

# Module 6B

## Fingerprint Characteristics

Forensic Science Teacher Professional Development



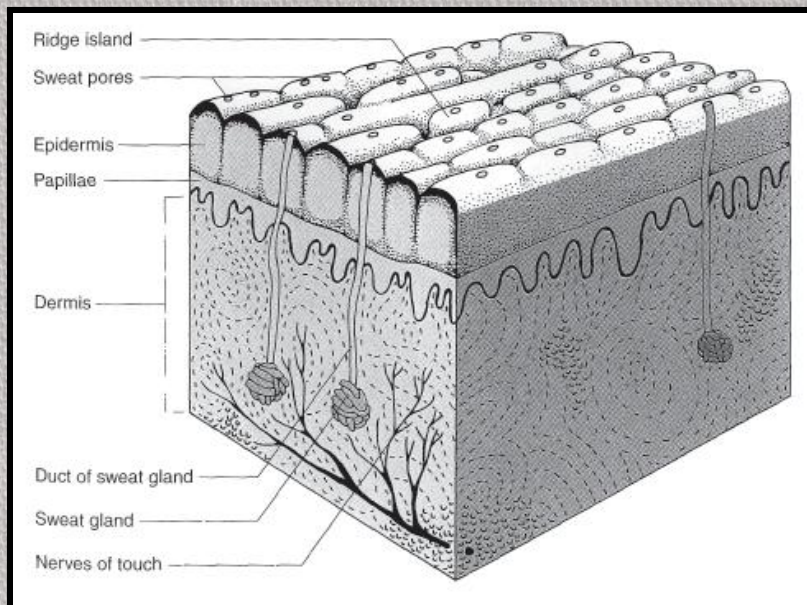
**Unit 2**  
**Fingerprint**  
**Characteristics**



# Part 1 Friction Skin Ridge

- Finger, palms, and sole areas of your skin display a series of ridges called friction ridges, which take varying shapes and forms. These are generally known as fingerprints, palmprints, and soleprints.
- Visit this link for a closer view of the structure of the epidermis:

<http://www.crcnetbase.com/action/showImage?doi=10.1201/9780203485040.ch1&iName=master.img-000.jpg&w=252&h=357&&>



**Figure 1**  
**Structure of Epidermis and Dermis**



# Part 1 Friction Skin Ridge

- Fingers develop in infants at around 6 to 7 weeks during gestation. Ridge development in fingers starts to appear at about 10 weeks during gestation.
- Latent fingerprints are prints formed on various items by natural secretions of the skin or deposits that are transferred to a surface leaving an outline of the friction ridges.
- The surfaces of fingers, hands, and the bottom of feet all have friction ridge skin. This type of skin has pores which contain small secretory glands called eccrines that secrete sweat onto the skin surface.
- This sweat from the eccrine glands is the basis for latent fingerprint residue.



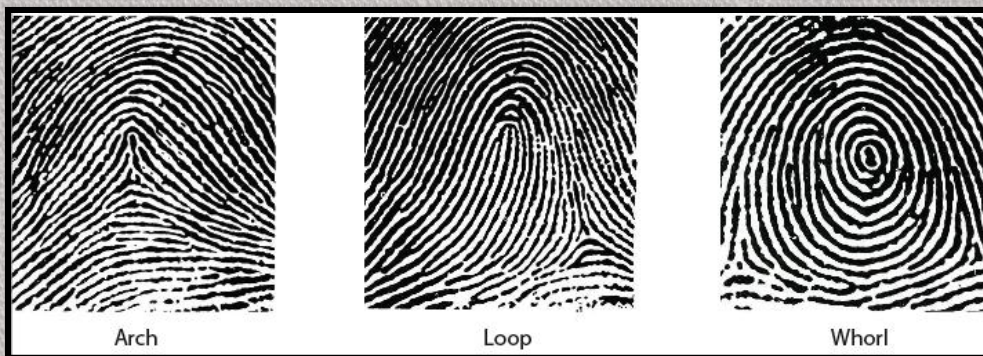
# Part 1 Friction Skin Ridge

- There are two other types of secretory glands: apocrine and sebaceous.
  - The apocrine glands are primarily found in armpits and genital areas.
  - The sebaceous glands are found in areas containing hair follicles, such as the face and scalp, and they secrete a sebum-rich deposit that is a heavier, oilier deposit than that from the eccrine glands.
- Latent fingerprint residue most commonly consists of deposits from eccrine and sebaceous glands.



# Part 1 Friction Skin Ridge

- Fingerprints are divided into three main classes according to their general patterns. These classes are arches, loops, and whorls.
- Each basic pattern has subcategories, and loop and whorl patterns have definable features such as ridges, cores, and deltas. Each fingerprint pattern has different distributions in the population. Loops are the most common pattern followed by whorls and then arches. Accidental whorl patterns are relatively rare.

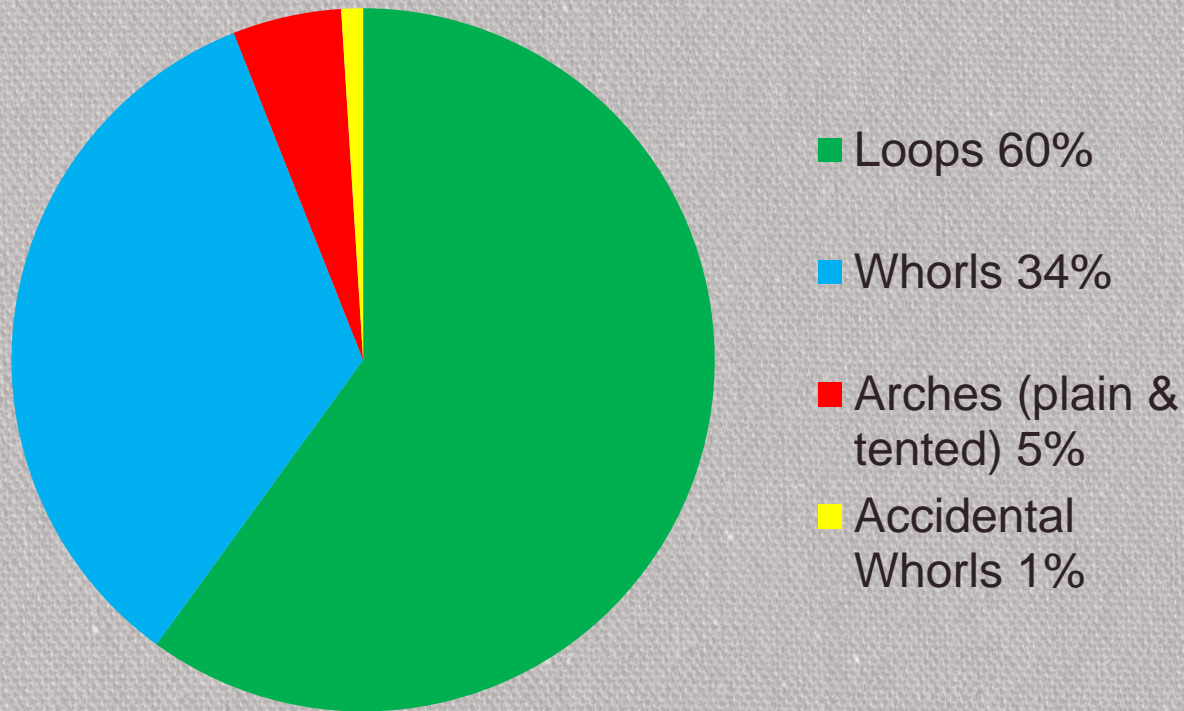


**Figure 2**  
**Three basic fingerprint**  
**patterns**



# Part 1 Friction Skin Ridge

## Fingerprint Patterns



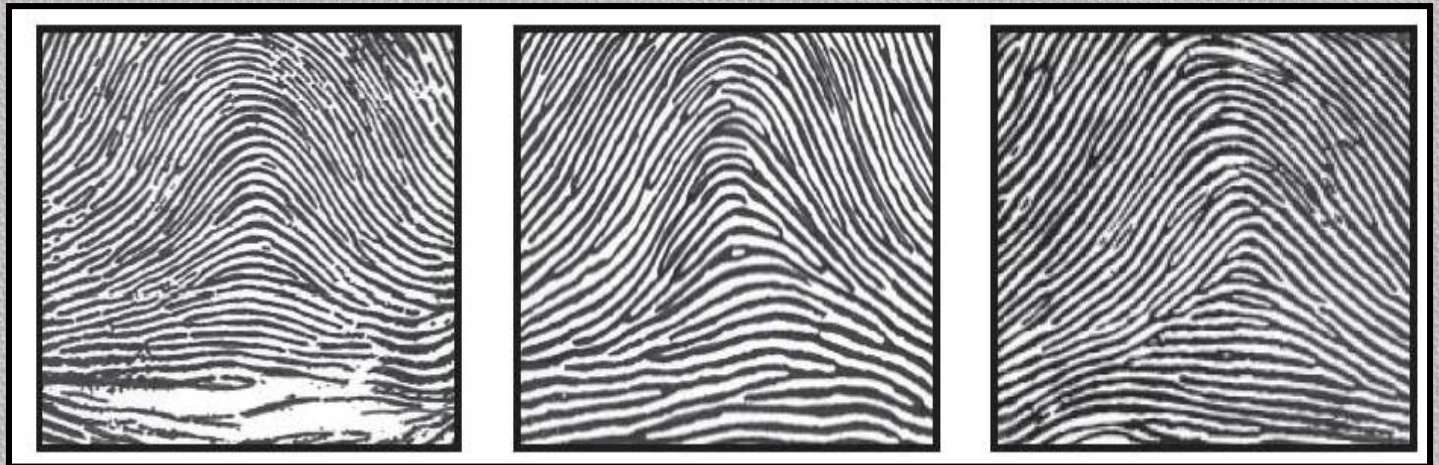
**Figure 3**  
**Fingerprint Pattern Distribution**  
(NOTE – percentages are approximate)



## Part 2 Arch

- Arches are the least common of the three general patterns and can be divided into plain and tented arches.
- Arch patterns account for approximately 5 to 15% of fingerprint patterns.
- The plain arch is the simplest of all the fingerprint patterns and does not have type lines, deltas, or cores.
- The ridges form a wavelike pattern.
- Plain arches are the simplest of all fingerprint patterns.
- Ridges enter from one side of the print and exit on the opposite side of the print.

