"An Empirical Study to Evaluate the Repeatability and Uniqueness of Striations/Impressions Imparted on Consecutively Manufactured Miami/EBIS Gun Barrels"

Thomas Fadul, Ph.D.

August 4, 2010

Purpose

- To examine the capability of identifying questioned bullets fired through multiple consecutively manufactured Glock Miami Gun Barrels (EBIS Barrels)

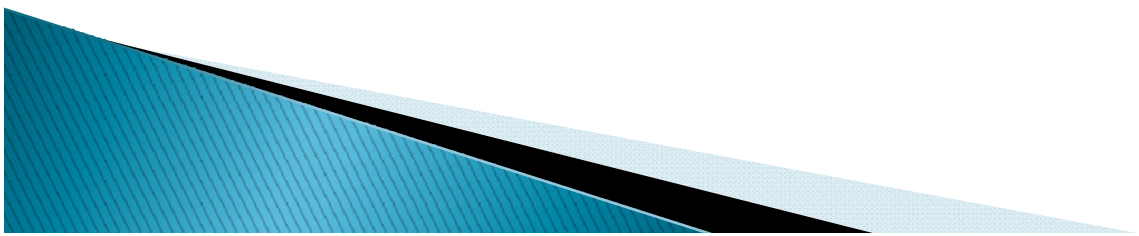
Research Question?

- Will firearm and toolmark examiners be able to identify the barrels that fired the questioned bullets when examining bullets fired through consecutively manufactured Glock Miami Gun Barrels (EBIS Barrels)?

Empirical Literature

Consecutively Manufactured Gun Barrels

- Freeman (1978)
- Hall (1983)
- NYPD (1996)
- Brundage (1998)
- Hamby (2001, 2007, 2009)



Empirical Literature
Miami Barrel/EBIS Barrel

- Carr and Fadul (1997)
- Fadul and Nunez (2003)
- Fadul and Nunez (2006)
- Chin and Sampson (2007)
- Martinez (2008)

New York Barrel

- NYPD
- November 1995
- 97 out of 200
  - 17%
- 183 out of 200
  - 53%

Buccigrossi (1996)

Survey – NYPD (1996)

- Los Angels Police Department identified approximately 5% of Glock bullets.
- Albany, New York: approximately 5%.
- MDPD: approximately 5%
- FBI's Firearm and Tool Mark Unit Chief reported that it was very difficult to identify fired bullets to the Glock pistol that fired them.

Buccigrossi (1996)

Survey – AFTE Forum

- What is your average success rate for identifications when comparing bullets fired from polygonal rifled barrels?
  - 0 – 25% 107 (89.9%)
  - 25 – 50% 9 (7.6%)
  - 50 – 75% 3 (2.5%)
  - 75 – 100% 0 (0%)

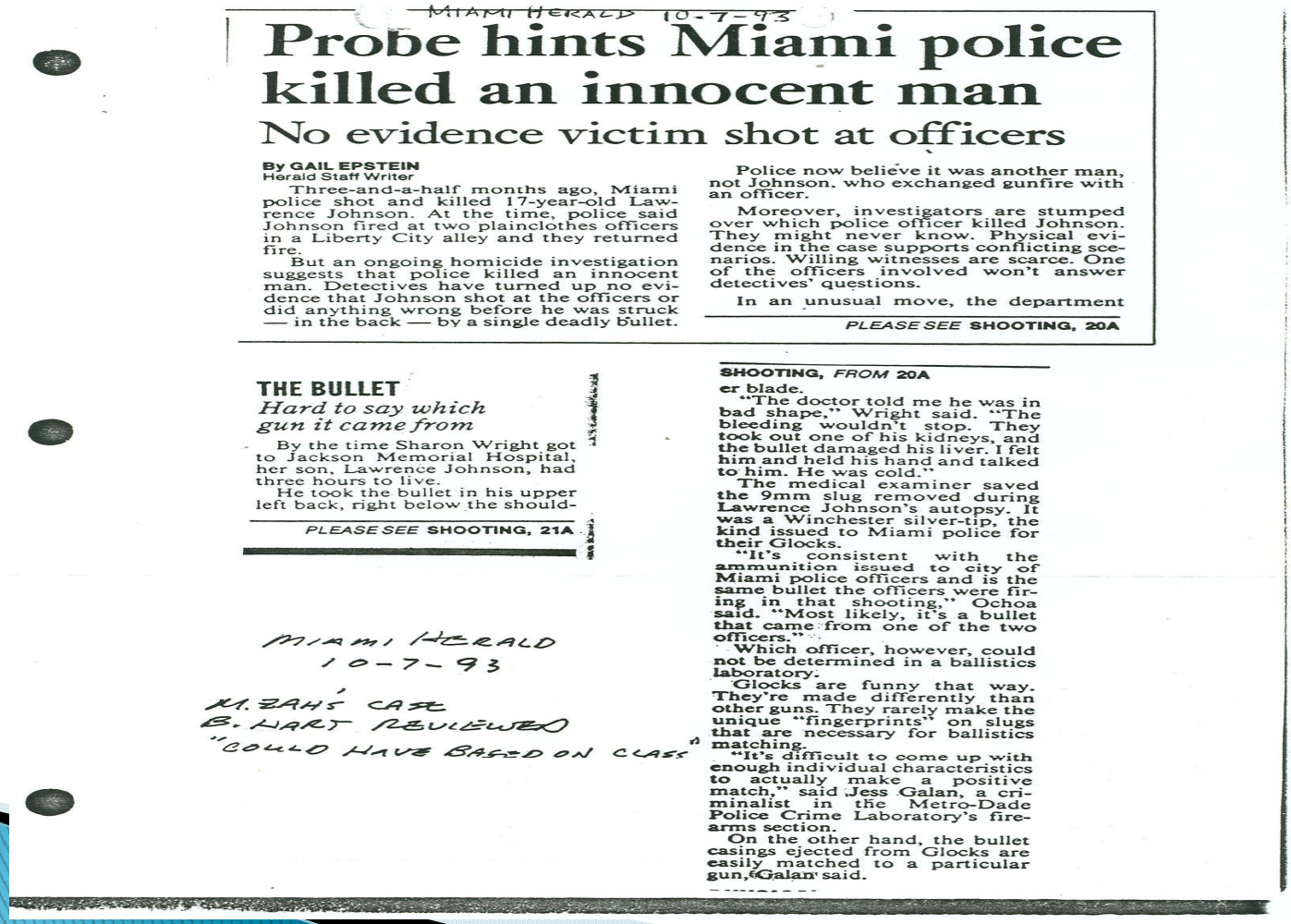
Total Voters: 119

http://www.afte.org/forum/smf1/index.php?topic=5392 (May 26, 2009)

Background

How did the Miami Barrel Evolve?

