Pattern of Firearm Discharge Residue on Cotton Cloth Substrate to Determine the Range of Firing by 7.65mm Caliber of Country Made and Standard Firearm: An Original Research Study

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Abstract

The main purpose of the study was to collect a data related to country made and standard firearm from close range on cotton cloth substrate to determine the range of firing, type of firearm used i.e standard or country made firearm as limited data are available for such lethality in india. The range of firing is very difficult to investigate by dispersion pattern of Gun Shot Residue in close range firing by country made pistol. This study was done to overcome that deficiency.

Method- This study over a period of 3 years was carried out on live cases brought to ballistics division of CFSL/CBI/New Delhi. Total No. of 180 samples were collected, from three different close range i.e., 4", 8" and 12"on cotton cloth substrate. 90 samples were collected by 7.6mm country made pistol and 90 samples were collected by 7.65mm standard pistol.

Result – Among 180 firing samples during study period, 30 firing has been done from each close range, from standard as well as country made pistol. The result showed the large variation in dispersion pattern of GSR from 4" range. At 4" distance, from country made pistol, the inner dispersion area of GSR was calculated i.e. **(7-19 cm^2 app.),** outer dispersion area of GSR was **(30-70 cm^2 app.)** whereas in case of standard pistol, the inner dispersion area of GSR was **(10-15 cm^2app.),** outer dispersion area of GSR was **(40-70 cm^2 app.)** .

Conclusions- It is found that large variation in dispersion pattern of GSR pattern has been observed, when firing has been done from country made pistol and standard firearm at 4" range. This study must be helpful in estimation of exact range of firing fired from close range by 7.65mm country made pistol and standard pistol by analyzing the dispersion pattern area of Gun Shot Residue.

Key words: *Firearm, Range of Firing, Country made firearm, Gun Shot Residue, Dispersion Pattern, 7.65mm caliber*

Introduction

In India, Country made firearms are most popular among criminals due to their easily availabity and cheap cost.

More than 75% of the cases related to firearms, country made firearms are used in the crime . The trend of country made firearms are increased in last few years. Country made firearms are more popular in UP, Bihar, Haryana and in some border states [1,2]. Use of country made firearm for crime is more common in Uttar Pradesh as compared to other states and firearm fatality rate in this city (Varanasi) was 3.1 per 1,00,000 population [3].

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Forensic experts are facing lots of difficulties in estimating the exact range of firing, in case where country made firearms are used, Particular attention can be drawn in case associated with unlicensed firearms and related evidences such as GSR.[4,5,6] GSR is also known as firearm discharge residue or Cartridge discharge residue. GSR is formed when a cartridge is being fired. When gun is being fired, it releases flame, smoke, burnt, unburnt and semi burnt particles along with bullet. These particles create a circular pattern on target area, when fired from close range.[7,8] Such type of pattern is known as dispersion pattern area of GSR. In this study, Author tried to estimate range of firing by calculating the dispersion pattern area of GSR from close range.

Material and Method

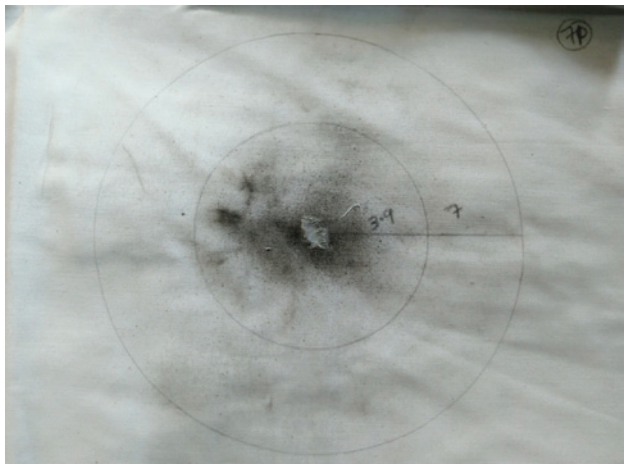
The present study was carried out in an indoor shooting range, of Ballistics division of CFSL/CBI/New Delhi, During period of 1st april 2015 to 22nd july 2018.. The ammunition used for test firing was manufactured by KF (Khadki Factory, Pune), 7.65mm caliber were used for test firing by standard and country made pistol.