**Figure 4**  
**Examples of**  
**plain arches**





# Part 2 Arch

- In a tented arch, the ridges meet at an angle of less than 90 degrees.
- Plain arches are more common than tented arches, which have a sharp upwards spike and not as smooth a rise as plain arches.

**Figure 5**  
**Examples of**  
**tented arches**





# Part 2 Arch

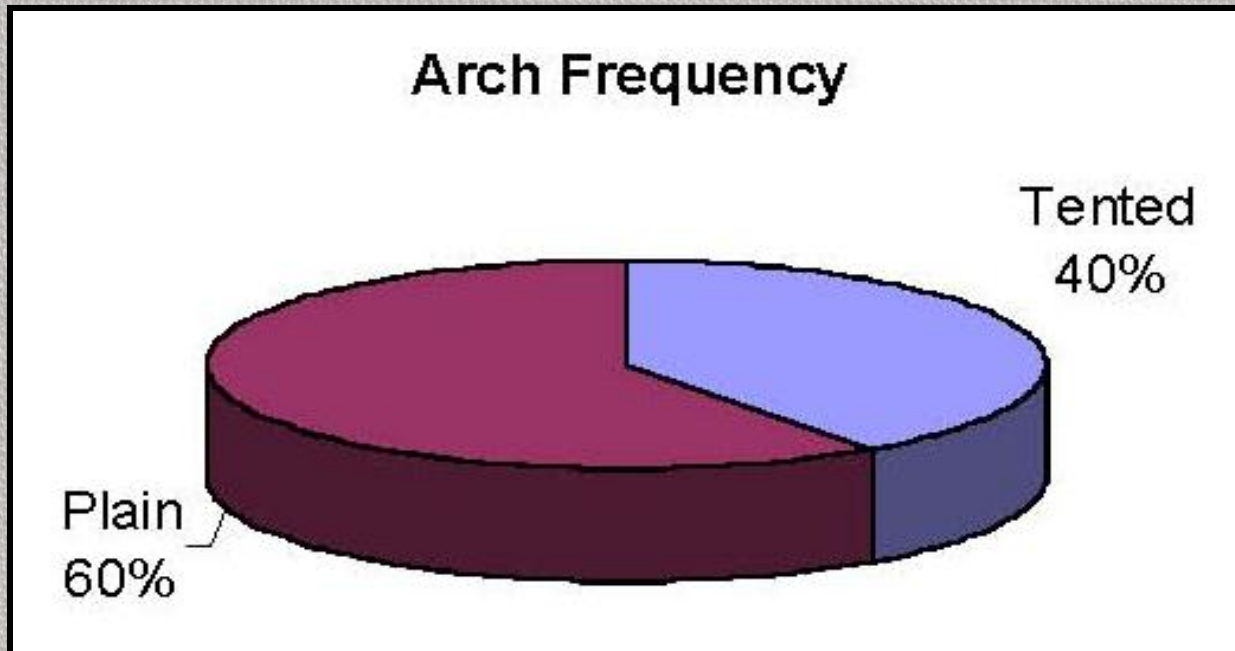
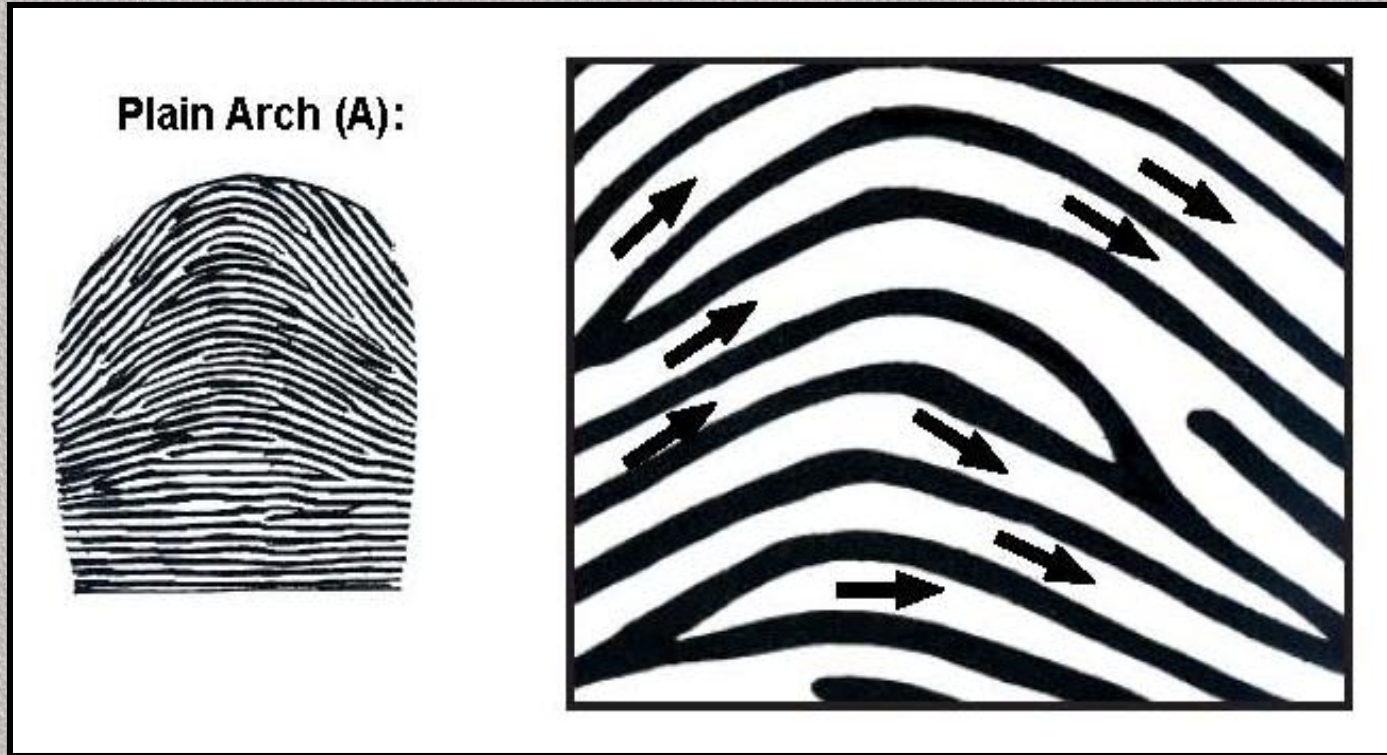


