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Scanning electron microscopy in discriminating between ricochet or direct bullet hitting the target- a case report

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ABSTRACT

A victim was shot using a 0.32 caliber revolver that might have been injured at the upper portion of the left chest region. A few days after the incident the accused confessed with his licensed weapon. Later, upon interrogation the accused had made a statement that he did not fire the victim directly instead, he fired the bullet inside the pub in air. He stated further that ricocheted bullet must have been hit the victim. Therefore there is a challenge before the Forensic Ballistician to scientifically establish whether the fired bullet is a direct or a ricocheted one. The study is pursued here through SEM-EDXA, Secondary electron image, profile analysis of hole portion of the jerkin of the victim and particles deposited on the nose portion of the bullet recovered from the injured body of the victim and their image comparison with a standard bone particles. The data obtained from the study is agreeing that the bullet fired from the 0.32 caliber revolver might have hit the victim directly and reducing the possibility of ricochet bullet injury. © 2009 Trade Science Inc. - INDIA

KEYWORDS

Forensic ballistics;
SEM EDXA;
Stereo microscope;
Secondary electron image;
Ricocheted bullet.

INTRODUCTION

When searched for the literature related to ricocheted bullet phenomenon it is found that the bullet impact site was reconstructed excising the surrounding bone and realigning the bony fragments through a photographic study using an operating microscope and matching the bullet to the bone impact signature^[1]. There is an another report relating to detection of bone and bone plus bullet particles in back spatter from close range shot to head. In that two weapons are suspected to be involved and identified which weapon is actually involved in the offence^[2] with the help of scanning electron microscopy and energy depressive X-ray analyzer. In the analysis and discrimination of forensic soil and

sediment traces^[3,4]. SEM coupled with EDXA are also used in the characterization of GSR particles of lead free ammunition^[5,6] and GSR particles which are modified by target impact^[7] and also in detecting GSR particles found at the bottom of the discharged bullet^[8]. Therefore in the present case an attempt is made here through SEM coupled with EDXA^[2-8] analyses leading to discriminate between whether the fired bullet is a ricocheted or direct one.

Case history

A group of youngsters appeared to have gathered for a late night party organized in a pub. They were enjoying the party sitting across a table. Just behind their table family members were sitting across another

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table and having their dinner. Under the influence of alcohol one among the group of youngster uttered a few words looking at the family lady. That appeared to be enraged her husband to involve in an heated argument with the group. Under provocation and anger he was reported to be fired a bullet through his 0.32 revolver. One among the youngster had a bullet injury and the injured was shifted to an hospital for medical treatment.

MATERIAL AND METHODS

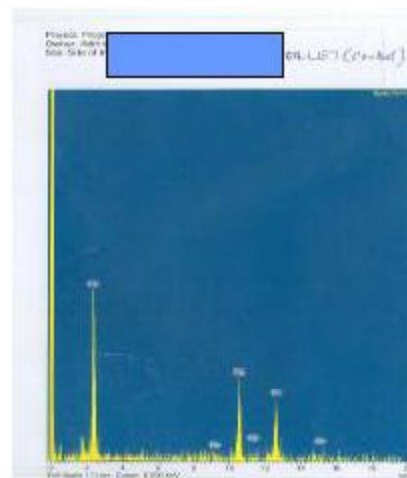
Examination of the scene of crime (Pub)

The spot, the front room of the pub where the firing reported to be taken place was examined. The room was searched thoroughly for evidence using high concentrated forensic search light but there was no ricocheted or direct dent/hole mark was noticed either on the floor, ceiling, side walls or on surroundings furnitures of the reported scene of crime.

A 0.32 caliber revolver, fired cartridge cases and live cartridges recovered from the accused and one jerkin and the bullet were reported to be recovered from the victim during medical examination. The recovered articles along with the injury report were produced to the laboratory for a forensic ballistics examination.

During examination of the bullet reported to be recovered from the victim was found to be 0.32 caliber lead bullet. The bullet was found to be having rifling marks with a slight deformation at its nose position. Further, the examination of the jerkin reported to be that of the victim has shown a bullet hole when viewed it under the stereomicroscope at high magnification. Later the bullet hole portion of the jerkin was carefully cut and subjected it to SEM coupled with EDXA for the identification of adhering foreign particles. The profile of the sample is showing the presence of only lead (Pb). (Spectrum-1).

Further, the recovered bullet was scanned at its various positions with the SEM- under different magnification. While scanning, the deformed nose position of the bullet, the secondary electron images under 600 magnification and 30 kv accelerating voltage of electron at an working distance 22.7 mm (Figure 2) had shown the deposition of some white particles. The



Sample Notes:

Spectrum processing :
No peaks omitted.

Processing option : All elements analyzed (Normalised).
Number of iterations = 1

Standard :
Pb - PbF2 - 1-Jun-1999 12:00 AM

Elem...	App...	Inten...	Wdig...	Wdig...	Atom...
	Conc.	Corr.			Sigma
Pb M	22.23	1.0397	100.00	0.00	100.00
Totals			100.00		

Figure 1 : EDXA spectrum of the bullet hole portion of the jerkin



Figure 2 : SEM image of white particles that are deposited on the nose portion of the bullet

EDXA elemental profile of the so found white particles is shown in the figure 3.

