $25 \pm 5.8$ , range 18–35). Thirty-nine (68%) of them were 35 years old and younger while 18 (32%) of them were elder than 35 years.

Regarding their work conditions, there were no patients such as marathon runners, football or basketball players, or any heavy industry workers among these patients with pathological uptake on scan.

## 4. Discussion

In the military regime period in Turkey, torture survivors were kept in detention centers for a very long time. According to our results, the duration of exposure to torture period extended up to 1–6 months in between 1992 and 1999 (while the military regime was still influential). The mean time was 35 days in 1992–1999 and 7 days in 2000–2010. Therefore, physical signs of torture could not be detected and documented efficiently.

Medical proof of torture is usually difficult to obtain, and sometimes it is necessary to use advanced diagnostic methods and comprehensive evaluation for diagnosis of torture. Accordingly, bone scintigraphy is a helpful tool for revealing evidence of torture. The most important aspect of evaluation and documentation of traumatized patients are to apply the holistic approach that facilitates differential diagnosis of torture and other types of

**Table 3**

Time since torture and duration of exposure to torture in patients without pathological uptake on bone scan.

Time since torture	Duration of torture n (%)		
	1–7 days	8 days and ↑	Total
Acute (5–30 days)	18 (90)	2 (10)	20 (50)
Subacute (1–6 months)	11 (100)	0 (0)	11 (27.5)
Chronic (7 mo and ↑)	7 (78)	2 (22)	9 (22.5)
Total	36 (90)	4 (10)	40 (100)

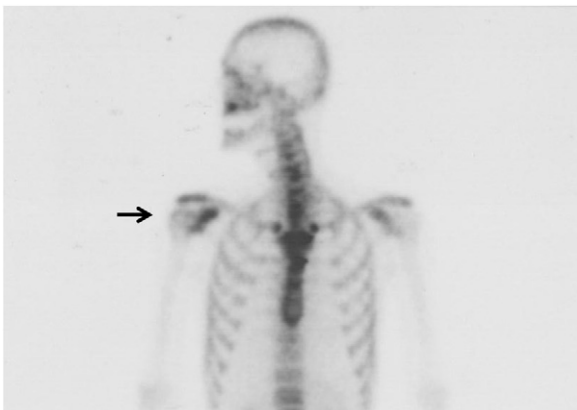
Chi-square: 2.716, *P*: 0.2572.

trauma. A holistic approach should consist of trauma type, frequency, application time, event history, as well as physical and psychological findings. Istanbul Protocol is a guideline that describes this holistic assessment [2].

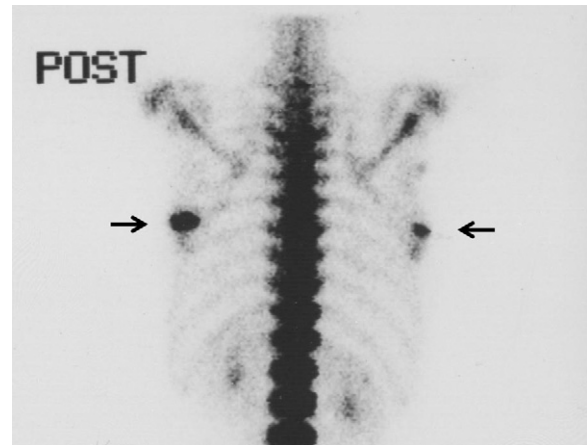
Previous studies have examined evidence of trauma, especially when the patients have no physical findings [4–6,20–22]. Lok et al. [4,5] evaluated the bone scintigraphy as evidence of previous torture. They found that the detectable bone lesion on bone scintigraphy rate was very significant (58%) in all patients and the mean time since the exposure of patients in chronic phase after torture was 10.5 years. In this study, the detectable bone lesion on bone scintigraphy rate is 59% in all patients, and very similar to Lok et al. Mirzaei et al. [6] evaluated 25 asylum seekers who were subjected to severe beating from 4 to 24 months after torture. They showed that bone scintigraphy is a highly sensitive and useful tool to document trauma consistent with allegation of torture, even 1–2 years after torture.

One of the most important results of this study is that if the duration of exposure to torture period had been longer (8 days and more) the detectable bone lesion on scintigraphy rate increased significantly (see Table 2). This result is very similar to the result of Lok et al. [4,5]. Hence the relationship between exposure to torture period and no uptake on scan would support this result. However results of Table 3 are not found significant which might be considered as a result of the relatively low number of cases.