Figure 6  
Arch frequency



# Part 2 Arch



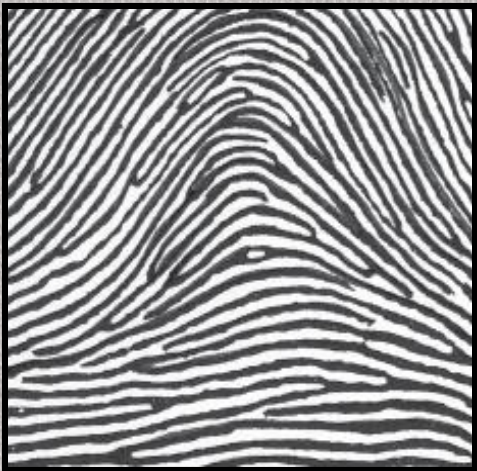
**Figure 7**  
**Plain arch**



# Part 2 Arch

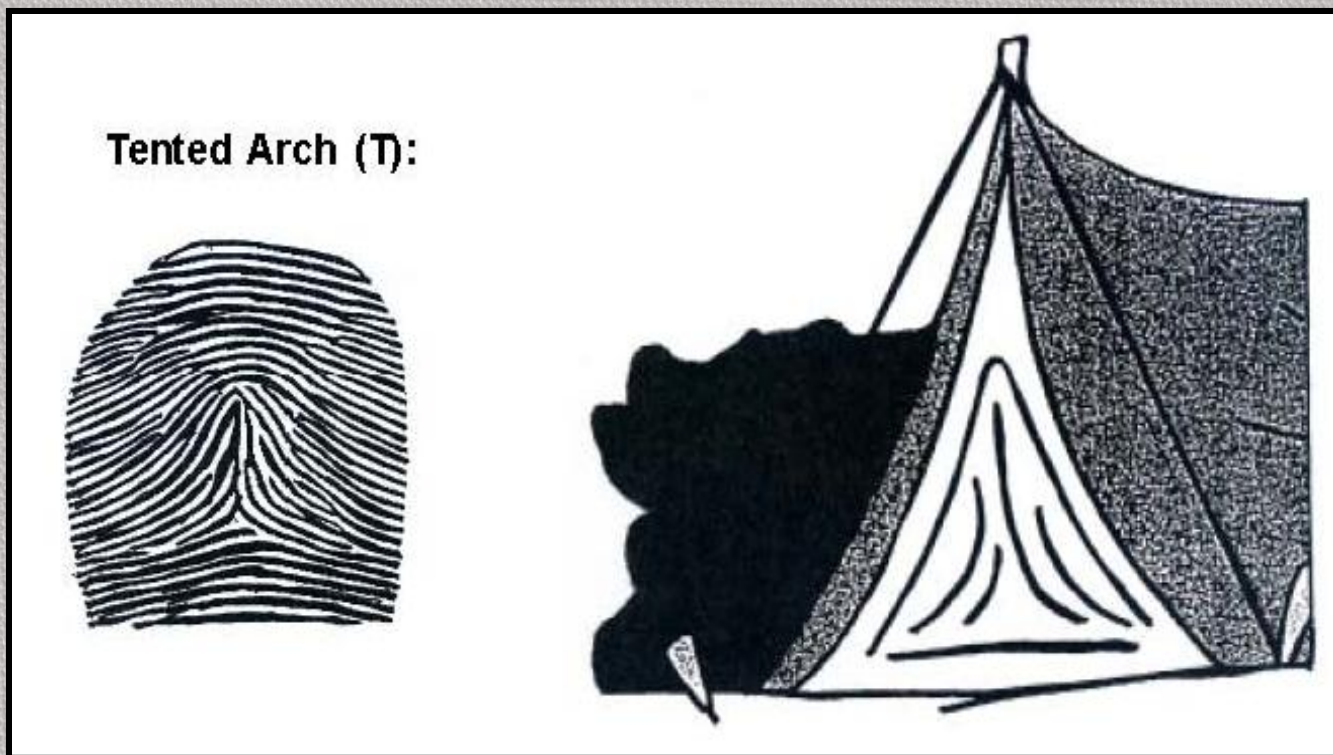


**Figure 8**  
**Examples of plain arches**





# Part 2 Arch



**Figure 9**  
**Tented arch**



# Part 2 Arch



**Figure 10**  
**Examples of tented arches**





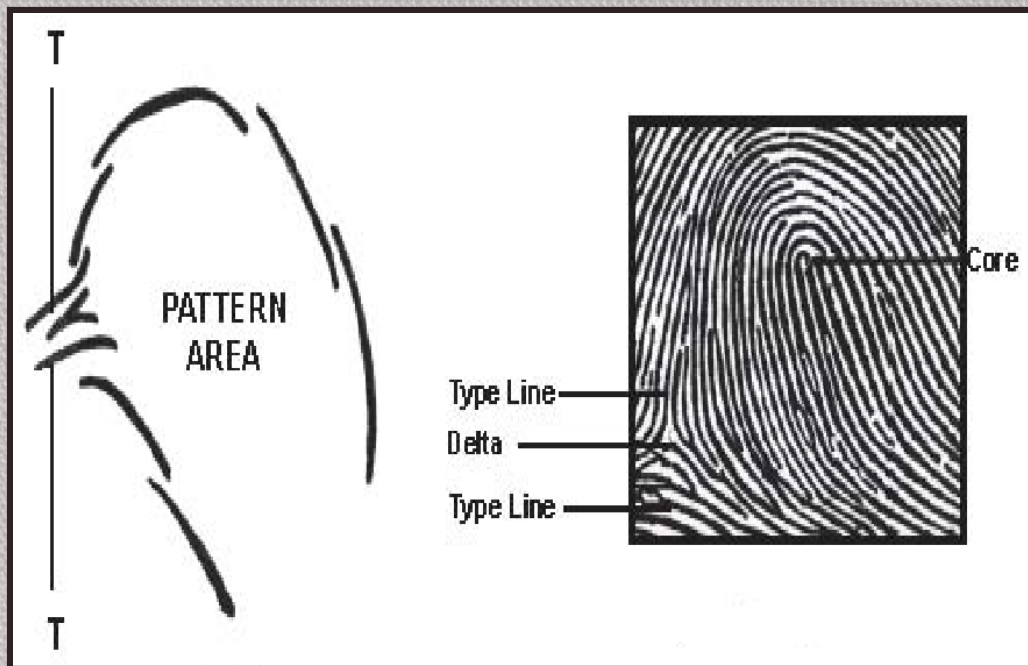
# Part 3 Loop

- Loop patterns are the most common of the three general types of fingerprint patterns.
- Loop patterns account for about 60 to 65% of all fingerprint patterns. Both right and left loops occur.
- The focal points of loop patterns are deltas and cores.
- Deltas are located between two diverging type lines.
- Cores are located in the approximate center of the pattern.
- One or more ridges enter either side of the pattern, recurve, touch or pass an imaginary line between the delta and core, and exit the same side as the ridge entry.



# Part 3 Loop

- Type lines are the two innermost diverging ridges of the pattern.
- The type lines run or start parallel to each other and then diverge and surround the recurring pattern area.