The targets were made up of cotton cloth having size 45cm X 45cm (app.), fitted on cardboard sheet having size 40cm X 40cm (app.). The cardboard was fixed to recovery box , Recovery box was 120 cm above the ground. The firearm was fixed in the stand , in front of the target and their position adjusted at different distances according to firing range i.e. 4",8" and 12". Thereafter, GSR pattern on the cotton cloth target was collected carefully and digital camera was used for photographing the image. After that dispersion pattern of GSR was calculated by visual method by taking the outer radius of the circle (outer radius of the circle was taken from the center of the circle to the outer dispersion line) and then inner radius of the circle (inner radius was taken from the center of the circle to the inner dispersion line) and put the formula of area of circle ($A = \pi r^2$). By using this formula, we can find out the dispersion pattern area of the Gun Shot Residue.

Results and Discussion

Total No. of 180 samples were collected, from three different close range i.e., 4", 8" and 12"on cotton cloth substrate. 90 samples were collected by 7.6mm country made pistol and 90 samples were collected by 7.65mm standard pistol. Among 180 firing samples during study period, 30 firing has been done from each close range, from standard as well as country made pistol. The dispersion pattern was somewhat irregularly circular. To find out the dispersion Pattern area, First we can draw two circles, One circle is drawn near the outer dispersion pattern area and another circle is drawn near the inner dispersion pattern area. Now, the dispersion pattern area was calculated by taking the outer radius and inner radius (Outer radius was taken from the centre of bullet hole to the outer dispersion area and the inner radius was taken from the centre of bullet hole to the inner dispersion area), then the area of outer circle and inner circle was calculated by using the formula ($A = \pi r^2$) . By using this formula, the area of dispersion pattern of 7.65mm caliber of country made and standard firearms were calculated. It will help in estimating the range of firing.

How calculation of area of dispersion pattern was done to be demonstrated by taking an example, to be illustrated:



In this fig, First we can drawn outer circle near the outer dispersion pattern area, then we can drawn inner circle near the inner dispersion pattern area with the help of campass by taking bullet hole as a center, the radius of the circle was calculated with the help of ruler.

Area of outer dispersion pattern : Radius= 7 cm

Putting the value of radius in the formulae of area of circle ($A = \pi r^2$),

value of π is 3.14, A= 3.14 x 7cm x 7cm = 53.38 cm^2(app.)

Area of inner dispersion pattern : Radius= 3.9 cm

Putting the value of radius in the formulae of area of circle ($A = \pi r^2$),

value of π is 3.14, A= 3.14 x 3.9cm x 3.9cm = 47.75 cm^2(app.)

Total nos. of 30 firing has been done from each distance and area of dispersion pattern of GSR was calculated. Thereafter, average of all samples were taken from each distance. The result showed the large variation in dispersion pattern of GSR from 4" range. At 4" distance, from country made pistol, the inner dispersion area of GSR was calculated i.e. **(7-19 cm^2 app.),** outer dispersion area of GSR was **(30-70 cm^2 app.)** whereas in case of standard pistol, the inner dispersion area of GSR was **(10-15 cm^2app.),** outer dispersion area of GSR was **(40-70 cm^2 app.)**

Table -1 Showing outer and inner dispersion pattern area of GSR on cloth target fired by 7.65mm calibre of country made pistol at different ranges.

Dispersion Pattern Area	Samples									
	1	2	3	4	5	6	7	8	9	10
	Range 4"									
Outer Dispersion Area	8.3 Cm^2	9.2 Cm^2	12.1 Cm^2	13.5 Cm^2	7.6 Cm^2	14.4 Cm^2	11.2 Cm^2	6.8 Cm^2	10.8 Cm^2	11.9 Cm^2
Inner Dispersion Area	39.4 Cm^2	43.1 Cm^2	52.8 Cm^2	59.4 Cm^2	34.5 Cm^2	54.4 Cm^2	69.5 Cm^2	61.3 Cm^2	66.8 Cm^2	49.7 Cm^2
	Range 8"									
Outer Dispersion Area	19.4 Cm^2	20.8 Cm^2	29.4 Cm^2	28.4 Cm^2	21.5 Cm^2	28.3 Cm^2	22.6 Cm^2	27.6 Cm^2	26.8 Cm^2	25.2 Cm^2
Inner Dispersion Area	72.4 Cm^2	79.6 Cm^2	98.3 Cm^2	92.4 Cm^2	79.3 Cm^2	91.6 Cm^2	78.5 Cm^2	88.4 Cm^2	84.6 Cm^2	83.3 Cm^2