RESULTS AND DISCUSSION

The bullet hole portion of the jerkin that was subjected to EDXA analysis for the elemental profile had shown only the presence of Lead (Pb) with $K\alpha$ intensities (keV) $L\alpha$ intensity at 10.5517. Similarly, the elemental profile of the white particles that are deposited on the recovered bullet indicates the presence of car-

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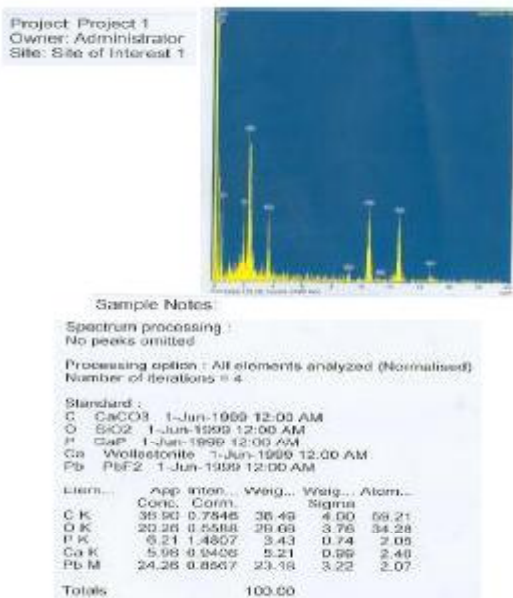


Figure 3 : EDXA spectrum of the white particles that are deposited on the nose portion of the bullet



Figure 4 : Scanned image of standard bone particles

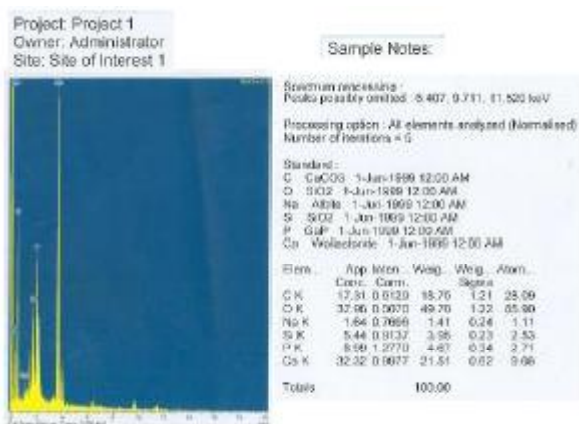


Figure 5 : EDXA spectrum of the standard bone particles

bon, oxygen, lead, phosphorous and calcium. The respective $K\alpha$ and $L\alpha$ intensities (keV) of the elements in that order are 0.2774, 0.5249, 10.5517, 2.0134 and 3.6905. The presence of phosphorous and calcium on the deformed nose portion of the bullet is suspected to

TABLE 1: The weight percent of the elements obtained for the cut portion of the hole of the jerkin, specimen and standard bone particle

Sl no.	Elements	Weight percent of the elements		
		Jerkin	Deformed nose portion of the bullet	Standard bone particles
1	Carbon	-	38.49	18.75
2	Oxygen	-	29.69	49.70
3	Calcium	-	5.21	21.51
4	Phosphorous	-	3.43	4.67
5	Lead	100	23.18	-
6	Silica	-	--	3.95
7	Sodium	-	-	1.41

be having the bone origin of the victim. To confirm it, the standard bone was scanned with SEM. EDXA under the condition of specimen for its particle structure (Figure 4). The SEM- EDXA profile of the standard bone (Figure 5) indicates the presence of the major elements that were almost identical with that of the white particles found deposited on the deformed nose portion of the bullet. The weight percent of the elements obtained for the specimen and standard bone are shown in. (TABLE 1).

Upon examination of the elemental profile obtained for bullet hole portion of the jerkin revealing the presence of only lead indicating that the hole might be due to the passage of lead projectile. Further, on comparison of the profiles obtained for white particles as identified by the secondary electron image at 600 magnification on the deformed nose portion of the bullet and the standard bone particles are almost confirming that the white particles found on the bullet are having the origin of the bone of the victim.

CONCLUSION

With all the above observations and the SEM and EDXA spectrums and images obtained are revealing that the bullet hole portion of the jerkin is containing only lead as a base element but there were no traces of any type of foreign materials such as soil and paint. Further, the white particles found deposited on the deformed nose portion of the bullet containing the elements, calcium, phosphorous and lead. The elements calcium and phosphorous appear to be having the bone particles of the victim. The crime scene examination indicates that neither the ricocheted nor the direct

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dent/hole mark was noticed either on the floor, ceiling, sidewalls or on the surrounding furnitures. Therefore the bullet fired from the 0.32 caliber revolver might have hit the victim directly and reducing the possibility of ricocheted bullet injury.

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REFERENCES

- [1] O.Brian C.Smith, M.D.Steven, A.Symes; Journal of Forensic Science, JFSCA, **36(6)**, 1736-1739 (1991).
- [2] B.RBurnett; Journal of Forensic Science, JFSCA, **36(6)**, 1745-1752 (1991).
- [3] Kenneth Pye, Debracraft; Forensic Science International, **165**, 52-63 (2007).
- [4] Salih Cenjiz, Ali Cinjiz Karaca, Ismail Cakr; Forensic Science Inter National, 141, 33-37 (2004).
- [5] Mathew J.Went, Michael J.Went; Forensic Science International, **31**, (2007).
- [6] A.Zeichner, H.A.Fomer, Dvorachek; Journal of Forensic Science, JFSCA, **34(2)**, 312-320 (1989).
- [7] M.S.Bryan Burnett; Journal of Forensic Science, JFSCA, **34(4)**, 808-822 (1989).
- [8] P.Bergmen, P.Enzel, E.Springer; Journal of Forensic Science, JFSCA, **33(4)**, 960-968 (1988).