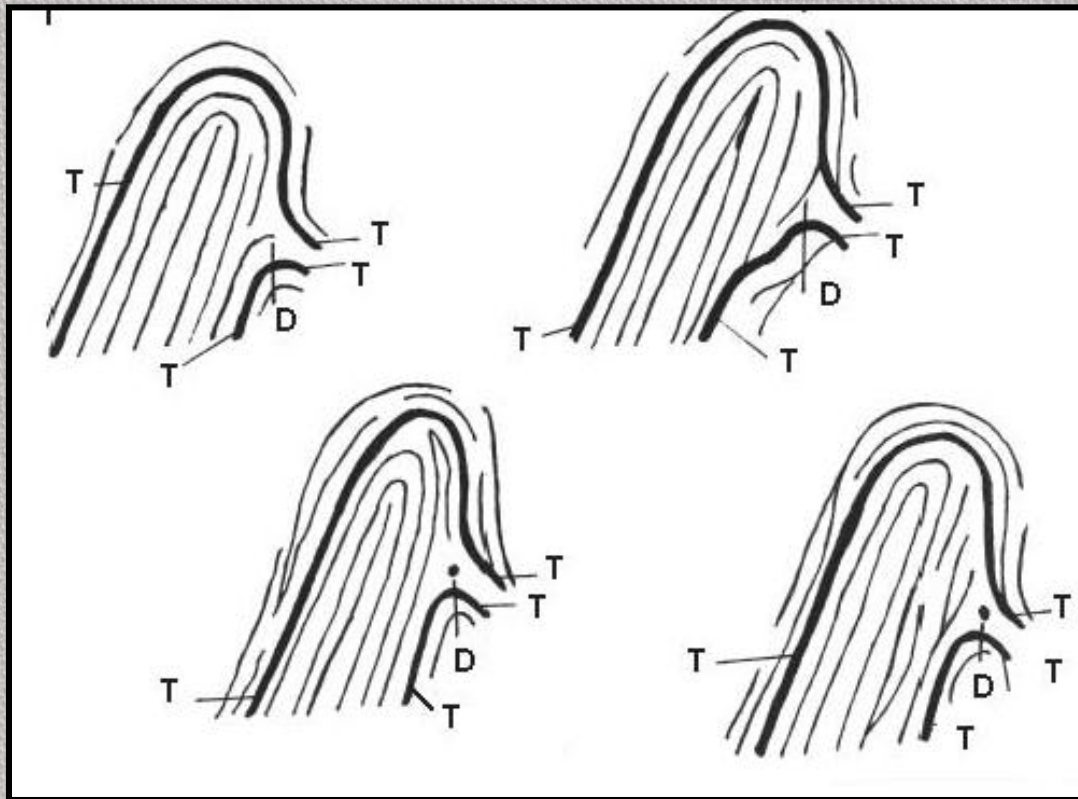


**Figure 11**  
Pattern area of a loop



# Part 3 Loop

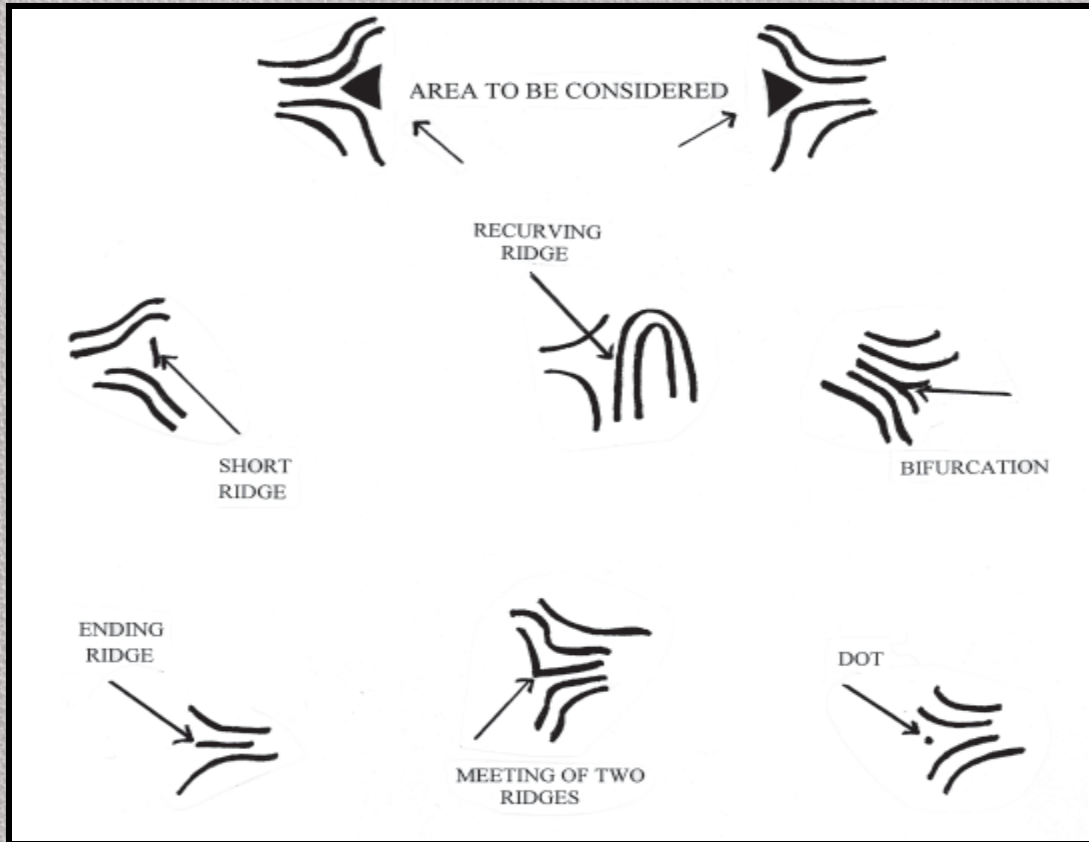
- A delta is located between two diverging type lines and is located on or directly in front of the point of divergence.
- Type lines (T) and deltas (D) are designated in Figure 12 below.



**Figure 12**  
Type lines and deltas  
of a loop



# Part 3 Loop

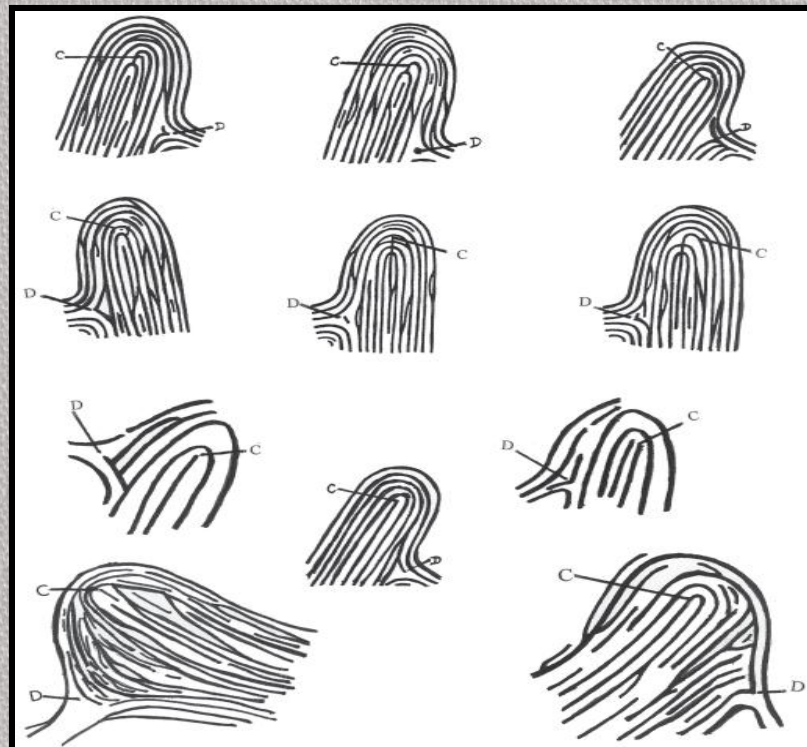


**Figure 13**  
**Examples of deltas**



# Part 3 Loop

- Cores are located in the approximate center of the pattern.
- They are located where the innermost recurve begins and curve to exit the same way as they came in.
- Cores (C) and deltas (D) are shown in Figure 14 below.



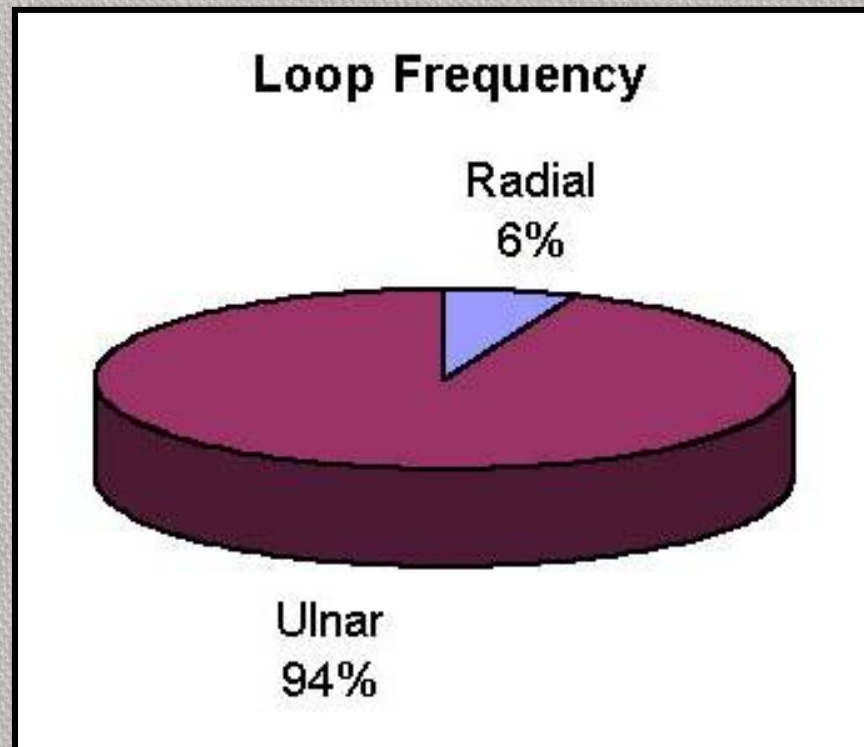
**Figure 14**  
**Cores and deltas**



# Part 3 Loop

- Loops can be ulnar loops or radial loops. Ulnar loops are the most common.

**Figure 15**  
Loop frequency





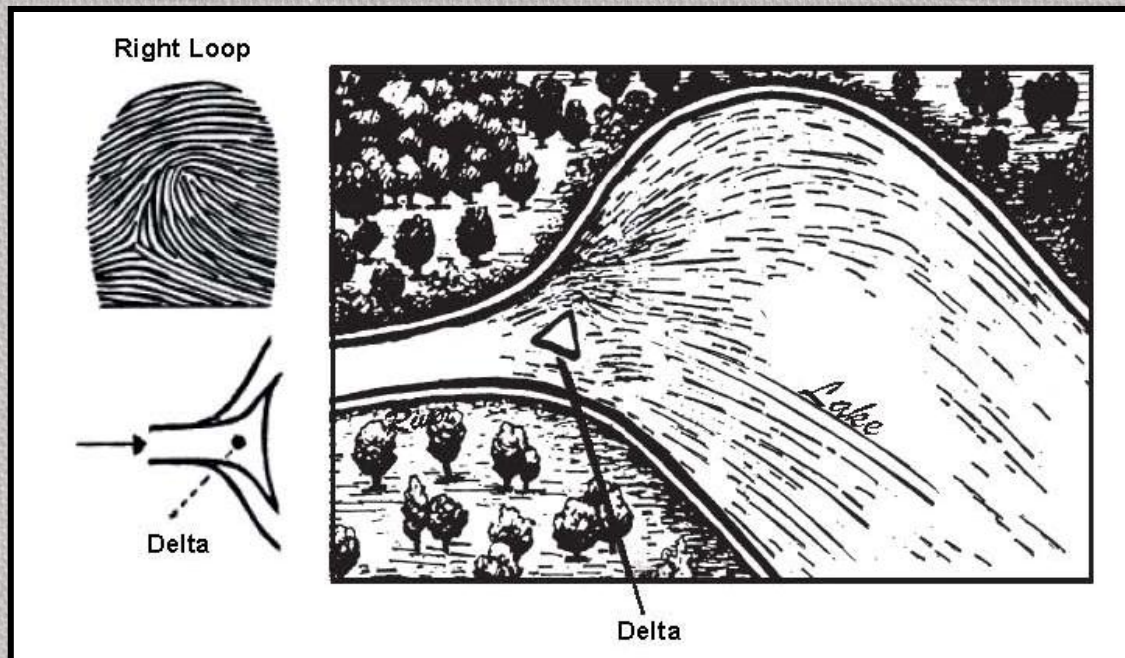
# Part 3 Loop

- Radial loops are named after the radius bone in the forearm that joins the hand on the same side as the thumb.
- The flow of the fingerprint pattern in radial loops runs in the direction of the radius, which is towards the thumb.
- Ulnar loops are named after the ulna bone in the forearm.
- The ulna is on the same side as the little finger and the flow of the pattern in an ulnar loop runs towards the little finger.