High Profile Police-Involved Shootings



MIAMI HERALD 10-7-93

Probe hints Miami police killed an innocent man

No evidence victim shot at officers

By GAIL EPSTEIN
Herald Staff Writer

Three-and-a-half months ago, Miami police shot and killed 17-year-old Lawrence Johnson. At the time, police said Johnson fired at two plainclothes officers in a Liberty City alley and they returned fire.

But an ongoing homicide investigation suggests that police killed an innocent man. Detectives have turned up no evidence that Johnson shot at the officers or did anything wrong before he was struck — in the back — by a single deadly bullet.

Police now believe it was another man, not Johnson, who exchanged gunfire with an officer.

Moreover, investigators are stumped over which police officer killed Johnson. They might never know. Physical evidence in the case supports conflicting scenarios. Willing witnesses are scarce. One of the officers involved won't answer detectives' questions.

In an unusual move, the department

PLEASE SEE SHOOTING, 20A

THE BULLET

Hard to say which gun it came from

By the time Sharon Wright got to Jackson Memorial Hospital, her son, Lawrence Johnson, had three hours to live.

He took the bullet in his upper left back, right below the shoulder blade.

PLEASE SEE SHOOTING, 21A

SHOOTING, FROM 20A

"The doctor told me he was in bad shape," Wright said. "The bleeding wouldn't stop. They took out one of his kidneys, and the bullet damaged his liver. I felt him and held his hand and talked to him. He was cold."

The medical examiner saved the 9mm slug removed during Lawrence Johnson's autopsy. It was a Winchester silver-tip, the kind issued to Miami police for their Glocks.

"It's consistent with the ammunition issued to city of Miami police officers and is the same bullet the officers were firing in that shooting," Ochoa said. "Most likely, it's a bullet that came from one of the two officers."

Which officer, however, could not be determined in a ballistics laboratory.

Glocks are funny that way. They're made differently than other guns. They rarely make the unique "fingerprints" on slugs that are necessary for ballistics matching.

"It's difficult to come up with enough individual characteristics to actually make a positive match," said Jess Galan, a criminalist in the Metro-Dade Police Crime Laboratory's firearms section.

On the other hand, the bullet casings ejected from Glocks are easily matched to a particular gun, Galan said.

MIAMI HERALD
10-7-93

M. ZAH'S CASE
B. HART REVIEWED
"COULD HAVE BASED ON CLASS"

T. Quirk's case
26-9459-P
Proj could have / class only

LOCAL
The Herald
SECTION B
THURSDAY, JUNE 16, 1994

Police bullet killed man; gun review ordered

By GAIL EPSTEIN
Herald Staff Writer

A Miami police officer fired the bullet that accidentally killed Jorge Luis Morales, an innocent bystander caught in the middle of a cops-and-robbers shootout last month, police sources said Wednesday.

Ballistics tests confirmed that the partial bullet recovered from Morales' body was fired from a Glock 9mm semiautomatic — the weapon used by Miami police for the last seven years. But experts could not determine which of two officers fired the fatal shot, the sources said.

The case has re-ignited a lingering controversy over the Glock. Some ballistics experts say it's difficult to match bullets to specific Glocks. That makes it harder to hold officers accountable for their shootings — especially in cases where more than one officer fires.

"We don't want to be guessing who's killing people out here," said Rodney Thaxton, a Dade assistant public defender and president of UP-PAC, the Unrepresented People's Positive Action Council. Thaxton is a vocal critic of the Glock.

But Glock company officials staunchly defend their product, which is used by dozens of police agencies nationwide, including Coral Gables and Medley. Metro-Dade officers, the largest force in the county, can choose a variety of makes and models, including 9mm semiautomatics and .38-caliber revolvers. Glocks are not on the approved list.

GLOCK 17

Caliber: 9mm
Magazine: 17 rounds
Barrel length: 4½ inches
Overall length: 7½ inches
Weight: 23 ounces (empty)
Main features: Durable, limited number of components, low weight with soft recoil
Source: Shooter's Bible

"We think it's the best gun out there," said Robert Gates, national sales manager for the Smyrna, Ga.-based manufacturer. He added: "The projectiles from Glock pistols are totally identifiable, and whoever says they're not doesn't know what they're talking about."

Concerned about public outcry over Morales' killing, Police Chief Calvin Ross has ordered a study that will determine whether the department sticks with the Glock. His decision came as officers were set to begin training with new Glock .40-caliber pistols. The .40-caliber uses a slightly larger projectile than the Glock 9mm and provides more stopping power.

"I think we owe it to our officers to equal the firepower they encounter on the streets," said Maj. Roberson Brown, who is coordinating the review. "But at the same time, let's not compromise our citizens by not being able to match projectiles with the weapons that fired them. That's the combination we seek."

Brown said his review is independent of the investigation into the Allapattah shooting death of

PLEASE SEE SHOOTING, 2B

Study Ordered!

Study ordered to decide if police will stay with Glocks

SHOOTING, *FROM* 1B

Morales, 43. Three young men have been charged with felony murder. Both officers who returned fire, Ariel Rojas and Jeffrey Locke, are back on patrol, and investigators said their actions appeared to be justifiable.

Rojas' attorney said blame should not fall on the officers, even if one of them fired the fatal shot.

"Even if the round were fired from a Glock, which is information I had heard, the moral and legal culpability is clearly on the shoulders of the robbers," said lawyer Bill Matthewman. "It must be remembered that officer Rojas came upon two gunmen who were robbing somebody."

Morales' death was not the first one that survivors will be left to wonder which officer shot a loved one. Lawrence Johnson, 17, was killed in Liberty City on June 19, 1993, in the middle of a police shootout. Two Miami cops fired, but ballistics experts can't tell which one left a bullet in Johnson's back.

