CHAPTER I

INTRODUCTION

Firearms, a subject which has interested man for centuries. Firearms were devised by man for the very purpose of hunting and protecting himself from other human beings or animals. Firearms were hence an essential tool used to shape the modern world. However, since firearms were considered lethal weapons, restrictions for the manufacturing, use, sale and ownership were implemented in almost all countries in an attempt to prevent the malicious use of firearms.

Since a firearm is a lethal weapon, it is one the perfect tools to commit a crime. Homicides, suicides, robberies, kidnappings and threats are some of the events in which firearms are extensively used. In order for justice to be delivered, certain scientific methods were implemented in order to match the firearm used to commit the crime to the fired projectile, the spent cartridge case and ultimately to the shooter.

These scientific methods of matching the projectile and spent cartridge case to the firearm are based on tool mark examination. Hence the field of Forensic Ballistics is based on tool mark analysis. The basic principle of tool mark examination is that softer materials are indented or imprinted with the markings of the harder material. In this case the harder materials are the parts of the firearm such as the barrel (bore), chamber and the breech face. The softer materials being the bullet/projectile and spent cartridge case.

A Firearm is defined as any weapon that is designed to propel a projectile or projectiles by means of combustion and expansion of gases. This definition is likely to vary depending on factors such as country legislation, amendments made to existing laws and the design of guns and the purpose they are intended for. The definition of firearms vary from country to country and hence some countries have strict firearm laws requiring the owner to have a license. In India the legal definition of a firearm according to the Arms Act 1959 is

"Firearms means arms of any description designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy, and includes,—

i) artillery, hand-grenades, riot-pistols or weapons of any kind designed or adapted for the discharge of any noxious liquid, gas or other such things,

(ii) accessories for any such firearm designed or adapted to diminish the noise or flash caused by the firing thereof,
(iii) parts of, and machinery for manufacturing, firearms, and
(iv) carriages, platforms and appliances for mounting, transporting and serving artillery"
The Arms Act 1959 is divided into
(i) Prohibited Bore (PB)
(ii) Non Prohibited Bore (NPB)

Prohibited Bore, Any firearm that is used as a service weapon by the defence forces such as the three wings of the military and the police force. This category includes Automatic, semi-automatic rifles, pistols (except the Ashani 7.65 IOF Pistol and double action .22 and 0.32 revolvers) revolvers and artillery. These weapons may not be operated or owned by any firearm license holder or non license firearm holder except to conditions mentioned in the No.11026/16/2009-Arms GOVERNMENT OF INDIA MINISTRY OF HOME AFFAIRS INTERNAL SECURITY-II DIVISION ARMS SECTION. [1]

Non Prohibited Bore, These firearms can be owned by the general public after acquiring a firearm license. The list of firearms are- [2]
.22 Sporting rifle
.315/8mm Sporting rifle
.30-06 Sporting rifle
DBBL 12 Bore Shotgun
SBBL Pump Action Shotgun
Modified .32 Pistol
Ashani MK II 7.65mm Semi Automatic pistol
.32 Revolver MK III
.32 Revolver Nirbeek (Light Weight)
.32 Revolver Anmol (Long Barrel)
.32 Revolver MK IV

Types Of Smooth Bore Firearms, Smooth Bore Firearms are firearms without rifling (Lands and Grooves) in the bore. The inner surface of the barrel(bore) is smooth. The barrel is smooth in order to facilitate the type of projectiles that may be used in the barrel i.e Bird Shot, Buck Shot and Slugs otherwise known as LG and SG, etc. Smooth bore firearms are generally categorised as-

- SBBL - Single Barrel Breech Loader Firearm- The Firearm consists of a single barrel and the ammunition is loaded from the breech end.
- DBBL - Double Barrel Breech Loader - The Firearm consists of two barrels (side by side vertically or horizontally) and the ammunition is loaded from the breech end.
- SBML- Single Barrel Muzzle Loader- The Firearm consists of a single barrel, but the ammunition is loaded from the muzzle end.
- DBML- Double Barrel Muzzle Loader- The firearm consists of a double barrel and the ammunition is loaded from the muzzle end.

In the beginning, all firearms were muzzle loaders but it was soon discovered that that the addition of lands and grooves in the barrel coupled with a cylindrical projectile was far more accurate and increased the range and trajectory path of the projectile when compared to more spherical projectiles, hence rifling of firearms was invented. However, these rifled firearms were not capable of firing multiple projectiles without gradually damaging the bore of the firearm and causing in-barrel pellet deformation and thus smooth bore firearms still exist today in the form of shotguns, country made/homemade or improvised guns and some artillery. It is also important to keep in mind that smooth bore firearm barrels are more easier to manufacture. The projectile fired from a smooth bore firearms may in some cases have the same muzzle velocity of many rifled firearms but the range substantially decreases due to the increased effects of external factors on the projectiles. Nevertheless smooth bore firearms can cause the same amount or even more damage than rifled firearms from close to mid range targets, especially when multiple projectiles are used. The barrel of most smooth bore firearms are capable of withstanding moderate to high amounts of pressure exerted on the barrel walls and hence larger projectiles such as the 1 ounce slug may be used as a single projectile in the 12 gauge/0.729" bore shotgun.