# Part 3 Loop

- Look at Figure 16 below. When a river (the small, narrow channel) dumps into a larger body of water (lake), a delta is visible. Compare the diagram to the fingerprint. If this print were on the right hand, this would be an ulnar loop. If it were on the left hand, it would be a radial loop.

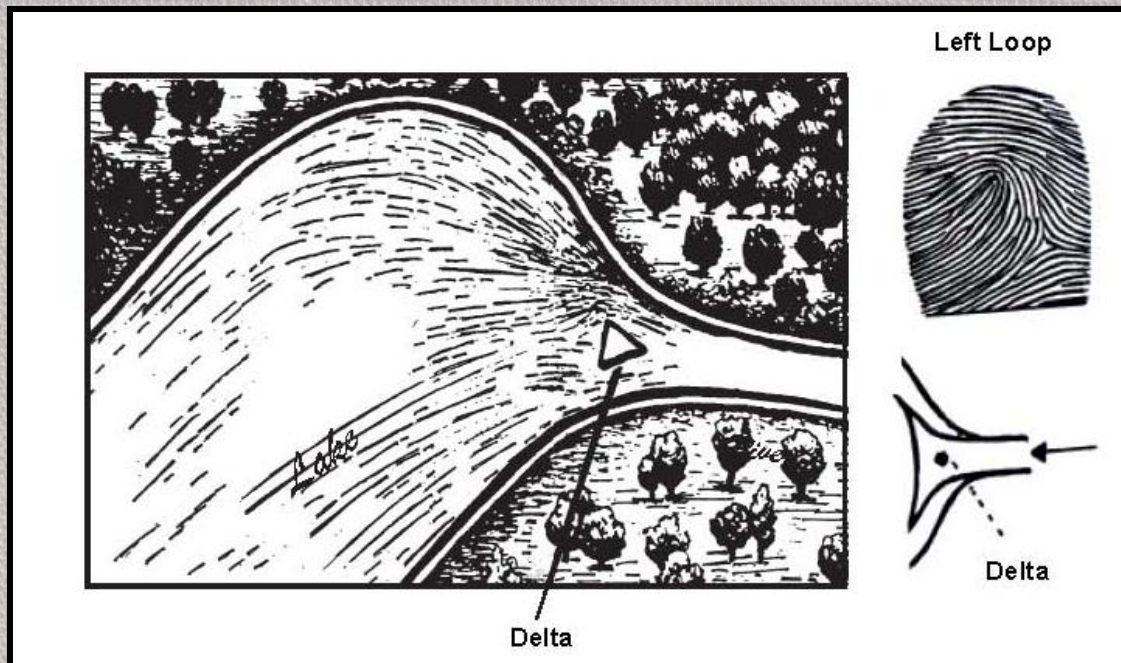


**Figure 16**  
Delta associated with a  
right loop



# Part 3 Loop

- From the notes made on the previous slide, if this print were on the left hand, it would be an ulnar loop (opening toward the ulna). If the same print were on the right hand, it would be a radial loop (opening toward the radius).

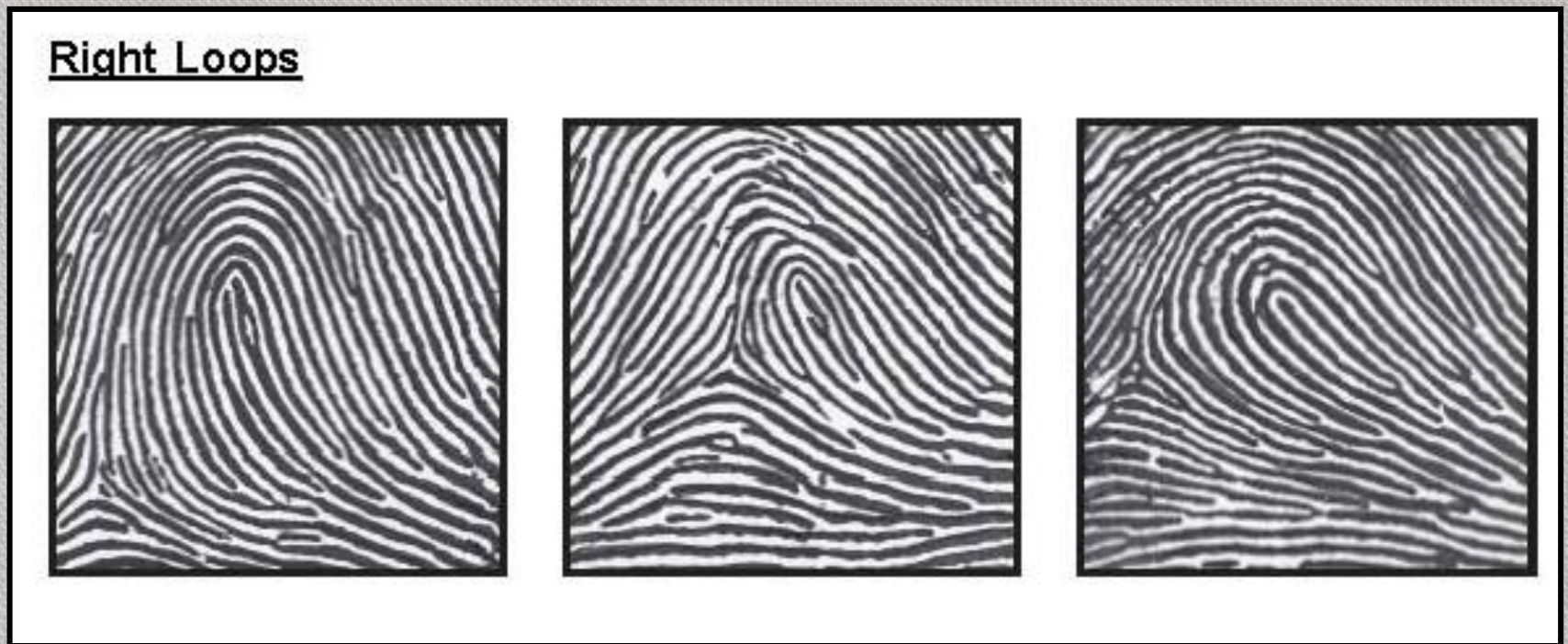


**Figure 17**  
Delta associated with a  
left loop



# Part 3 Loop

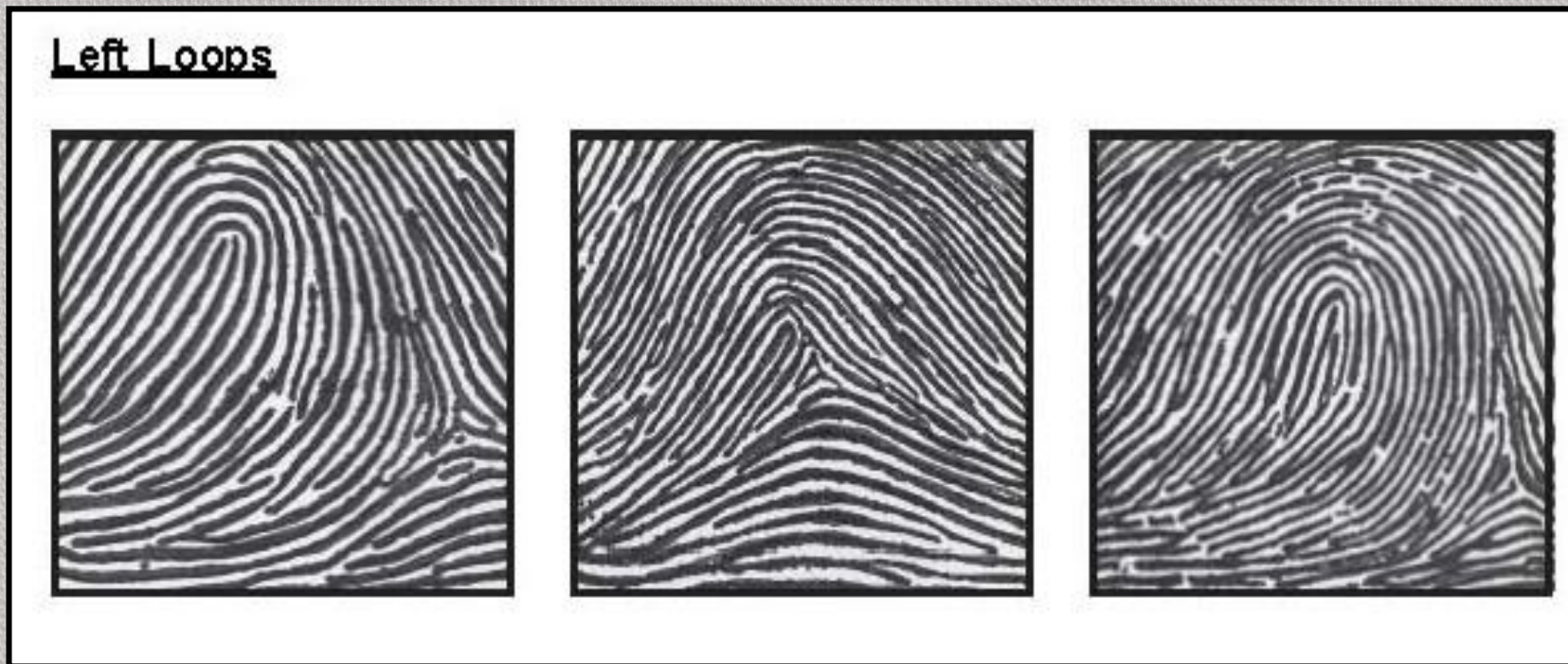
- The identification of whether the print is an ulnar loop or radial loop is dependent upon which hand the print comes from.