Brown's review entails gathering information from local, state and federal firearms experts around the nation. He met Wednesday with Gates and a ballistics expert retired from the Royal Canadian Mounted Police.

At the Metro-Dade Crime Laboratory, Brown had ballistics technicians test-fire the Glock and 9mm Winchester silver-tip ammunition currently used by Miami police. The lab also tested the new Glock with the Winchester SXT .40-caliber ammunition that the department plans to use.

Brown said no one has told him it's impossible to match bullets to Glocks, although it is more "labor intensive."

That's because the inside of Glocks barrels are made differently from other guns. Their smooth, hexagonal rifling allows bullets to travel faster and more accurately — features police love about the weapon — but it also leaves fewer markings than conventional rifling.

Complicating the problem is the silver-tip ammunition Miami officers use. Brown said t ammunition is soft, fragmer easily and doesn't take indent tions well. Switching to the Wi chester SXT .40-caliber shou bring improvement on all tho counts, making positive match more likely, he said.

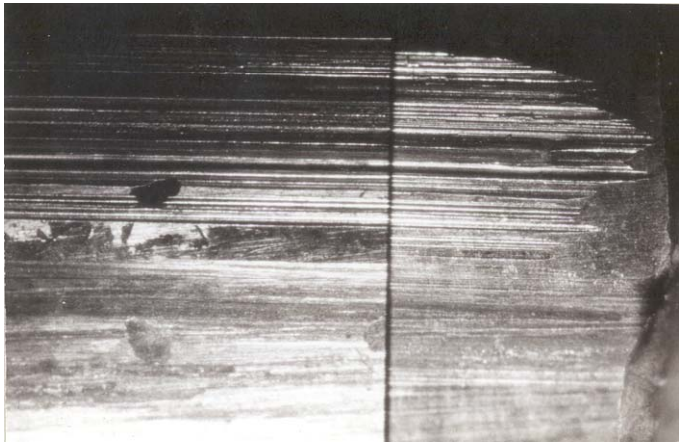
The department also plans t test four other weapons compar ble to the Glock .40-caliber, ar three other types of ammunitio

Despite the department's lon standing relationship with Gloc Brown said he plans an objecti review. Thaxton said he believe it when he sees it.

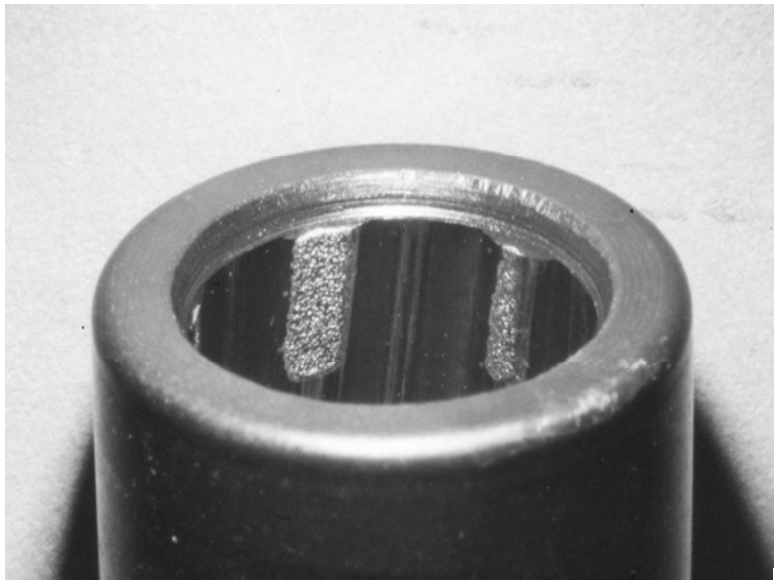
"It's a tough world out there UP-PAC's president said. " don't want to handcuff the polic altogether, but I want them to a responsibly."

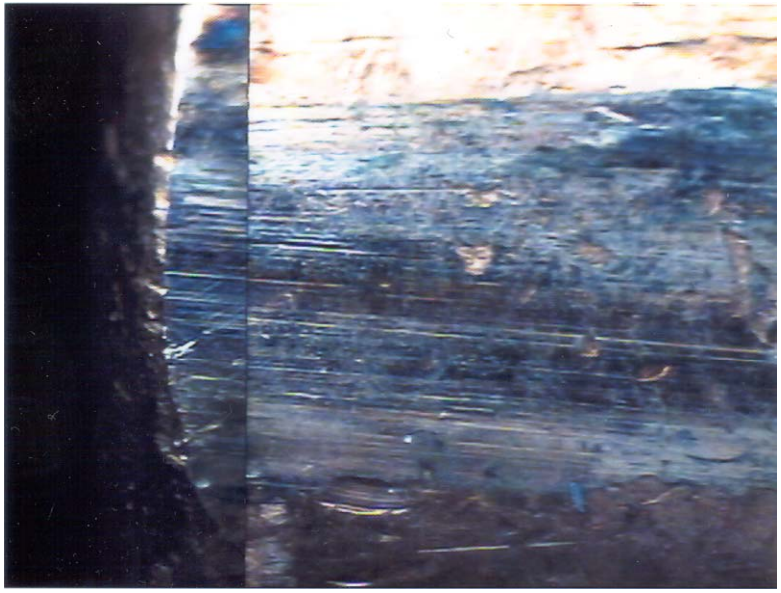
John Mathews (RCMP)

- June 15, 1994



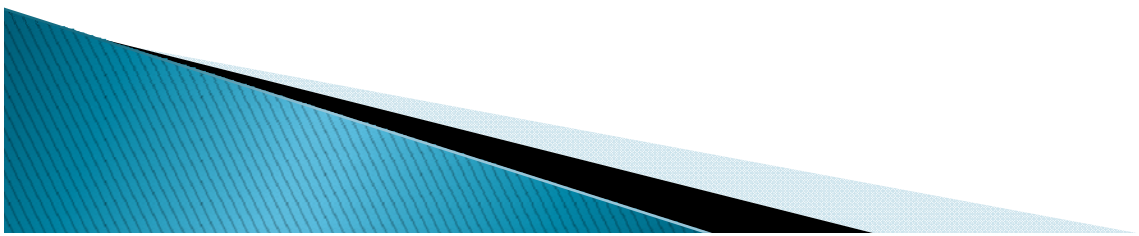
Electronic Spark Reduction Method





“Readily Identifiable”

- “The result of ‘readily identifiable’ means that several areas of the bullet can be positively identified to other bullets of the same brand fired from that pistol (barrel). It further describes the signature of a fired bullet that is typically received in this laboratory as evidence and because of the quality of the signature, we expect to identify it with the comparison microscope.”