	Range 12”									
Outer Dispersion Area	38.7 Cm2	36.9 Cm2	40.8 Cm2	42.6 Cm2	41.8 Cm2	39.5 Cm2	44.7 Cm2	43.3 Cm2	40.8 Cm2	37.5 Cm2
Inner Dispersion Area	141.2 Cm2	137.2 Cm2	151.8 Cm2	159.4 Cm2	157.7 Cm2	148.5 Cm2	168.5 Cm2	102.4 Cm2	151.8 Cm2	138.6 Cm2

Table-2: Showing outer and inner dispersion pattern area of GSR on cloth target fired by 7.65mm calibre of Standard pistol at different ranges.

Dispersion Pattern Area	**Samples**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Range 4”									
Outer Dispersion Area	10.9 Cm2	11.8 Cm2	12.8 Cm2	11.4 Cm2	14.9 Cm2	13.7 Cm2	13.4 Cm2	10.4 Cm2	14.3 Cm2	10.5 Cm2
Inner Dispersion Area	49.4 Cm2	55.4 Cm2	60.2 Cm2	54.6 Cm2	68.4 Cm2	63.7 Cm2	62.2 Cm2	48.5 Cm2	68.2 Cm2	49.2 Cm2
	Range 8”									
Outer Dispersion Area	20.9 Cm2	21.7 Cm2	24.8 Cm2	24.3 Cm2	23.8 Cm2	21.4 Cm2	22.9 Cm2	24.2 Cm2	23.2 Cm2	21.3 Cm2
Inner Dispersion Area	80.2 Cm2	83.2 Cm2	96.4 Cm2	96.2 Cm2	92.6 Cm2	81.9 Cm2	84.8 Cm2	94.2 Cm2	91.9 Cm2	81.9 Cm2
	Range 12”									
Outer Dispersion Area	36.4 Cm2	38.2 Cm2	42.3 Cm2	46.4 Cm2	40.8 Cm2	39.4 Cm2	41.6 Cm2	37.5 Cm2	39.4 Cm2	47.8 Cm2
Inner Dispersion Area	130.9 Cm2	142.6 Cm2	155.9 Cm2	164.2 Cm2	153.2 Cm2	143.6 Cm2	150.4 Cm2	133.5 Cm2	143.7 Cm2	164.6 Cm2

Table- 3 Showing comparison of dispersion pattern area on Cloth substrate fired by 7.65mm calibre of country made pistol and standard pistol at different ranges.

Range	Dispersion Pattern Area	
Substrate- Cloth	**Country made Pistol**	**Standard Pistol**
4”	I.D : 7-18 Cm2 (app.) O.D : 30-70 Cm2 (app.)	I.D : 10-15 Cm2 (app.) O.D : 40-70 Cm2 (app.)
8”	I.D : 20-30 Cm2 (app.) O.D : 70-100 Cm2 (app.)	I.D : 20-25 Cm2 (app.) O.D : 80-100 Cm2 (app.)
12”	I.D : 35-45 Cm2 (app.) O.D : 130-170 Cm2 (app.)	I.D : 35-50 Cm2 (app.) O.D : 130-170 Cm2 (app.)

Conclusion

It is found that large variation in dispersion pattern of GSR pattern has been observed, when firing has been done from country made pistol and standard firearm at 4” range. This study must be helpful in estimation of exact range of firing fired from close range by 7.65mm country made pistol and standard pistol by analyzing the dispersion pattern area of Gun Shot Residue. This study will be helpful in easy disposal of the cases where, range of firing is to ascertain.

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