Article

Directionality in Swipe Patterns

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Abstract: The method for determining direction of motion for swipe patterns in bloodstain pattern analysis is outlined in numerous references. These methods, however, have not been previously studied in depth for verification and validity, and some of these methods are now under scrutiny within the discipline.

This study identifies five physical characteristics that appear in swipe patterns and their orientation in relation to direction of motion. The study suggests that the presence of an irregular demarcation in conjunction with any of the other four characteristics in the opposite boundary is a valid indicator of direction of motion for the pattern.

Introduction

Swipe patterns are a very common pattern of blood found throughout violent crime scenes. Whether defined by the International Association for Identification, the International Association of Blood Pattern Analysts (IABPA), or any given author, the definition of a swipe will generally contain the following elements:

> The transference of blood from a bloodied object,
>
> to a secondary unstained surface,
>
> via contact,
>
> with lateral movement of some nature between the two objects.

By their very nature, swipe patterns are often pattern transfers as well, showing specific characteristics of the object causing the swipe. Examples of such patterns include finger swipes and hair swipes. Lacking these types of identifying characteristics, a simple swipe merely defines moving contact of some nature and, in many instances, the direction of the associated motion of the contact. By far, the majority of swipes encountered fall into this latter, less precise category.

The Problem

The definition of motion in a swipe pattern (i.e., the determination as to which way the bloodied object made contact with the unstained surface) is the most significant information derived from the common swipe pattern. Until recently, the conventional manner in which this was done has been a matter of record in various publications and has been generally unchallenged. Those methods are now under scrutiny, but the manner of the challenge seems to be nothing more than the expression of individual opinion, much as the original method was. There are no studies previously published that support any particular methodology.

Purpose

The purpose of this study is to establish what characteristics are evident in the swipe pattern that might assist in making the determination of direction of motion. In order to accomplish this, several questions must be addressed:

1. What specific physical characteristics are present in swipe patterns?
2. Do these characteristics appear in any specific orientation when correlated to the direction of motion in the swipe?
3. Are any one or some combination of these characteristics, when present, reliable as an indicator of direction of motion of the swipe?

Background

As discussed, the definition of a swipe is generally accepted across the entire spectrum of current authors. But the discussion of how to define motion in the swipe pattern has led to the recent controversy of how reliable the "feathering" characteristic of a swipe is or is not for making this determination. Unfortunately, feathering is one of the few characteristics that has been described in literature.

Feathering in swipe patterns was first noted by MacDonell in 1993 while discussing hair swipes. In his book *Bloodstain Patterns*, MacDonell reported that hair swipes left very characteristic patterns that included:

> " ...fine line and feathered edged reproduction of the individual hairs."[1]

MacDonell did not go so far as to state that feathering was a mechanism for determining the direction of motion present in the swipe. In considering his accompanying figure example, however, it is apparent he did make such decisions.

In 1994, the IAI Bloodstain Pattern Identification Subcommittee presented a standardized vocabulary for bloodstain pattern analysis. Included in this vocabulary was the definition of a swipe and a reference to the feathering characteristic, which stated:

> " Direction of motion is usually determined by the feathered edge or accumulation of blood at one end of the pattern."[2]

Stuart James, in defining standard experiments in bloodstain pattern analysis, made a similar reference in his text *Scientific and Legal Applications of Bloodstain Pattern Interpretation*. In Experiment 11, which deals with swipes, wipes, pattern transfers, and smudges, James provides guidance for the student, which includes:

> "Create a hair swipe by soaking a wig with blood and dragging it across the cardboard surface. Determine directionality of the swipe by studying the feathered edge of the pattern."[3]

In 1997, the author, along with Tom Bevel, reported in the text *Bloodstain Pattern Analysis With an Introduction to Crime Scene Reconstruction* that:

> "Besides a thinning of the color and consistency of the [swipe] stain, we may also see trailers leading away from the main stain. These trailers are created when the bloody object loses contact with the target surface. Such trailers are also referred to as feathering of the stain."[4]

When and where the challenge of this basic belief actually began is not clear. It is unreported in any standard text on bloodstain pattern analysis. An undated training handout (believed to be post 1997) prepared for a bloodstain pattern workshop reported:

> "Rules for determining directionality of wipes and swipes. Blood dries in the direction of travel and becomes gritty. Volume is displaced (pushed) in the direction of travel. Feathering is not a characteristic to be used."[5]

A more recent bloodstain pattern workshop abstract (IAI, 2001) also refers to the issue of feathering, stating:

> "Attendees will be cautioned against using "feathering" in making these [directionality] determinations."[6]

The feature feathering, it would seem, lies at the heart of the current controversy. A critical aspect of this controversy may be nothing more than an issue of semantics: What is feathering and how is it defined? This study will attempt to define more conclusively the nature of any evident characteristics and which, if any, assist in determining motion in swipes.