"Not Readily Identifiable"

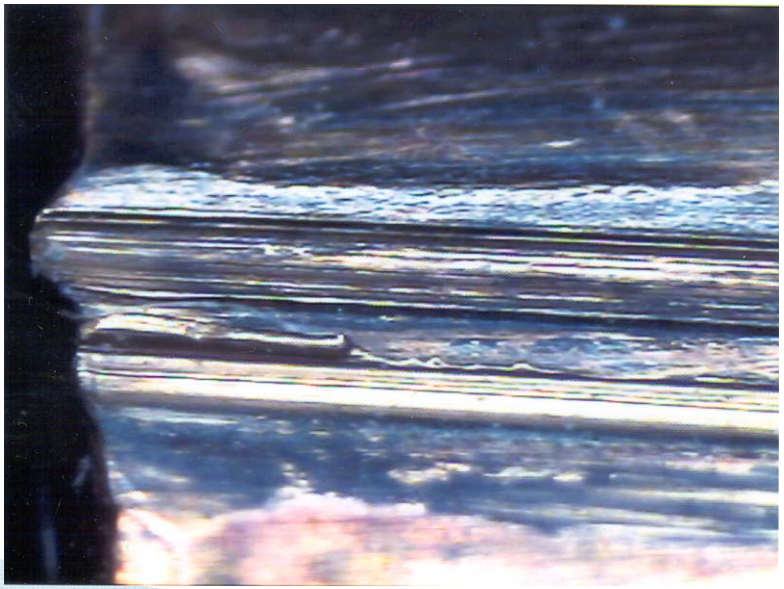
- "The result of 'not readily identifiable' means that tests of the same brand fired in the same pistol (barrel) could not be positively identified or that the identification generally could only be made on a small or select area of the bullet. The term further describes the signature of a fired bullet that is typically received in this laboratory as evidence and because of the general lack of detail or repeatable markings that identifications are difficult or sometimes impossible. It should be noted that all of the test bullets examined are not damaged or expanded, and therefore, they have the potential of receiving maximum transfer of barrel signature for that brand and type of ammunition."

2001 – Police Shooting

- Mass media attention
- State Attorney's Office
- ATF concurs with MDPD

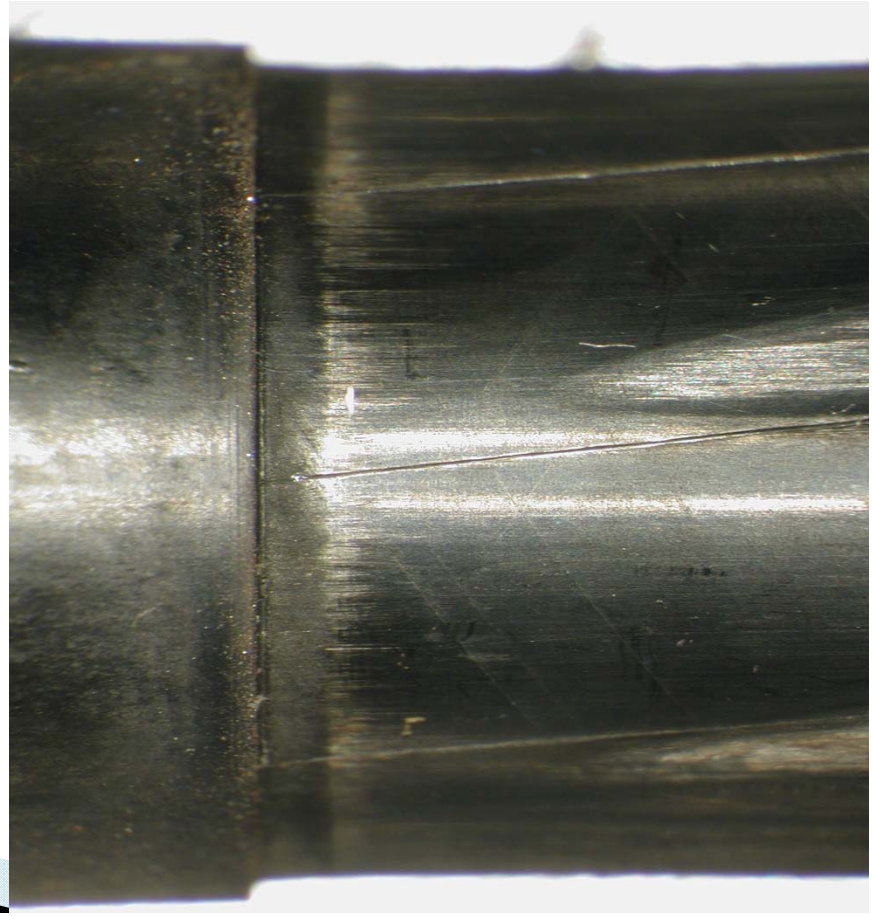
September 27, 2001

- TM – 8 different areas of muzzle.
- Crudely placed (possible chisel).
- 1 of 8 identifiable.



Ten Glock Barrels Received
January 29, 2002

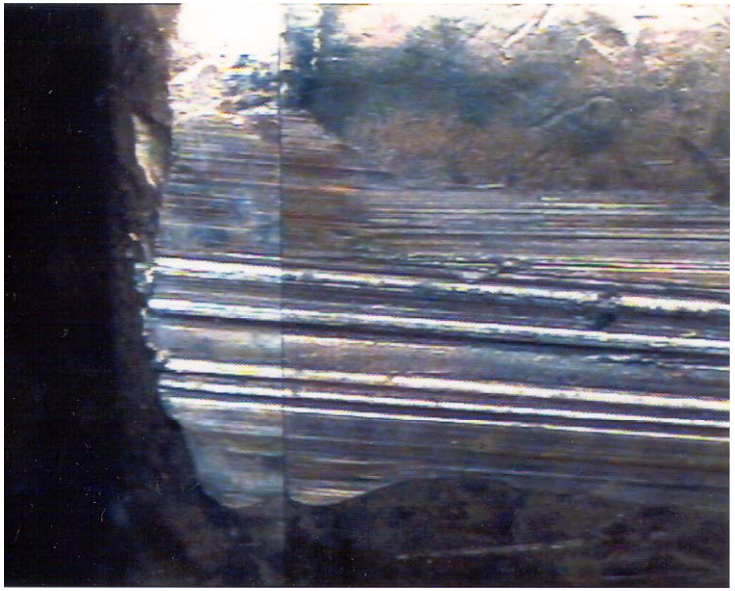
- Fine lines randomly spaced.
- Not readily identifiable.
- Sub-class.