Company Made Firearms, means those firearms that are manufacture according to all standards of firearm manufacturing and the within the jurisdiction of that country.

Company made firearms are generally manufactured on a large scale by companies such as Remington, Berretta, Colt, Indian Ordinance Factory, Rifle Factory Ishapore etc, but small scale manufacturers may also manufacture company made firearms within the jurisdiction of the country. The minimum requirement of a firearm to be classified as a company made firearm is have registered engraving of a serial number on the action mechanism, the barrel and the slide, standard testing must be conducted on the firearm such as durability test, firing test, jamming test, chambering tests, extraction and ejection tests, accuracy tests and so forth, before it can be marketed under the brand of the company in that country. Registered engraving means that once the firearm is issued to or purchased either as a service weapon or a civil weapon to an armed personnel or a civilian respectfully, the serial number of that firearm must be registered to the arms license of that individual. This is done in order to keep track of the firearm in case it is lost or used maliciously.

Country Made Firearms, on the other hand are those firearms that are made without the authority and licensing of that country where they are manufactured. These firearms are manufactured by small scale manufacturers who do not follow any standards or regulations of that country. These firearms are made either by unskilled gunsmiths or by skilled gunsmiths with the sole purpose of making an income by use of their skills or for malicious use. Country made firearms do not contain any serial numbers and hence are very difficult to trace back to the owner or manufacturer. Country made firearms may be based on company made models of firearms or may be designed by the manufacturers themselves. Improvised firearms are a type of country made firearm that is made from materials or tools that were intended for very different purposes. The nail gun for example can be used to fire live cartridges instead of nails with some amount of alterations. Another great example is the blank gun, that can be modified to fire live ammunition by drilling through the bore. Country made firearms can be divided as-

- Zip guns- Improvised guns that are not made by gunsmiths. Made with available household materials and hardware supplies. Example Nail guns and blank guns.
- Pipe guns- These guns are also made with various hardware materials but the barrels of these firearms are made from metal pipes and hence the name. Most country made muzzle loaders are in fact pipe guns where the smooth inner surface of a metal pipe is considered as a smooth bore firearm barrel.

- Replica Firing Guns- These guns are made by skilled or professional gun smiths working as small scale manufactures. These guns are made as close as possible to
- company made gun models. These guns are even chambered in the exact same calibre as the company made models. They do not have engraved serial numbers but resemble and work in the exact same way as a company made firearm.
- An important thing to keep in mind is that country made firearms can be made to chamber standard company made ammunition or country made ammunition as well. Country made firearms are available in SBBL, DBBL, SBML and DBML variants. Most country made firearms are smooth bore firearms.

Forensic Significance**,** Firearms as mentioned earlier can be identified from their empty cartridge cases and fired projectiles. It is based on the principle of tool mark examination where softer materials are imprinted or indented with the impressions of the harder materials when they come into contact with a certain amount of force. This is very true as an empty cartridge case ejected from a firearm, is covered with identifiable marks of that firearm such as chamber marks, extractor and ejector marks, breech face impressions, slide drag marks, magazine lip marks, firing pin impressions, firing pin drag marks, firing pin hole marks etc. The fired projectile also contains these marks in form or rifling marks called lands and groove marks. These land and groove marks on the recovered projectile/bullet can be matched to the firearm it was fired from by comparing the rifling marks to a test fired bullet fired from the suspected firearm into a bullet recovery box, and comparing the bullets under a comparison microscope for a positive or negative match. The same is done for the spent cartridge case and a positive or negative match is determined. Cartridge cases and projectiles are recovered from the scene of crime to be examined by a ballistics expert, if the firearm in question is found then the test of comparison may be commenced. The comparison of spent cartridge cases is a common practice for both smooth bore and rifled firearms. The projectile comparison on the other hand is only applicable for rifled firearms as smooth bore firearms do not leave rifling marks on the projectiles. This is a huge limitation in the field of forensic ballistics.
Crime Scenario: A person wielding a 12 bore pump action shotgun walks into a bank to commit a robbery. The suspect has no intention of causing harm to anyone in the bank, however the situation is critical and the suspect ends up shooting a cashier, who succumbs to his injuries. Being of ballistics background the suspect is aware of the

advancements in cartridge case comparison and hence takes the cartridge case along with him as he leaves the bank with the stolen cash. After the post mortem examination of the victim, six projectiles were recovered from the chest and sent to the forensic science laboratory as evidence items. A few weeks later a suspect is apprehended and a 12bore shotgun is seized and sent to the forensic science laboratory as evidence that may be linked to the shooting at the bank.