Question # 1: What specific physical characteristics are present in swipe patterns?

Swipes occur from random contact with a variety of objects. Any kind of contact between objects can act as a mechanism for creation of a swipe. Nevertheless, swipe patterns do appear to share common characteristics across this spectrum.

In order to identify these characteristics, a number of actual crime scene photographs were evaluated (Figures 1 through 5). Consideration was not given to any previous determination of directionality. The patterns were chosen based on conformance with swipe pattern definition and clarity. Each pattern was evaluated singularly for physical characteristics that were manifest in the pattern. In effect, this was simply a re-definition of a swipe pattern based on physical characteristics present in the stain rather than on the creation mechanism.

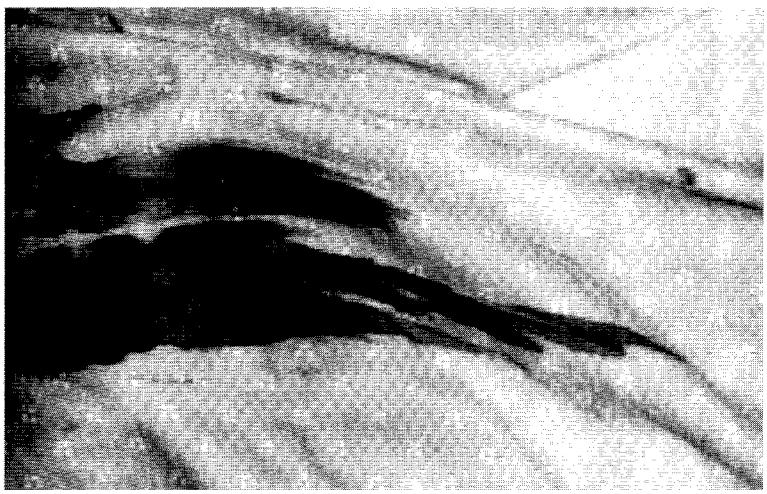

Figure 1

An irregular but contiguous demarcation.

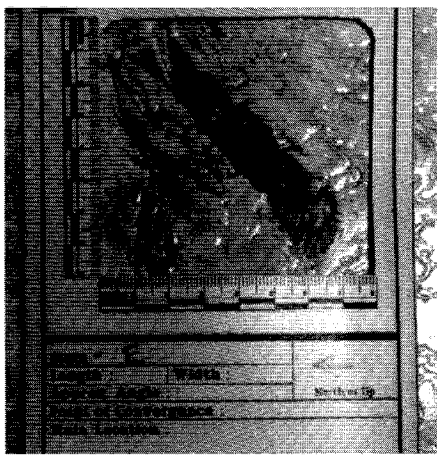

Figure 2

A feathered demarcation.

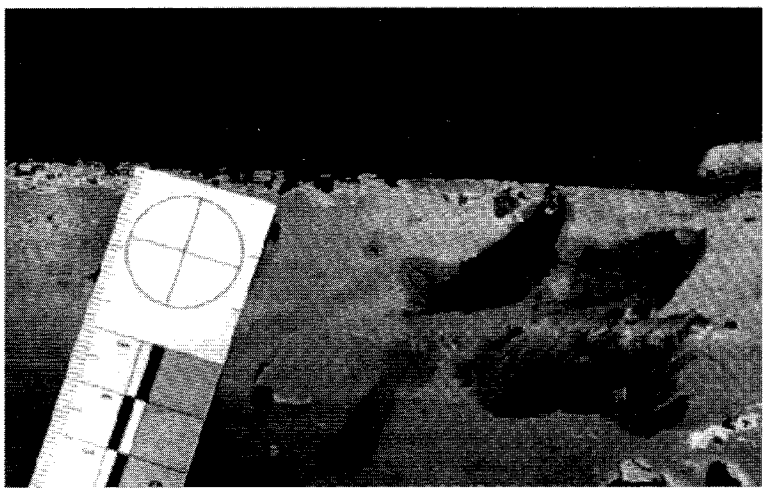

Figure 3

Striations.