Cross Section of Barrel.

Six Glock Barrels Received May 10, 2002

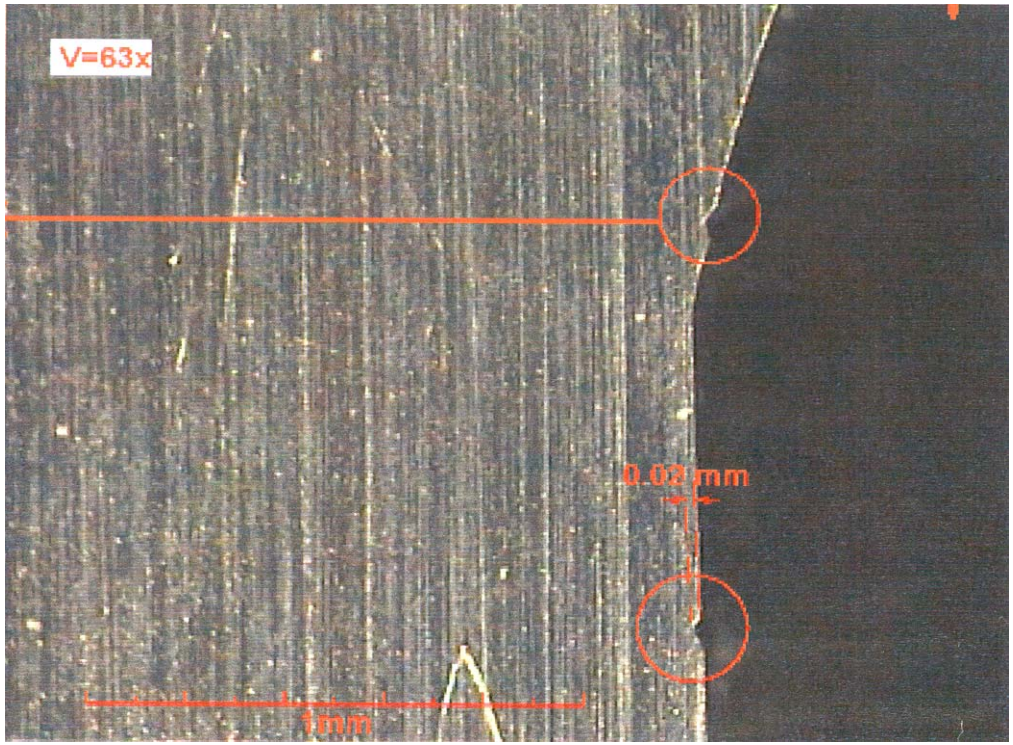
- Fine lines seen in casts were not scoring the circumference of the bullets.
- Gross markings, barrel to barrel.
- Not readily identifiable.



Reinhold Hirschheiter

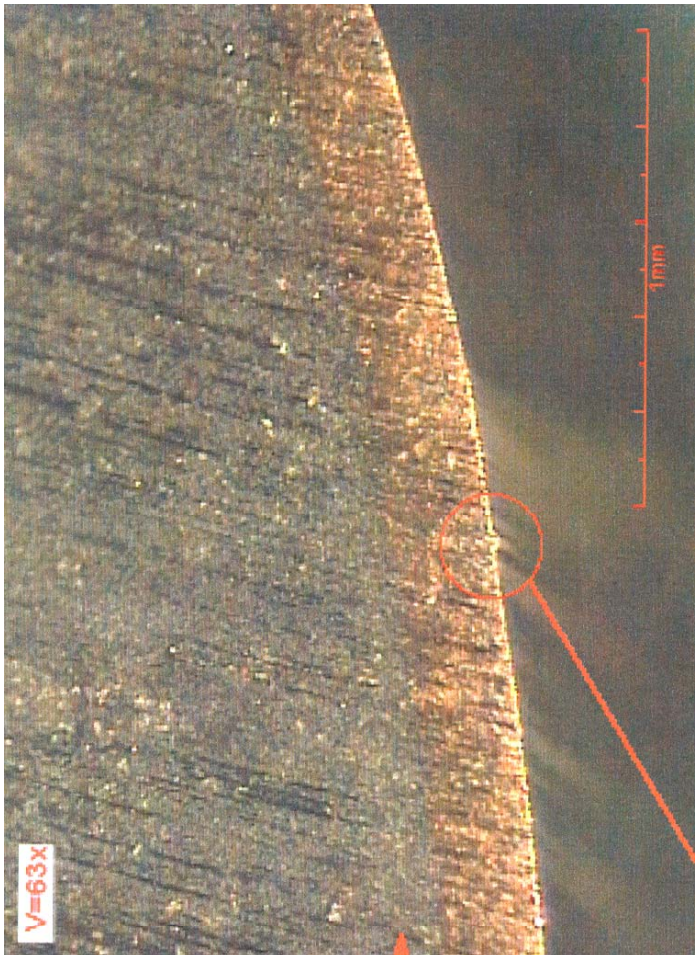
- Glock's chief Engineer.
- One tool with single cutter.
- Passed automatically
- Multiple strikes at each groove.
- Barcode.
- 80,000 combinations