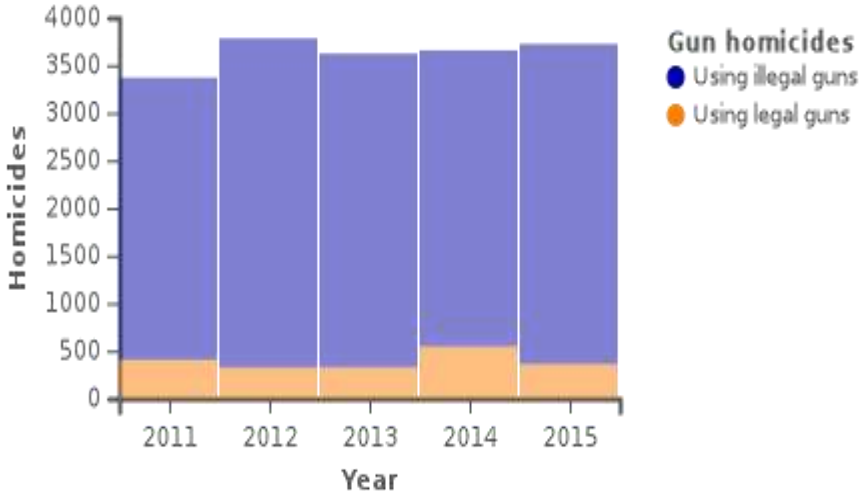
The fired cartridge case however is not recovered and hence advancements in the case has come to a complete halt. The ballistician states that there is no standard method of comparison to compare pellets fired from a smooth bore firearm to the suspected firearm. The comparison of pellets/projectiles fired from a smooth bore firearm cannot be compared to test fired pellets or projectiles, because when pellets are fired from a smooth bore firearm, the pellets may or may not touch the walls of the gun barrel in the exact same spot the previous pellets had touched. Which means that questioned pellets/projectiles cannot be compared to test pellets for barrel marks because of the irregular trajectory of the pellets within the barrel from the breech end till the muzzle end after firing occurs.

Forensic Science Laboratories therefore stick to just cartridge case examination and comparison in case of smooth bore firearms. However**,** in a country like India, most shootings occur with the use of country made firearms and not company made firearms. Country made firearms as mentioned earlier have smooth bores instead of rifled bores (1.3 country made firearms, page 4, line 1). Hence comparison can only be conducted on test fired cartridge cases. This however, has major limitation, as cartridge case comparison can only be done is the firearm was designed to do so. Only breech loading firearms are capable of firing cartridge cases, muzzle loaders do not fire cartridge cases. Muzzle loaders instead are loaded first by measuring black powder and pouring it down the barrel, then a charge wad(cloth, cotton or even coir) in inserted and rammed using the ram rod, after which the pellets are inserted followed by another wad and again rammed by the use of a ram rod. Hence, there is no cartridge case for comparison.

Therefore, if the question of comparison arises for country made muzzle loaders or any smooth bore firearm where the cartridge case has not been found. The answer would be "Comparison between test pellets and questioned pellets, in order to prove or disprove whether the questioned pellets were fired from this firearm or not, cannot be done due to the lack of evidences".

If this is the case, then most crimes related to muzzle loaders and smooth bore firearms are left unsolved. This is a major issue whether the forensic science laboratories acknowledges the fact or not, most gun related crimes in India are committed by the use of illegal guns, mostly because they are easily available, inexpensive and most importantly they cannot be traced.

According to *Small Arms Survey 2016* there are 61,401,000 illegal firearms (mostly country made firearms).



[1]

fig 1.1 Small arms statistics

From this statistical chart it is evident that most gun crimes (homicides) are committed using illegal guns. This is the major reason a standard needed to be implemented in order to identify smooth bore firearms by the examination of their pellets. Thus the principle of this topic. "The identification of smoothbore firearms (including country made firearms) by the analysis of their projectiles under a comparison microscope" If a reliable standard is implemented, then many of these pending cases may be examined.

Contributions to The Study, The main contribution of this study would be to establish a method for the identification of smooth bore firearms by the examination of their pellets or projectiles. Unlike rifled firearms, there is no standard method for comparison of pellets fired from a smooth bore firearm. The other major contribution to the study would be to prove or disprove the credibility of a comparison method developed during the years 1970 to 1980. If proved positive, then the comparison method

may be developed as a standard. However, if proved negative then this method may not be adopted or attempted in the future again. The comparison method was developed

nearly 40 to 50 years ago in Chandigarh, India, but due to reasons unknown, this method has not been adopted by most, if not all forensic science laboratories in India. This study would stand as evidence to approve or disapprove the credibility of that method. According to many forensic science laboratory experts and directors, this method was not adopted because the method has not been tried and tested since its development , moreover the method was developed 40 years ago and no one had any interest to implement it into the laboratory as a standard.

As stated above, if gun crime in India is committed largely by the use of country made firearms, it is a matter of concern, especially if there is no standard method of comparison for smooth bore firearms. This method, surely should have been proven or disproven years or even decades ago, but no interest was shown in this regard, in the field of ballistics, and even if it was shown, it was never documented. If nobody had proved or disproved this method before, any effort put towards doing so, would mean overcoming a huge milestone in the field of forensic ballistics in India. The method of comparison according to the persons who developed it, is very simple and inexpensive to carry out, yet bears accurate results. I want to prove or disprove this method and put an end to the controversies behind this method.