**Figure 18**  
**Examples of right loops**



# Part 3 Loop

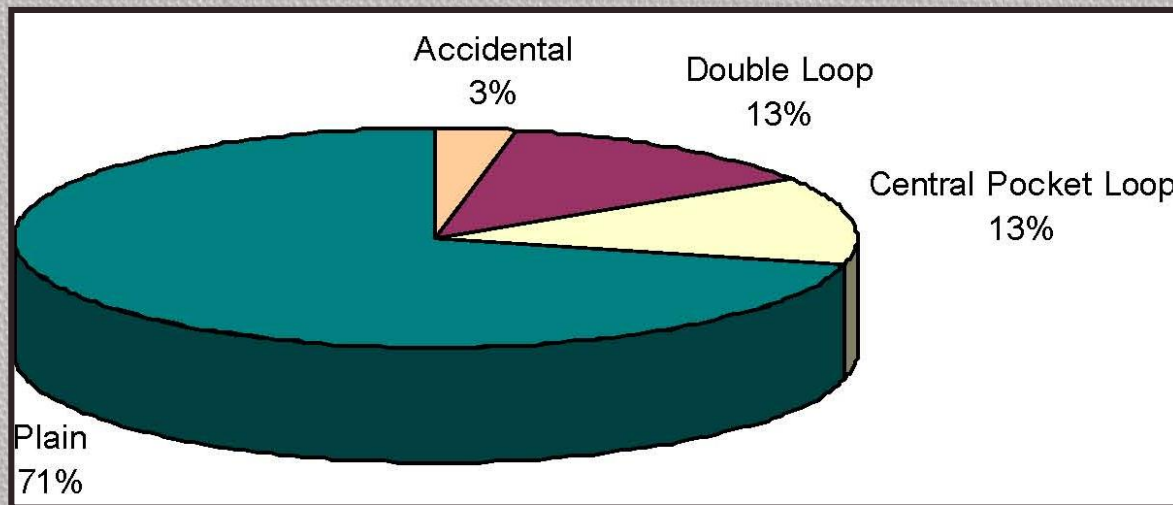


**Figure 19**  
**Examples of left loops**



# Part 4 Whorl

- Whorls are the second most common of the three general fingerprint patterns.
- Whorls account for about 30 to 35% of fingerprint patterns.
- They can be further divided into accidental whorls, double loop whorls, central pocket loop whorls, and plain whorls.
- Figure 20 below shows sub-pattern frequencies.



**Figure 20**  
**Whorl frequencies**



# Part 4 Whorl

- Plain whorl patterns must have both type lines and a minimum of two deltas. In a whorl pattern, the ridges are usually circular.

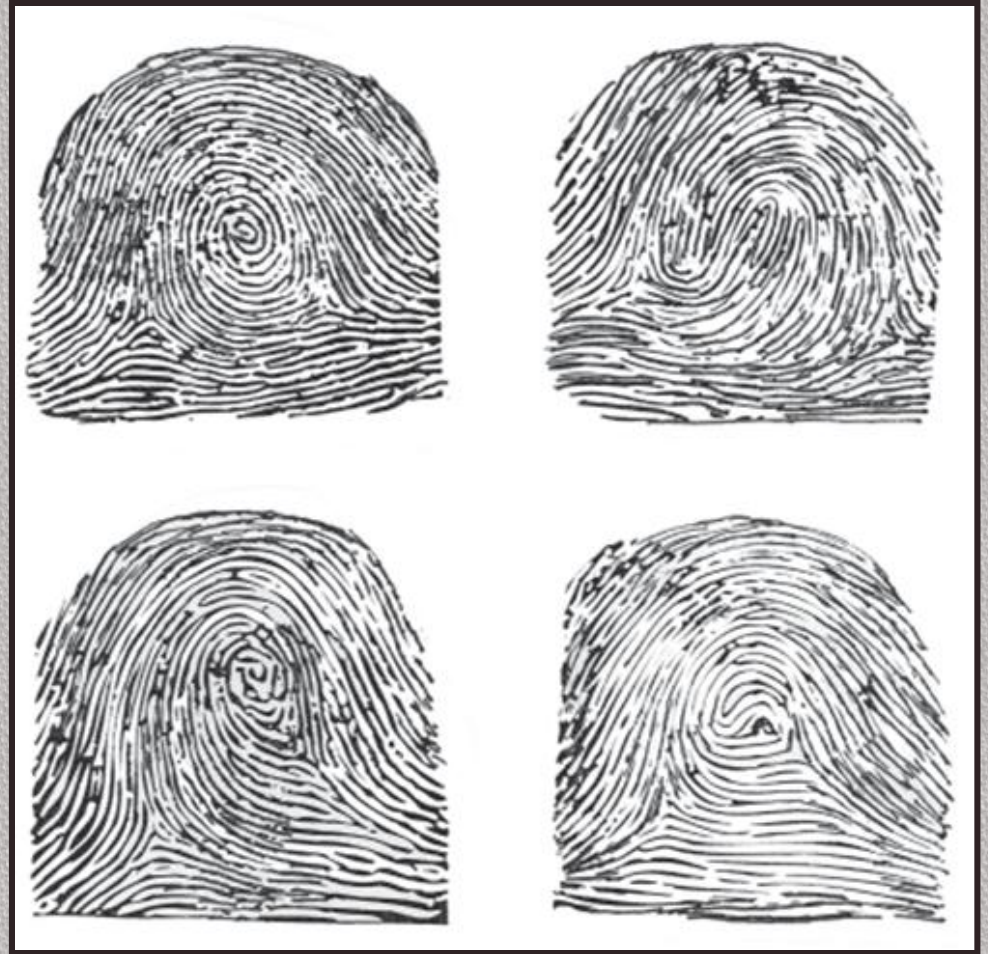


**Figure 21**  
**Examples of plain whorls**



# Part 4 Whorl

- The top left print is a plain whorl.
- The top right print is a double whorl.
- The bottom left print is a central pocket whorl, and the bottom right print is an accidental whorl.
- Plain whorls must have a minimum of two deltas and a recurving ridge in front of each delta. Ridge patterns in whorls are usually circular.

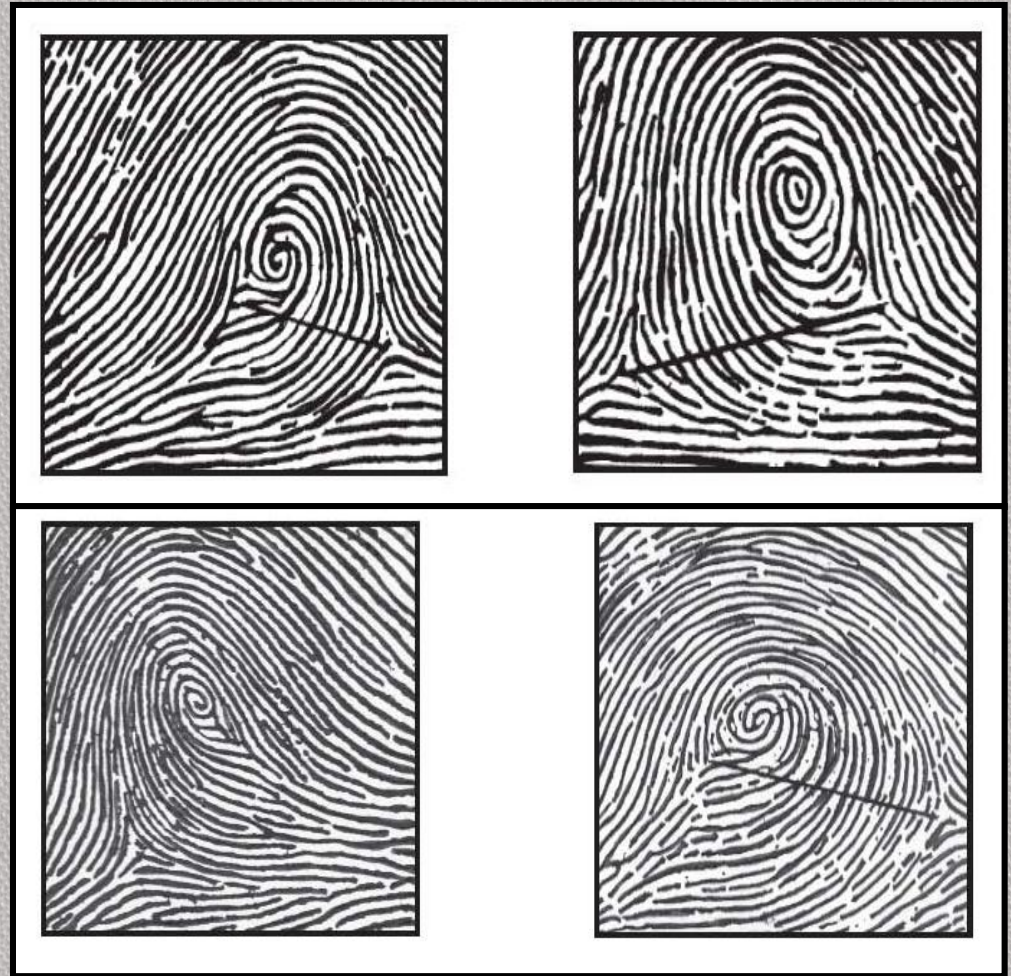


**Figure 22**  
**Different types of whorls**



# Part 4 Whorl

- Central pocket loop whorls must have a minimum of two deltas and one recurving ridge in front of each delta.
- The imaginary line connecting the two deltas must fall below the outermost circular ridge of the pattern.