Cut in Barrel Produced by Glock Tool



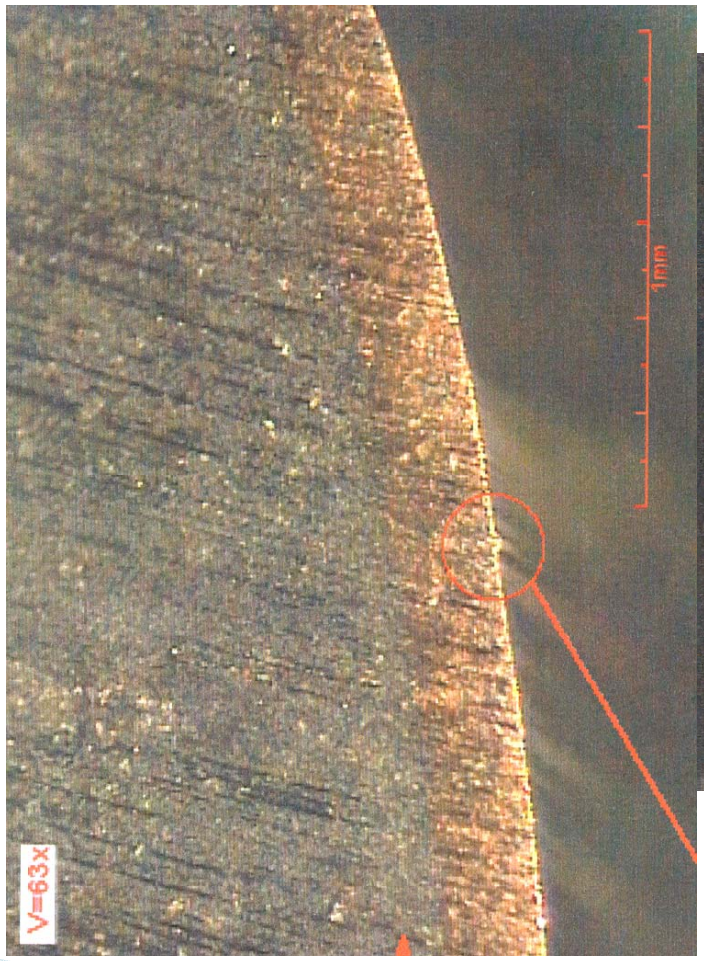
Hirschheiter 2002)

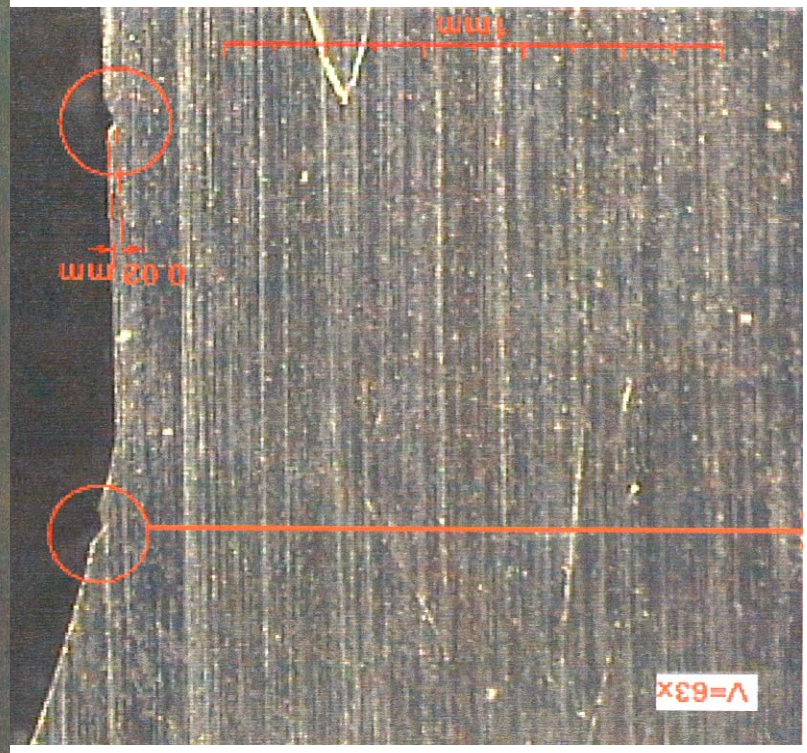
Mark in Bullet from Cut in Barrel



Hirschheiter 2002

Mark Produced by Cut





Hirschheiter 2002)

Six Glock Barrels Received July 17, 2002

- Gross marks more pronounced.
- 9 examiners
  - (readily identifiable)
- Durability Testing
  - (not readily identifiable)

Three Glock Barrels Received February 21, 2003

- Series of fine lines – more pronounced.
- Randomly spaced.
- Same pitch as the polygonal rifling.
- Readily Identifiable
- Durability – Readily Identifiable

Enhanced Bullet Identification System (EBIS)

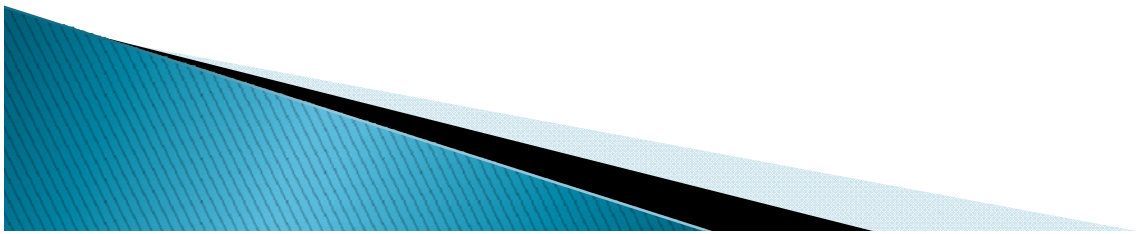
- U. S. Patent Application No. US2003/0143354A1 published July 31, 2003
- Finger like tool – cutting process

Enhanced Bullet Identification System (EBIS)

- Die with laser (Martinez, AFTE 2009)
- Etched by laser (Martinez, AFTE 2009)
- Micro-etched (Dall"au, Glock Annual, 2010)

Chin & Sampson 2007

- Examine four barrels.
- Correctly identified.
- Expressed the same concern about subclass characteristics as Fadul and Nunez (2006) about the subclass characteristics.
- Suggested a need for future study with consecutively rifled polygonal barrels utilizing the Enhanced Bullet Identification System.



Martinez 2008

- Reported that 29% of the participants with 5 to 10 years of experience reported that there were not enough individual characteristics present to conclude an identification, and/or elimination.
- 14% of the participants with 5 to 10 years of experience reported identifications and the ability to eliminate.
- Martinez believed that the identifications were made utilizing the process of elimination.