For Reference to the study of smooth bore firearms, the British Pellet data chart and the American Pellet data chart are as follows-

Designation	Diam. (in.)	Diam. (mm)	Weight (g)	Pellets/oz
LG	0.36	9.1	4.54	6
SG	0.33	8.4	3.54	8
Special SG	0.30	7.6	2.58	11
SSG	0.27	6.8	1.89	15
AAA	0.20	5.2	0.81	35
BB	0.16	4.1	0.40	70
1	0.14	3.6	0.28	100
3	0.13	3.3	0.20	140
4	0.12	3.1	0.17	170
5	0.11	2.8	0.13	220
6	0.10	2.6	0.10	270
7	0.095	2.4	0.08	340
7 1/2	0.090	2.3	0.07	400
8	0.085	2.2	0.06	450
9	0.080	2.0	0.05	580

fig 1.2 British Pellet Data Chart [4]

Designation	Diameter (in.)	Diameter (mm)	Pellets/oz	
			Lead	Steel
No. 000 Buck	0.36	9.1	6	
No. 00 Buck	0.33	8.4	8	
No. 0 Buck	0.32	8.1	9	
No. 1 Buck	0.30	7.6	11	
No. 2 Buck	0.27	6.9	15	
No. 3 Buck	0.25	6.4	19	
No. 4 Buck	0.24	6.1	21	
FF	0.23	5.8	24	
F	0.22	5.6	27	40
TT	0.21	5.3	31	
T	0.20	5.1	36	52
BBB	0.19	4.8	43	62
BB	0.18	4.6	50	72
Air rifle	0.175	4.4	55	
B	0.17	4.3	59	
1	0.16	4.1	71	103
2	0.15	3.8	87	125
3	0.14	3.6	106	158
4	0.13	3.3	130	192
5	0.12	3.0	170	243
6	0.11	2.8	220	315
7	0.10	2.5	290	422
7 1/2	0.095	2.4	340	
8	0.09	2.3	400	
9	0.08	2.0	570	
10	0.07	1.8	850	
11	0.06	1.5	1350	
12	0.05	1.3	2335	
Dust shot	0.04	1.0	4565	

fig1.3 American Pellet Data Chart [4]

CHAPTER II

LITERATURE REVIEW

J.K Sinha and M.L.K Shettry (1972) " Pellet Identification" Identification of pellets fired through smoothbore firearms is not known and is looked upon as insoluble problem. But the importance of pellet identification cannot be over emphasised, especially in India, where the use of smooth bore firearm is encountered very frequently in crimes, it has been observed that pellets, especially of larger sizes such as L.G. And S.G., often carry identifiable markings. These are scratched by the surface irregularities of the barrels. The pellets carrying these markings can be identified provided such markings can be produced on test specimens. However, statistical probabilities are very small that other shots fired through the same barrel, would touch exactly identical points every time. Due to the difficulties in obtaining desired test specimens, the identification of fired pellets remains impracticable. Identification of such pellets should be possible if the markings from the requisite points area could be reproduced. A successful attempt has been made to obtain such test specimens. With special reference to smooth bore country made pistols (short barrel) chambered for 12 bore cartridges. The possibility of identifying pellets identified through bore firearms has been investigated with special reference to locally made smooth bore pistols chambered for 12 bore cartridges. It has been found that fired pellets having identifiable markings can be identified. However, for comparison, instead of firing test cartridges, test specimens are obtained by pushing slightly oversized cylindrical lead pieces through the barrel.[3]

Tom Warlow (2016) "Shotgun Missile Injuries" Normal small shotgun pellets used in the loadings of game or clay pigeon shooting cartridges have relatively low penetrating power in most materials, including human tissue, once the pattern has spread so that pellets impact the target separately. fig 2.2 providing details of pellet striking energy versus range, shows that the individual pellets carry only modest amounts of kinetic energy due to their low mass and relatively low velocities. Tom Warlow also states that wadding used in shotgun cartridge cases may contain the inner barrel markings just like pellets. Moreover If the muzzle end of a firearm is rough, it will impart scratches on plastic cartridge wads, especially if the barrel of a shot gun is sawn off for greater spread of pellets at short distances.

This technique may come in handy when implemented in this study in case a country made/improvised/modified SBBL or DBBL firearm is encountered. As SBBL and DBBL firearms often use standard size 12bore/10bore/.410" etc, cartridges which contain wads of either fibrous material or plastic. This confirms that even wads recovered from the crime scene must be compared to the inner walls of the suspected smooth bore firearm in order to confirm a positive or negative match.[4]

	Striking Velocity (m/s) and Striking Energy (J) at Ranges (m)					
Shot	20	25	30	35	40	45
BB	284/16.5	269/14.8	254/13.4	238/11.7	226/10.4	212/9.3
3	272/7.62	253/6.60	236/5.74	219/4.94	203/4.25	188/3.68
4	269/6.14	249/5.26	231/4.53	214/3.89	197/3.30	181/2.78
5	265/4.62	244/3.91	224/3.30	205/2.76	188/2.32	171/1.92
6	261/3.65	239/3.06	219/2.57	199/2.12	180/1.73	163/1.42
7	257/2.81	234/2.33	212/1.92	191/1.55	172/1.26	154/1.01
9	247/1.52	220/1.19	196/0.96	171/0.75	150/0.55	128/0.40
	Striking Velocity (ft/s) and Striking Energy (ft·lb) at Ranges (yd)					
Shot	20	30	35	40	45	50
BB	942/12.4	860/10.3	815/9.24	770/8.25	729/7.38	688/6.56
3	915/5.79	804/4.48	753/3.92	704/3.43	657/2.99	612/2.59
4	905/4.68	788/3.54	735/3.08	683/2.66	635/2.30	587/1.97
5	893/3.52	768/2.60	711/2.23	656/1.90	604/1.61	555/1.36
6	883/2.80	752/2.03	691/1.71	634/1.44	579/1.20	528/1.01
7	871/2.16	731/1.52	667/1.27	606/1.06	549/0.86	496/0.70
9	840/1.18	680/0.77	608/0.62	537/0.48	475/0.38	412/0.28

fig 2.2[4]

CHAPTER III

AIM AND OBJECTIVE

Aim:-

The aim is to identify smooth bore firearms, by the analysis of their projectiles under a comparison microscope.