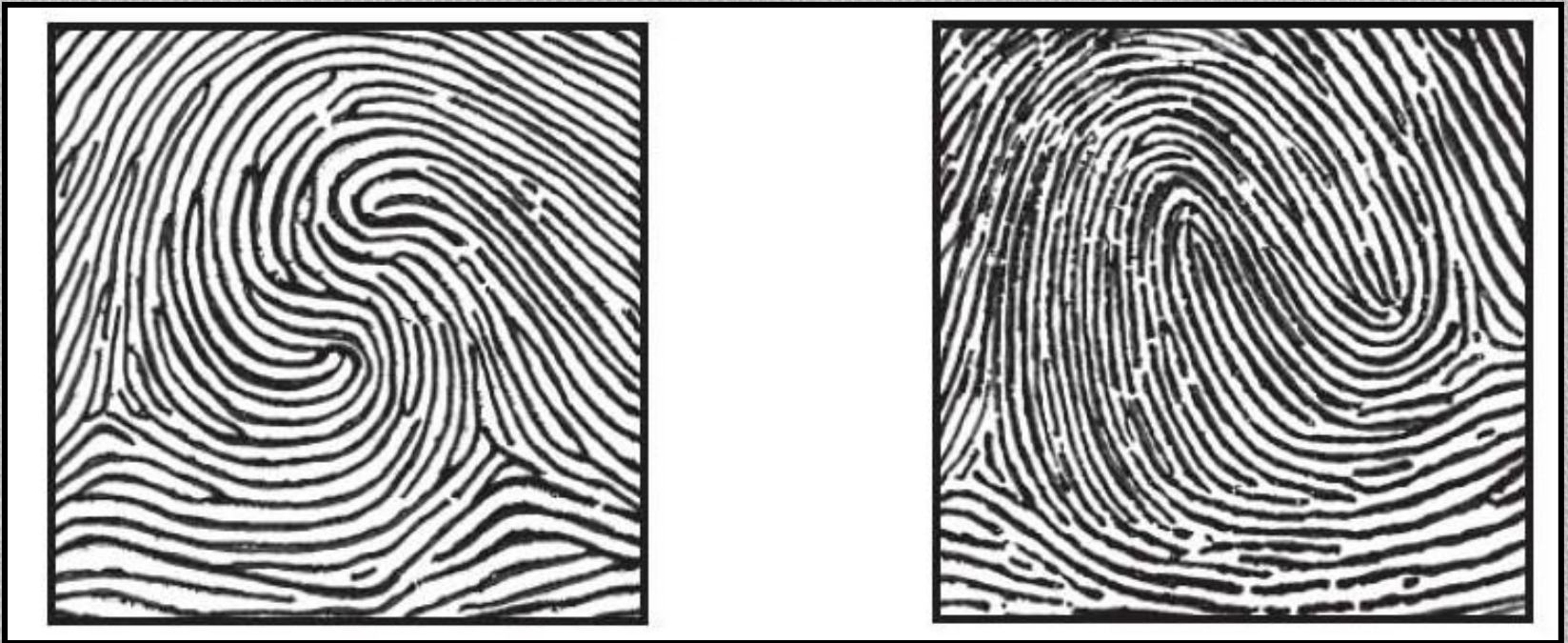


**Figure 23**  
**Examples of central pocket loop whorls**



# Part 4 Whorl

- Double loop whorls are made up of two loops combined into one fingerprint.



**Figure 24**  
**Examples of double loop whorls**



# Part 4 Whorl

- Accidental whorls are very rare.
- They consist of a combination of two different types of patterns (except for plain arches).
- Accidental whorls may occur in the following combinations: loop and whorl, loop and tented arch, loop and central pocket loop, and double loop and central pocket loop.
- Accidental whorls have two or more deltas.



**Figure 25**  
**Examples of accidental whorls**



# Part 4 Whorl

- The fingerprint shown in Figure 26 is an example of an accidental whorl because it does not conform to any other definition, pattern or category type.

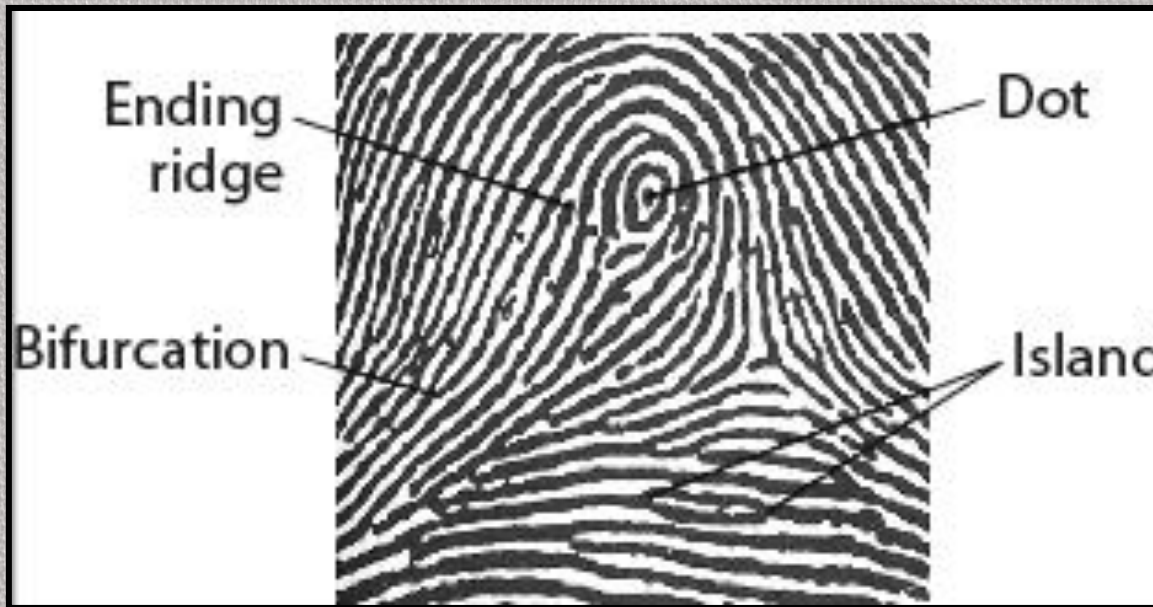


**Figure 26**  
**Accidental whorl**



# Part 5 Minutiae

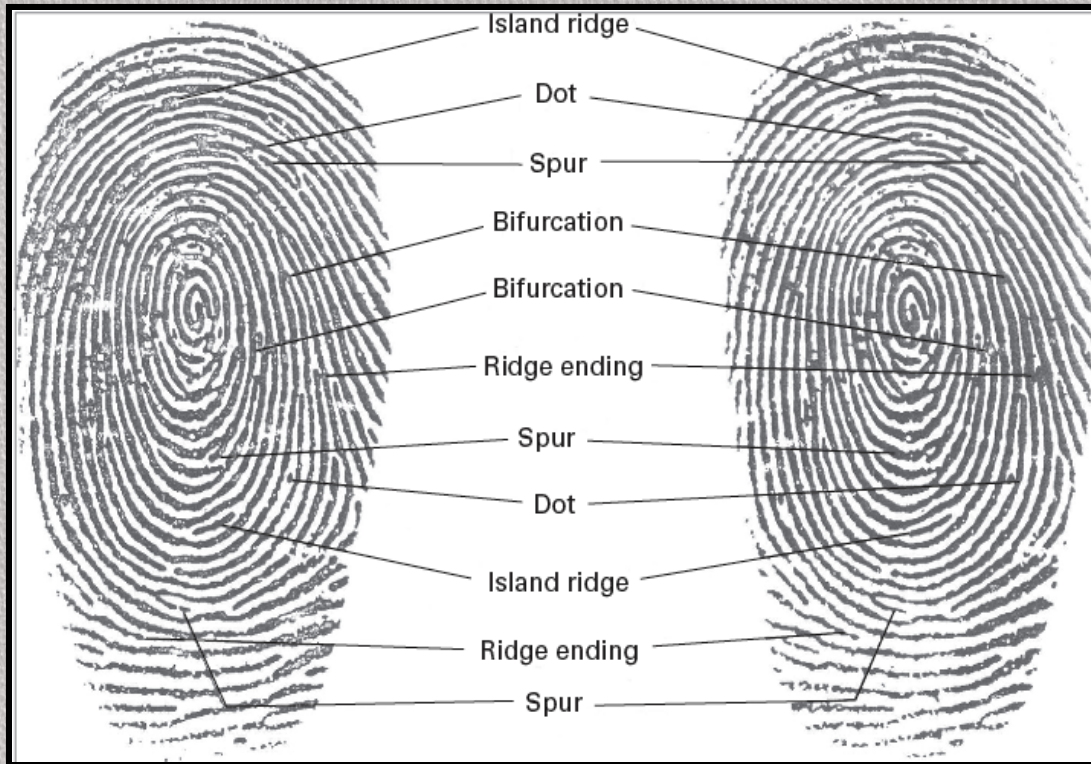
- Fingerprint minutiae are ridge features that individualize the overall pattern.
- Major minutiae features in fingerprints are known as bifurcations, ridge endings, islands, deltas, cores, dots, spurs, and crossovers.