Study Needed with Consecutively Manufactured Glock Miami Barrels (EBIS Barrels)

- Requested 10 consecutively manufactured Glock barrels, consecutively rifled with the EBIS tool.
  - Was not present
  - Did not have same pattern

Participants

- Firearm & Toolmark Examiner
- 2 year training program
- Blast email to AFTE Membership

From: AFTE Members
To: Fadul, Thomas G.;
CC:
Subject: Glock Miami Gun Barrel (EBIS Barrel) study
Date: Monday, February 23, 2009 8:37:28 PM
Attachments:

Dear AFTE Members,

The purpose of this email is to invite you to participate in a consecutively manufactured Glock Miami Gun Barrel (EBIS Barrel) study. We have obtained 10 consecutively manufactured Glock Miami Gun Barrels (EBIS Barrels).

You have been specifically selected to participate in this study because of your expertise in firearm and tool mark identification and your membership with the Association of Firearm and Tool Mark Examiners (AFTE).

The study is designed to determine the examiner's ability to correctly identify known bullets fired from 10 consecutively manufactured Glock Miami Gun Barrels (EBIS Barrels) to tests shot from the same barrels. There will be two test bullets from each of the 10 Miami Barrels, which will be scribed and placed in an envelope marked 'KNOWN'. Additionally, there will be fifteen test bullets that will be scribed and placed in individual envelopes marked 'QUESTIONED'. You will need to conduct your examinations as you would normally do in your laboratory and fill out the answer sheet that will accompany the test set.

Your participation will remain completely anonymous. All participants will be allowed to keep their test set for future use as appropriate within their organization.

There are a limited number of test sets and they will be distributed based on order of response.

To participate, please forward your mailing address to tgfadul@mdpd.com.

Thank you for your time.

Tom

Thomas G. Fadul Jr., Laboratory Manager

Data Collection Methods

- Participants received via mail:
  - Questionnaire/answer sheet
  - 15 questioned bullets
  - 10 sets of known standards

- Instructed
  - Examine the questioned bullets and the known standards
  - Complete the questionnaire/answer
  - Fax, or mail the questionnaire/answer sheet

Answer / Survey Sheet

Miami-Dade Police Department
Crime Laboratory Bureau
9105 NW 25th Street, Miami, Florida 33172
(305) 471-2050

Firearm & Toolmark Unit

Answer Sheet: Consecutively Rifled Glock Miami Barrel Test Set Test Number: _____

Name:_____Job Title:_____Date:_____

Years Experience:_____Years Training:_____Type of Training:_____

Brand & Model of Microscope:_____Type of Lighting:_____

Do you examine other types of evidence: Yes No If Yes, what other types?_____
_____

Do you belong to a professional or forensic organization(s)? Yes No Please list:_____

Have you attended the FBI Specialized Techniques School? Yes No CMS Trained? Yes No

Did you use Pattern Matching or CMS for this test? _____

Have you ever encountered the Miami or EBIS Barrel in your case work? Yes No If yes, How many times?_____

Please microscopically compare the known test shots from each of the 10 barrels with the 15 questioned bullets submitted. Indicate your conclusion(s) by circling the appropriate 'alpha' designator on the same line as the known test shots indicated. Note: There are at least one or more bullets associated with each of the 10 known bullet sets. All 15 questioned bullets were fired from the 10 barrels represented by these test shots. Please allow at least one 8 hour day to conduct your examination. It doesn't have to be done all at one time, but sufficient time to adequately examine this material is necessary. Although the bullets have been scribed on the base, you may elect to confirm the 'identifier' on the base and rescribe it on the nose of the bullet.

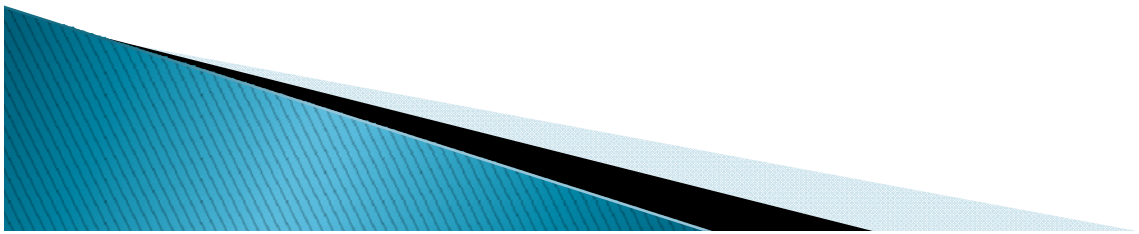
Knowns Unknowns

1. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
2. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
3. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
4. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
5. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
6. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
7. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
8. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
9. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z
10. A…B…C…D…E…F…G…H…I…J…K…L…M…N…O…P…Q…R…S…T…U…V…W…X…Y…Z

Adapted from the Indianapolis-Marion County Forensic Services Agency with the permission of Dr. James E. Hamby

Test Sets

- 150 Test sets were created
- 150 Crime Labs
- 44 States Plus District of Columbia
- 9 Countries

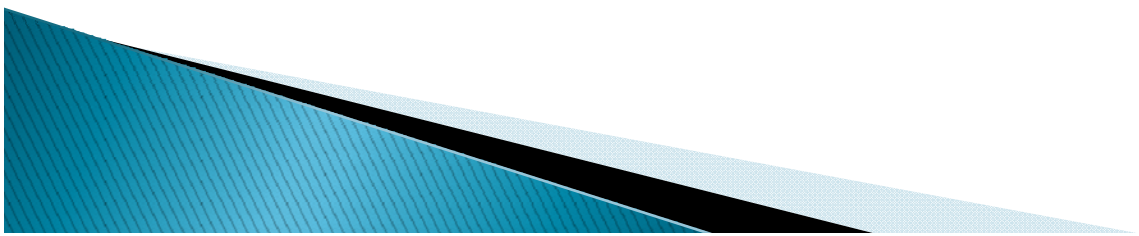


Results

- Based on:
  - 183 Participants
    - Excluded 30 Participants (< 2 Yrs. Training)
  - 124 Laboratories
  - 42 States
  - District of Columbia
  - 9 Countries