Objective:-

- To prove that the identification of smooth bore firearms from the analysis of their projectiles can be accepted as a standard method.
- To study the striation pattern on differently shaped projectiles.
- To determine if the study is applicable to all smooth bore firearms or not.

CHAPTER IV
MATERIALS AND METHODS

Materials Required

1. Steel Strip/Aluminium Strip having thickness of 0.50 to 0.80 mm.
2. Binding metal wire (any metal) of thickness and length as required.
3. casting sand or clay.
4. Lead scraps or recycled lead.
5. A steel container.
6. Any source of fire that is capable of exceeding a temperature of 400^0C.
7. Metal forceps or cast iron blacksmiths pliers or stainless steel pliers.
8. Recovered pellets.
9. Questioned smooth bore firearm.
10. Ramrod.
11. Stereo microscope.
12. Comparison microscope.
13. Bullet Recovery Box.
14. SBML Single Shot removable barrel firearm.
15. SBML Multi Shot removable barrel firearm.
16. Metal pellets/ projectiles to be test fired.

Methodology

Sample Collection:

- 2 cylindrical projectiles (C1 and C2) were fired from a single shot SBML firearm with a removable barrel.
- 2 spherical projectiles (S1 and S2) were fired from a multi shot SBML firearm with a removable barrel.
- The projectiles were loaded into the firearm after measuring the required amount of black powder using a measuring cylinder and pouring it down the barrel from the muzzle end.
- The projectiles were loaded into the firearm by first covering the muzzle end with cotton, placing the lead projectiles on top of the cotton and then ramming it into the

barrel. Additional cotton was rammed into the barrel after the projectile, to prevent the projectile from falling out.

- A percussion cap was placed on the nipple and the hammer was half cocked for safety.
- Keeping safety in mind, the firearm was aimed at a tank of water and fired into the water tank to collect the projectile, as using an improvisedbulletrecovery box with cotton would not only be a tedious task but dangerous as well.
- The fired projectiles were then recovered and wrapped in a thick cotton layer and tied with thin binding wire. Each projectile was packaged separately and then placed in a rigid box for support.
- The 2 cylindrical projectiles which were recovered from the water tank were marked as C1 and C2. C1 and C2 are projectiles fired from the single shot SBML firearm with a removable barrel.
- The 2 spherical projectiles which were recovered from the water tank are marked as S1 and S2. S1 and S2 are projectiles fired from the multi shot SBML firearm with a removable barrel

Manufacture of Lead Casts

Lead casts, one of the most important materials required for the experiment are relatively simple to manufacture.

1. First the bore diameter of the breech end of the suspected firearm was noted using a Vernier Caliper.
2. A circular casting mould was formed by winding(coiling) the steel/aluminium strip in accordance to the diameter of the bore of the firearm. Once the desired diameter was achieved, metal binding wire was used to hold the mould from unwinding(uncoiling). Hence the exact bore diameter was achieved by this trial and error process.
3. This steel mould was then placed in casting clay or casting sand and pushed about 1/4 of its height into the clay. This was done in order to stop the molten lead from seeping out from that side while being poured.
4. A steel container containing lead was placed on the burner and heated to approximately 328^0C (327.5^0C is the melting point of lead).

5. Once the lead had melted, an iron rod was used to clear the Dross(floating impurities) aside.
6. The molten lead was poured into the steel mould and allowed to cool only for a minute and half, before removing the mould along with the cast using the metal pliers, it was then placed into a bucket of water. This should be done after the lead solidifies but before it returns to room temperature because if the lead is left to return to room temperature, it may fuse to the steel or aluminium strip. Although unlikely, it is better to follow this method, or the melting and casting process might have to be repeated again in order to achieve the desired cast.
7. The lead cast was then removed from the steel mould by gently opening the mould from one side, taking care as to not scratch the cast.
8. The walls of the cast were examined for a smooth finish.
9. 2 lead Casts were produced in the same manner for the single shot SBML pistol and the multi-shot SBML pistol respectively according to their bore diameter.
10. The lead casts were labelled as cast 1 and cast 2. Cast 1 was used for the comparison of C1 and C2. Cast 2 was used for the comparison of S1 and S2.
11. It is observed that aluminium strip is better to obtain and coil than steel strip. I certainly recommend that aluminium be used instead of steel. Aluminium is not affected by the molten lead as aluminium has a melting point of 660.3^0C.

fig4.1 Cast 1 (Cylindrical projectile)

fig4.2 Cast 2 (spherical projectiles)