In this study, increased duration of exposure to torture had a strong correlation with the detectable bone lesion on bone scan, particularly in the chronic phase. 10 patients assigned to this phase had an enhanced uptake on scans. Seven of them had been exposed to torture more than 8 days and three cases for less than 8 days (see Table 2). Therefore scintigraphy is recommended as a diagnostic method for all patients in chronic phase after torture.



**Fig. 1.** Hyperactivity in right shoulder joint.

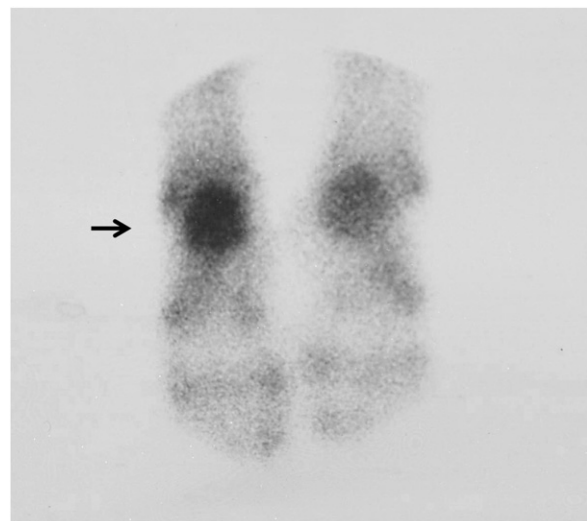


**Fig. 2.** Hyperactivity in the end of scapulars.

Mean duration after torture for the detectable bone lesions is 5.5 years, which indicates added diagnostic value for patients in chronic phase after torture. The detectable bone lesion on bone scintigraphy for one patient even after 12 years supports this statement. The main reason for this result can be assumed to be the duration of exposure to torture. The patient had been tortured for 183 days in the detention center in 1992.

The other important aspect of these results was that the findings of bone scan were consistent with the trauma history explained by the patient. The history of the patient in chronic phase 12 years was highly specific. The patient had been subjected to beating, Palestinian suspension, falanga, electric shock and had been dragged down the stairs by the feet three or four times, causing the head to hit the concrete steps in the detention center. Hyperactivity on the occipital bone was detected on the bone scintigraphy scan. This finding was highly consistent with his trauma history.

The other patient, an 8 years after torture, was subjected to beating and pulling of the arm while his right shoulder was pressed with a foot in several times. This was highly consistent with the hyperactivity on the medial area of the right shoulder joint on the scintigraphy scan (Fig. 1). Detailed history is the most important issue of the differential diagnosis of torture and other possible types of trauma, especially when examination of patients in



**Fig. 3.** Hyperactivity in the right ankle.

chronic phase after torture. We adopted Istanbul Protocol principles for evaluation of the coherence with the history and findings.

All of the patients reported repetitive and severe beatings and various forms of torture methods. Therefore differential analysis between methods is not easy. The bone scans showed various combinations of hyperactive foci on ribs, shoulder joints (Fig. 1), scapulars (Fig. 2), ankles (Fig. 3), knee joints, metatarsal bones, and metacarpophalangeal bones while there were no degenerative disease of bone and joints.

Severe, long lasting and recurrent torture methods such as falanga and severe beatings may cause (presumably irreversible) periosteal reaction and occult fracture that cannot be detected clinically and radiologically [4]. In addition, we have 41% of patients without pathological uptake on scans with severe torture history. Many factors such as severity and frequency of trauma, age, gender, health condition, body structure and type of trauma can affect this situation.

We were not able to use a control group of individuals with the same age and sex distribution who had no history of torture because of the retrospective nature of the study and we were not able to follow-up with any patient because of their unsettled lifestyles.

## 5. Conclusion

Bone scintigraphy should be considered as a valuable non-invasive diagnostic method to evaluate and document traumatized patients with no detectable marks upon physical examination.

Despite this retrospective study has some limitations (the absence of a control group and follow up), this study revealed that bone scintigraphy is a highly useful tool to document trauma consistent with allegations of torture. This method of physical detection could be used to provide confirmation of testimony of torture. However, we recognize that well-organized prospective studies are needed.

## Conflict of interest

The authors declare that they have no conflict of interest.

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