Conclusion

- 176 Examiners 100% Correct
- 7 Examiners did not achieve 100% (11 errors total)
  - 5 = 1 Error
  - 1 = 2 Errors
  - 1 = 4 Errors
- 2734 Correct Identifications
  - 99.6%
  - “To a reasonable degree of scientific certainty”

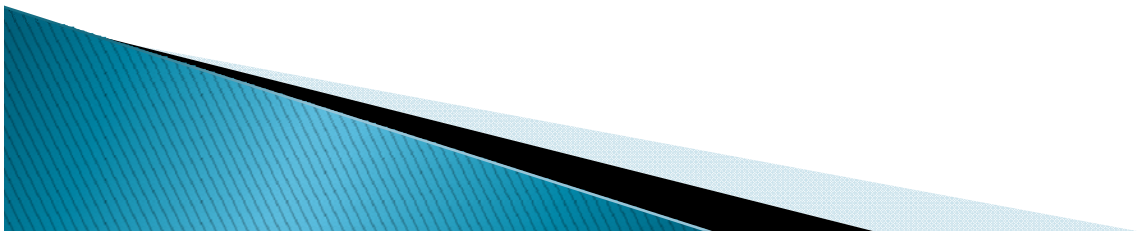


Error Rate

$$\frac{11}{2745\ (183\ \text{participants} \times 15\ \text{unknowns})} \times 100 = 0.4\%$$

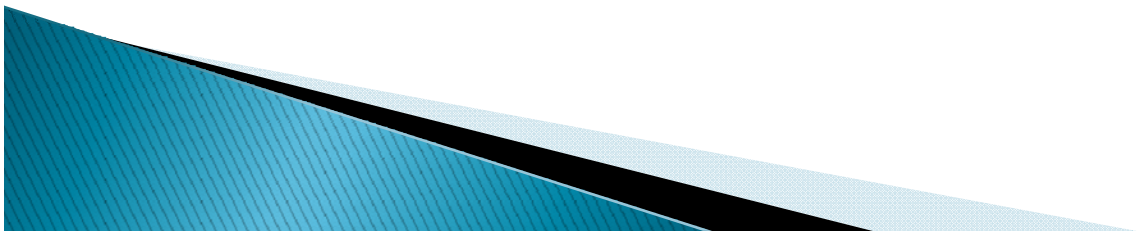
Internal Validity Strengths

- The test materials
  - Assembled in a crime laboratory setting
  - Questioned bullets and known standards labeled with a number or letter
  - Containers utilized to keep the questioned bullets separated into groups
- Every 10th test set was examined
- Instrument (Answer/Survey Sheet)
  - Documented & used in previous studies



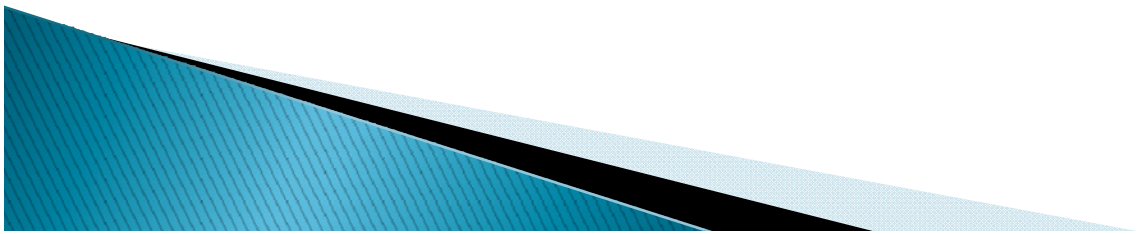
Internal Validity Weakness

- Dependent upon the accuracy of the assembly of the tests
- Communication
- Q Bullets & K Bullets fail to mark



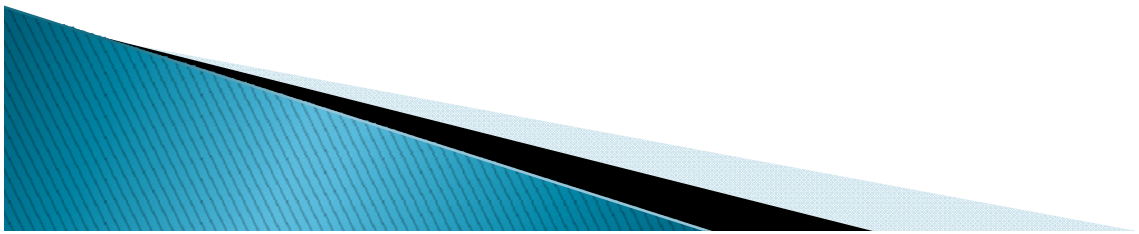
External Validity Strengths

- All testing was conducted in a crime laboratory setting
- Comparison Microscope
- Trained Firearm & Tool Mark Examiners
- Training & Experience of participants
- Exceed sample size
- Randomization of AFTE members



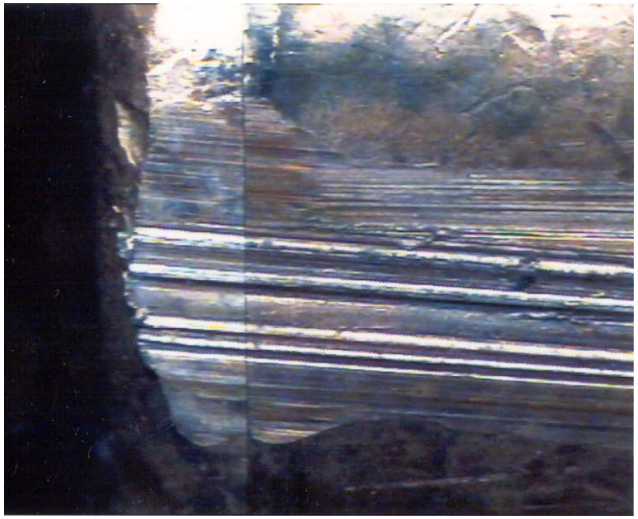
External Validity Weakness

- Assume that participants followed AFTE Procedures
- No control over the equipment used by the participants
- Training and skill level of the participants
- Participant can start/stop & resume



Future Research Needed

- 10 consecutively manufactured Glock barrels
  - Consecutively rifled with the EBIS tool
  - The same pattern



Questions