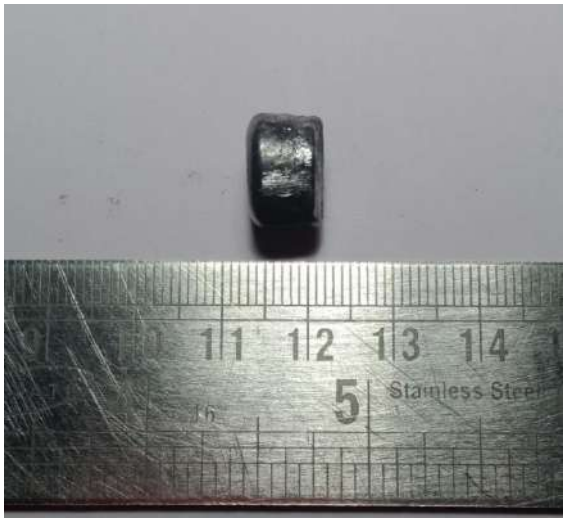


fig4.3 C1

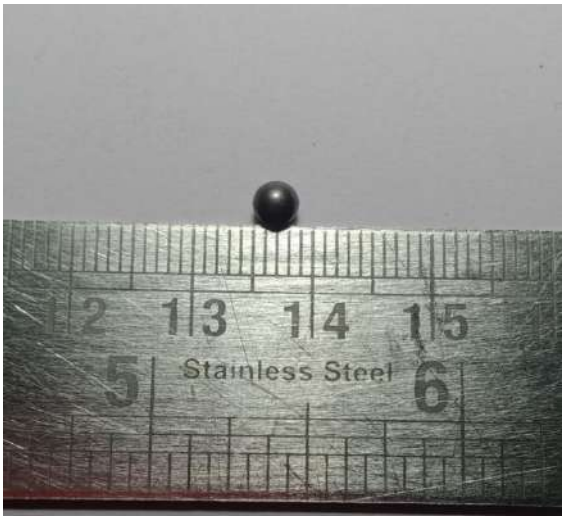


fig4.4 S1

fig 4.5 C2

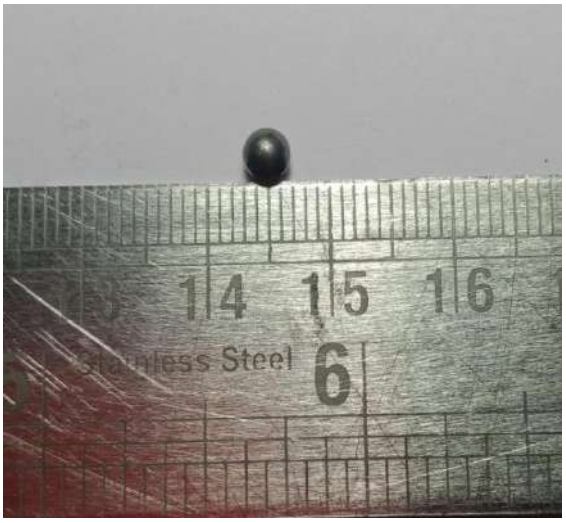


fig 4.6 S2

fig 4.7 Removable SBML Firearm Barrel used to shoot Cylindrical Lead Projectiles

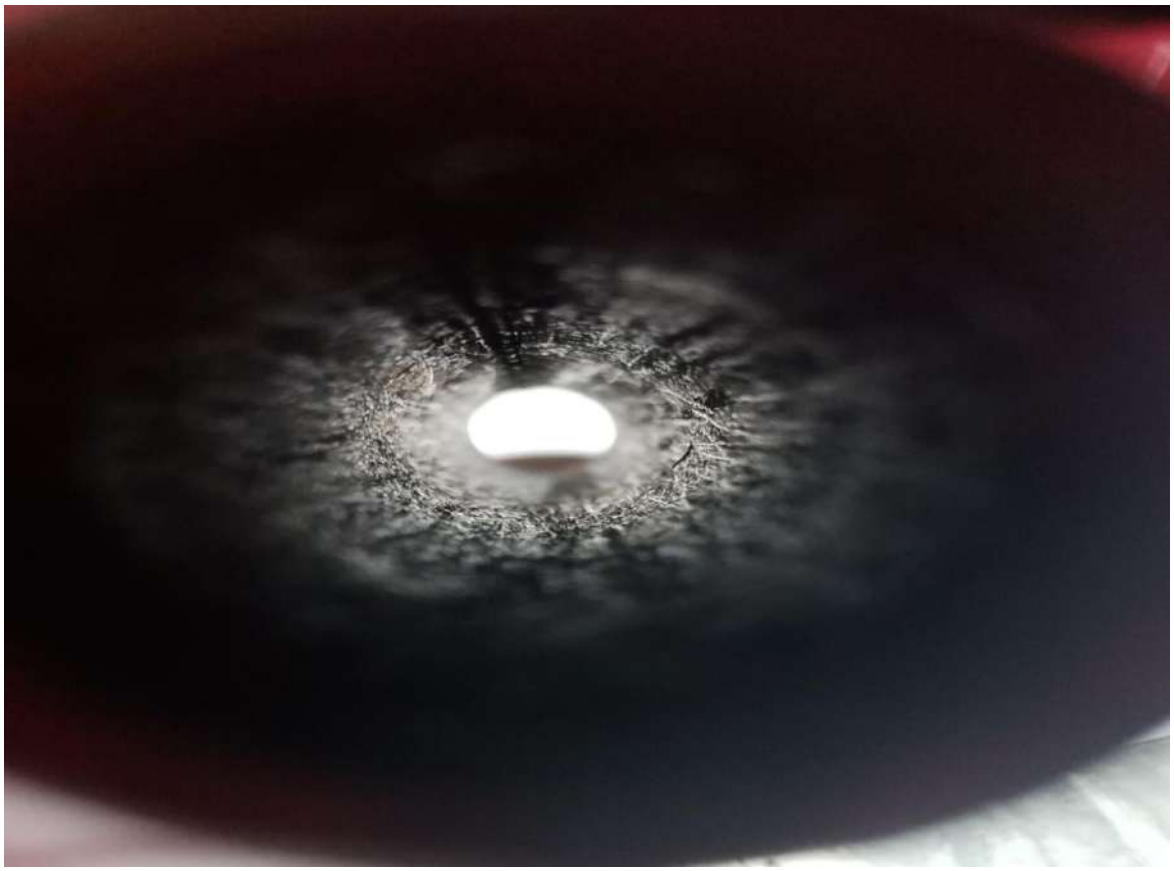


fig4.8 Bore Surface irregularities of the smooth bore firearm

CHAPTER V

OBSERVATIONS

Observations follow a standard observation procedure. The samples were first observed by naked eye, then under a stereo microscope and finally under a comparison microscope.

Observations made under a comparison microscope were documented. First the cylindrical projectiles were observed and documented. Then the spherical projectiles were observed and documented.