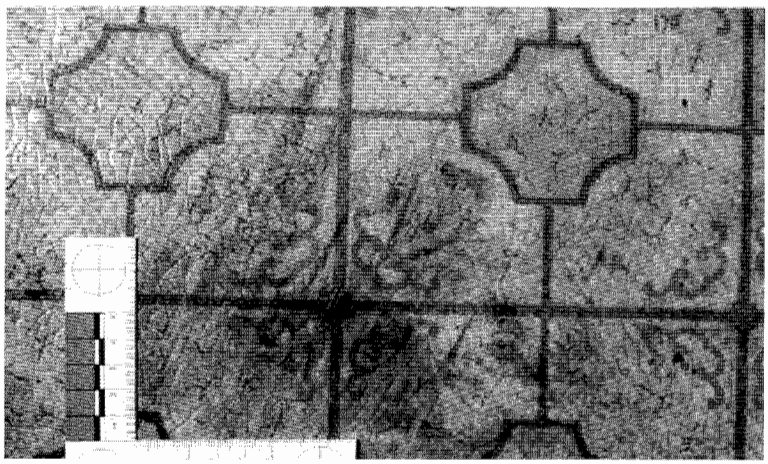

Figure 4
Diminished volume.

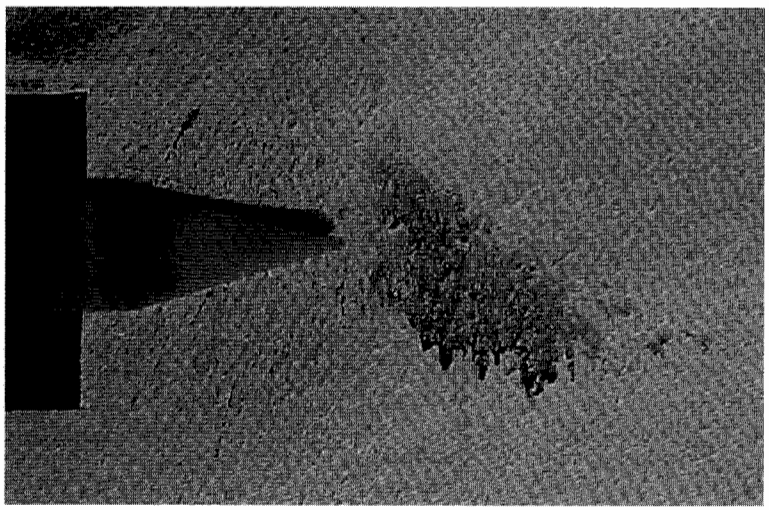

Figure 5
Welling.

From this evaluation, five recurring characteristics were identified. Not all of the five characteristics were evident in each pattern, but at least two to three were found in every pattern. These characteristics were:

Irregular but contiguous demarcation. This is a boundary in the pattern that had relatively solid or smooth demarcation. On this boundary, the blood deposition, whether solid or striated, was evenly distributed giving the appearance of a contiguous contact on that boundary. Figure 3 is an example of this characteristic.

Feathered demarcation. This characteristic would best be described as feathering. These boundaries appeared as a number of small striations of varying lengths emanating from the body of the stain or a boundary made up of a number of jagged projections of varying sizes. Figure 4 is an example of this characteristic.

Linear striations within the body of the stain. This characteristic manifests itself as lines running across the body of the stain. In some instances, these lines ran the length of the stain; in others, they appeared oriented to one side or the other of the body of the stain. Figure 5 is an example of this characteristic.

Decreasing volume in the body of the stain. This characteristic most often manifests itself as a change in the saturation of the stain. For ease of description and reporting, the characteristic is described as decreasing (changing from dark to light). Figure 6 is an example of this characteristic.

Welling of blood in a stain boundary. This characteristic manifests itself as a boundary of the stain that had a significant volume of blood when compared to the adjacent stain body. Figure 7 is an example of this characteristic. Orientation of a swipe pattern on a vertical surface combined with a significant deposition of blood often results in welling of blood on the lower boundary as a result of gravity. Gravity alone, however, is not responsible for all welling observed in vertically oriented swipes.