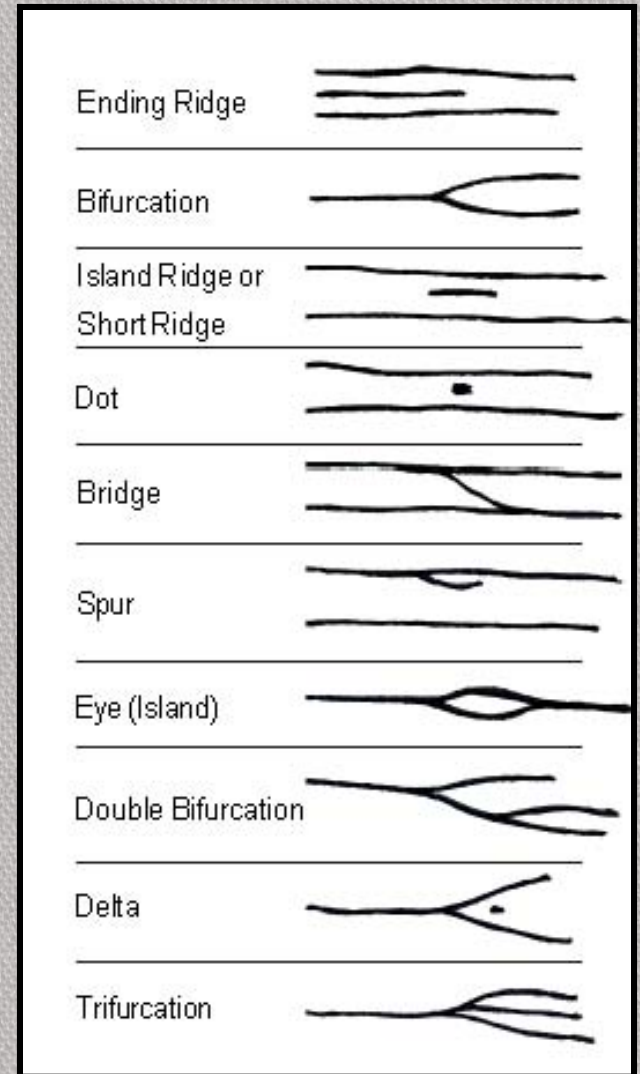
**Figure 27**  
**Fingerprint indicating different minutiae**



# Part 5 Minutiae



**Figure 28**  
Ridge features on a fingerprint

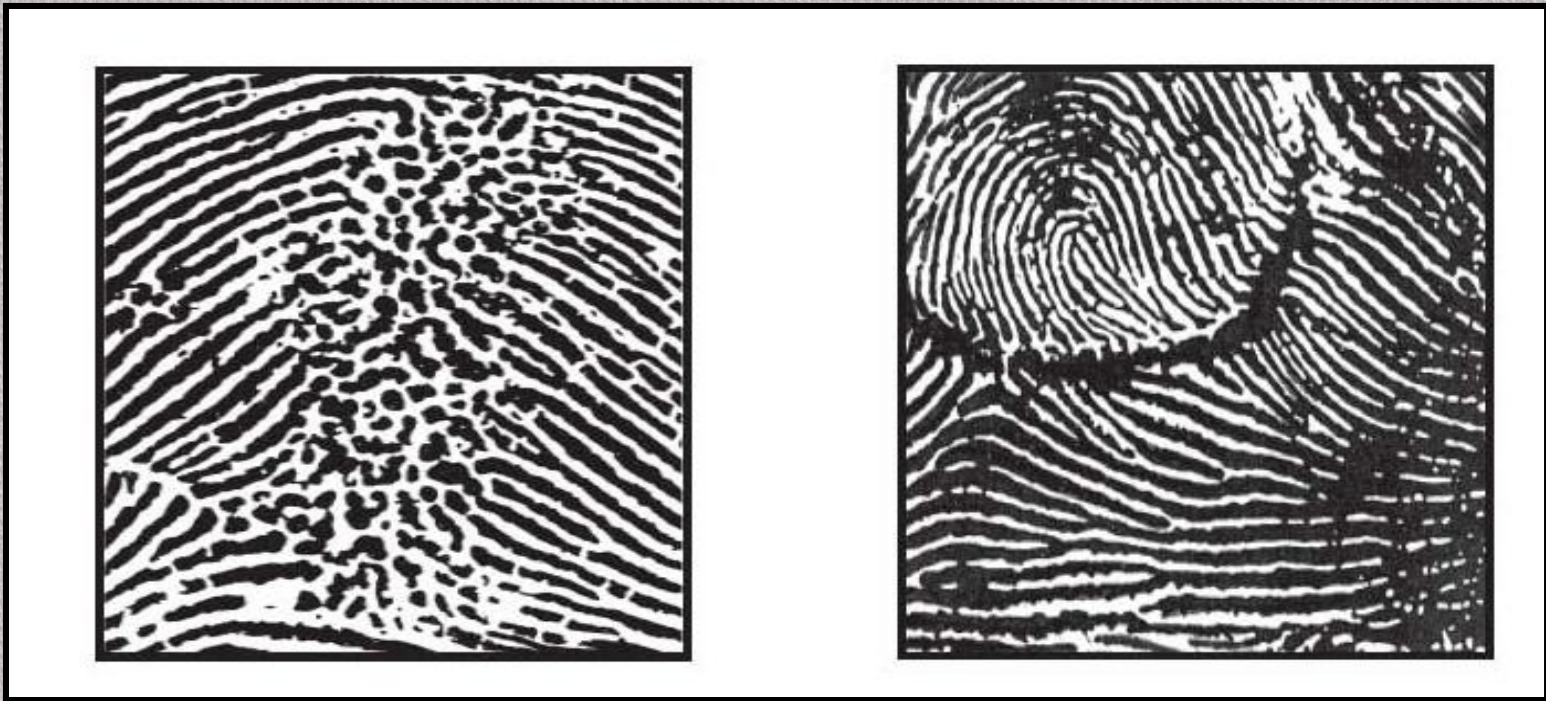


**Figure 29**  
Ridge features



# Part 5 Minutiae

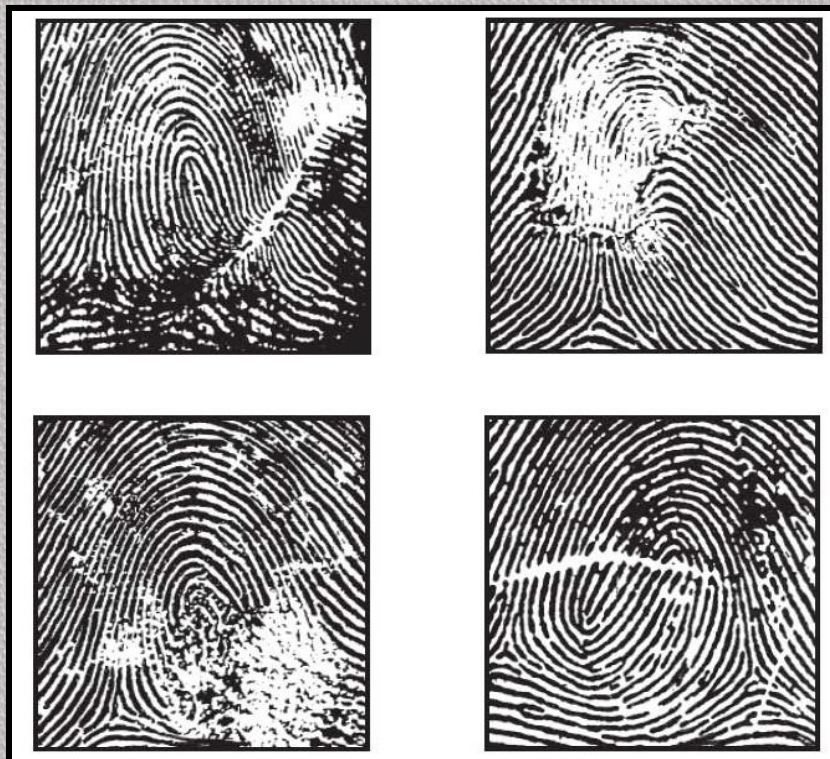
- A person's fingerprint can be altered by an injury that penetrates down below the epidermis. Permanently scarred patterns do occur. Examples of scarred patterns are shown in Figures 30 and 31.



**Figure 30**  
**Fingerprints indicating scars**



# Part 5 Minutiae



**Figure 31**  
**Fingerprints indicating scars**



# End of Module 6B

Forensic Science Teacher Professional Development