Cylindrical Projectiles

- C1 and C2 were compared for a positive or negative match.
- It was observed that C1 and C2 have different barrel striations on their surfaces when compared to each other.
- It was observed that C1 matches the striations present on lead Cast 1.

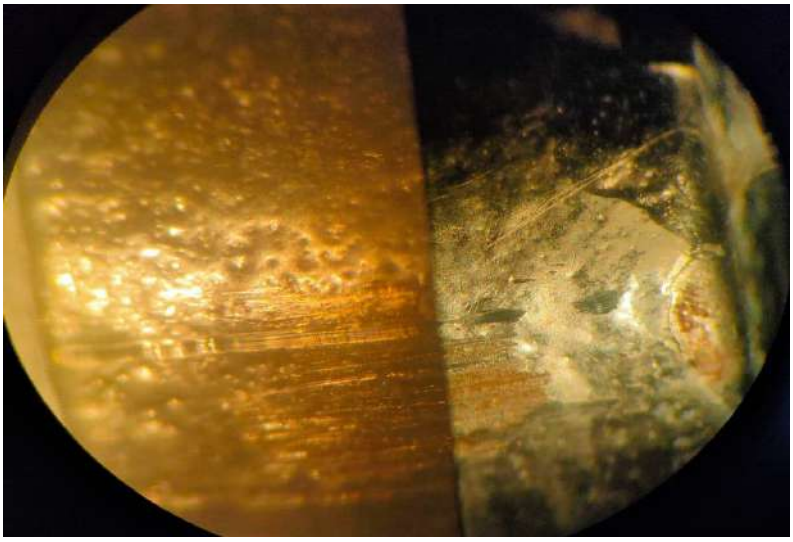


fig5.1 Match of C1 with Cast 1

- It was observed that C2 matches the striations present on lead Cast 1.

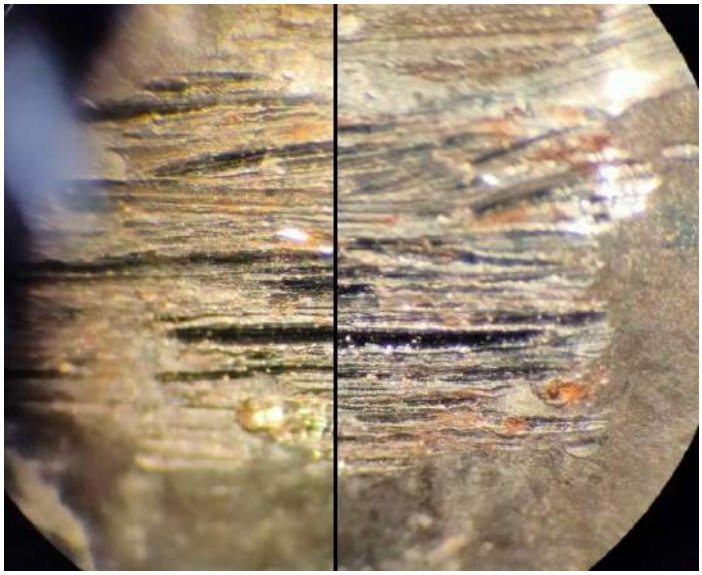


fig5.2 Positive Match of C2 with Cast 1

Spherical Projectiles

- S1 and S2 are compared for a positive or negative match.
- It was observed that S1 and S2 have different barrel striations on their surfaces when compared to each other.
- It was observed that S1 matches the striations present on lead Cast 2.