Question # 2: Do these characteristics appear in any specific orientation when correlated to the direction of motion in the swipe?

A number of swipes were created under known conditions in which the direction of motion was clearly established. The characteristics were then evaluated against the known motion to see what, if any, correlations existed.

Because swipes are so random, the amount of blood and the actual application of the objects to the surface were varied as much as possible to create random swipe marks. No attempt was made to apply the swipes in exactly the same manner. However, a singular lateral motion was a necessity in considering the samples. In instances where a slip or unsteady hand resulted in an unclear contact or direction, the stain was marked and excluded. Smooth poster board was used as a control surface and then a variety of surfaces were used to approximate real evidence scenarios.

Three hundred swipe mark samples were produced on smooth poster board. Three methods were chosen to simulate finger swipes, fabric swipes, and swipes from other bloodied items (e.g., weapons). The samples included:

- Contact with a surface using a bare bloodied finger (100 samples)
- Contact with a surface using a piece of bloodied cloth (100 samples)
- Contact with a surface using a piece of untreated bloodied wood, 1" in width (100 samples)

Four hundred and eleven samples were created on various surfaces to simulate different scene variations (e.g., absorbent and nonabsorbent surfaces). These surfaces included:

- Cotton sheet/heavy cotton cloth
- Plastic
- Formica counter top

After creation, each swipe was individually evaluated for the five characteristics. If present, it was noted on what boundary or in what orientation the characteristic appeared in relation

to the application of the bloodied object. Three orientations of interest were noted:

- Appearance of the characteristic on the contact side (the beginning of the swipe)
- Appearance of the characteristic on the departure side (the end of the swipe)
- Appearance of the characteristics on both the contact and departure side

Results - Poster Board Samples (See Table 1)

Irregular but contiguous demarcation: This characteristic was oriented to the contact side of the swipe in 79% of the poster board samples. Although it was found on both sides of some swipes, it was never oriented singularly on a departure side.

Feathered demarcation: This characteristic was oriented to the departure side of the swipe in 75% of the poster board samples. Once again, although found on both sides of some swipes, it was never found singularly on the contact side of the poster board standards.

Striations: This characteristic was found oriented to the departure side in 31% of the poster board samples and on both sides in 58% of the poster board samples. It was an extreme exception (only 3 samples) to locate this characteristic exclusively on the contact side of the poster board samples. When this occurred, it was related more to the nature of the swiping object (e.g., cloth fabric).

Diminished volume: This characteristic was never found oriented singularly to the contact side of the swipe samples. It occurred on the departure side in only 3% of the samples.

Welling: Welling was never found oriented to the contact side of the swipe. It appeared on the departure side in only 10% of the samples. In 11.3 % of the standards, welling appeared on neither the contact or departure side boundaries, but did appear in the boundaries at right angles to the lateral movement (upper or lower boundaries).

Considering only the poster board samples, the combination of an irregular demarcation on the contact side and a feathered demarcation on the departure side was the most reliable combination of characteristics to accurately identify direction of motion. Striations in the stain were the least valid because they appeared on both sides of the stain routinely. This was particularly true of cloth swipes, where the fabric weave itself often created significant striated characteristics in the swipe pattern.

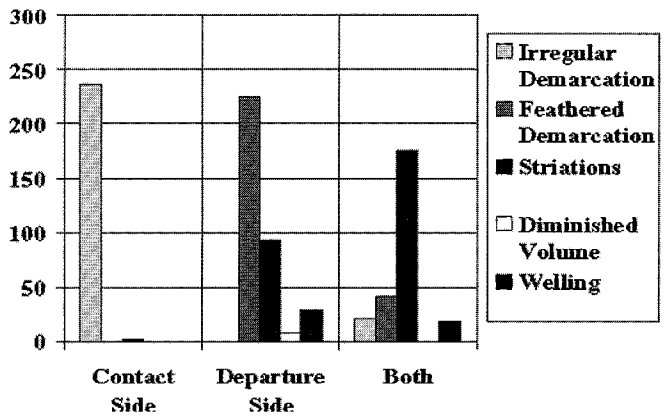

Table 1

Poster Board Samples.