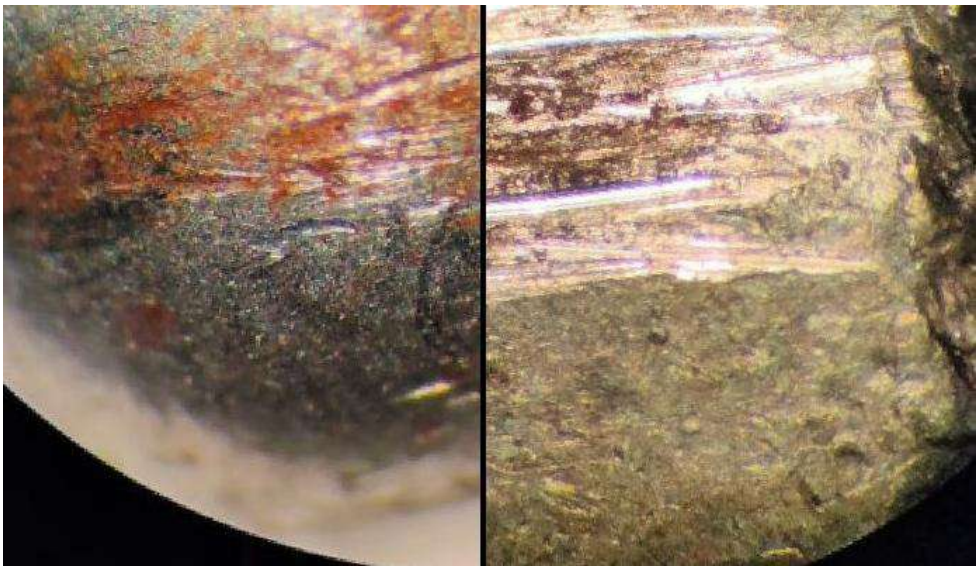


fig5.3 Positive Match of S1 with Cast 2

- It was observed that S2 matches the striations present on lead Cast 2.

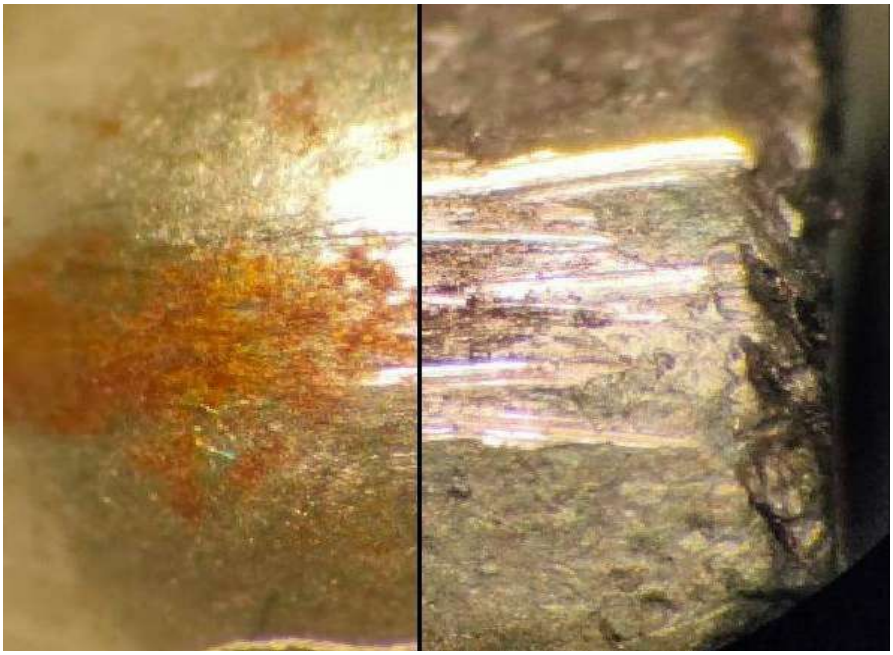


fig5.4 Positive Match of S2 with Cast 2

CHAPTER VI
RESULTS AND CONCLUSIONS

Result

Both Cylindrical projectiles C1 and C2 are having identifiable striation patterns both spherical projectiles S1 and S2 are having identifiable striation patterns. Both cylindrical projectiles and spherical projectiles are matching with their respective casts.

Limitations

- Since the projectiles (regardless of shape) fired from a smooth bore barrel have minimum contact with the barrel walls, they may or may not have barrel striations on their surfaces. If any pellet with barrel striations is observed, it must be compared to a lead cast of the barrel of the suspected smooth bore firearm.
- The process of matching the projectiles to their lead cast will take a fair amount of time and hence this method is a time taking process.
- Lead casting, although an easy process requires good skill to be casted according to the bore diameter of the firearm.
- This method is not applicable to SBML and DBML Firearms in which one end of the barrel is permanently sealed. However if matching the firearm to the pellets/projectiles is crucial to the case investigation, then the sealed end of the barrel may be cut and removed with permission from the court.

Conclusions

It was concluded that the method for comparison of smoothbore firearm projectiles to the lead casts of the barrel is a reliable method of comparison.

It was concluded that smooth bore firearms can be identified by the analysis of their pellets/projectiles under a comparison microscope.

It was also observed that this method is very suitable for firearms that have a tapering barrel or a choke present at the muzzle end. This method is a reliable method for comparison of pellets/projectiles, and may be adopted or implemented by the forensic science laboratories as a standard comparison method for smooth bore firearms.

CHAPTER VII

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