Results - Alternative Surface Samples (See Table 2)

Irregular but contiguous demarcation: Once again, this characteristic tended to be the most likely single characteristic to appear on the contact side, but with a lesser degree of frequency (41%). The presence of this characteristic in both contact and departure sides was also significant here, occurring in 28% of the standards. (On cloth, this characteristic was often evident in both contact and departure sides. This was also true for the mechanism of cloth in contact with Formica.)

Feathered demarcation: This characteristic was often oriented to the departure side of the swipe, but with far less frequency than that evident in the poster board samples (34%). On heavy cotton cloth, feathered demarcations were significantly absent.

Striations: These striations were more likely to be found in the departure side or both sides of the swipe pattern. It was the exception to locate striations only on the contact side.

Diminished volume: Diminished volume was never found oriented singularly to the contact side of the swipe standards. Its appearance in the contact side at all was associated only with non-wetting surfaces, and even this was a significant exception.

Welling: Welling was found in multiple orientations here. Once again, welling was as likely to appear in the lateral boundaries as in the departure boundary. It rarely appeared in the contact side of the alternative surface stains and never appeared on the contact side alone.

Table 3 depicts all samples (poster board and alternative surfaces) combined. Taken in totality, the presence of an irregular demarcation on a single side of the stain with the presence of any combination of the additional characteristics on the opposite side of the stain would appear to be a reliable indication of directionality.

The irregular demarcation identifies the contact side of the pattern. The presence of diminished volume in a single edge was also a significant characteristic, almost always appearing on the departure side. Thus, the combination of an irregular demarcation with an evident diminished volume on the opposite side of the stain would appear to be the most valid combination of characteristics for defining the direction of motion of a swipe pattern.

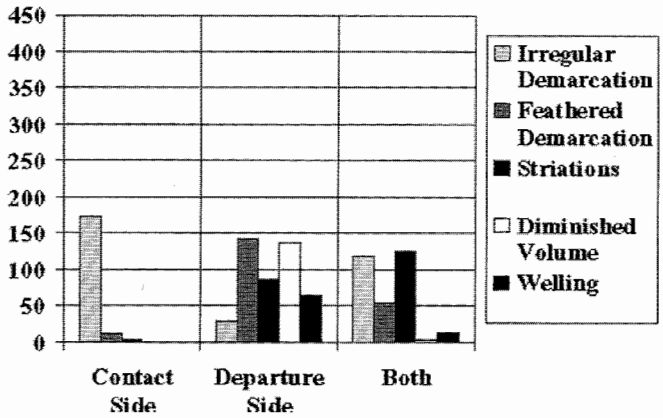

Table 2

Alternative Surface Samples.

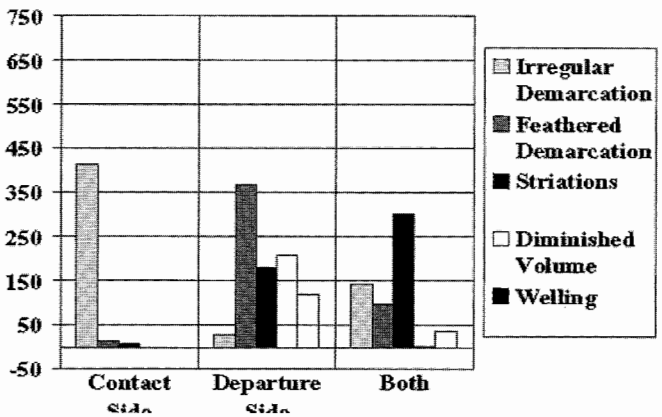

Table 3

Combined Results

Question # 3: Are any of these characteristics (individually or in some combination) reliable as indicators of direction of motion of the swipe?

A blind test was created to evaluate the author's ability to determine swipe direction. There were no rules applied to creation of the test swipes, allowing for varying orientations, directions, and mechanisms. A total of 22 test swipes were produced. The test swipes were then analyzed for direction of motion using the conclusions developed in Question # 2. The study results were applied irrespective of the condition of the test swipe (e.g., similar contact and departure edges, or swipes in which no attempt would be made to identify direction of motion in an actual crime scene). The results indicated by the study were then compared to the actual direction of motion.

In three of the twenty-two samples (13.6%), the motion was identified incorrectly. Two of the three incorrect identifications involved cloth application.

In another three of the twenty-two samples (13.6%), the last motion in multi-directional swipes was identified. The initial direction of motion in these multi-directional swipes was not evident or indicated by application of the study results.

In sixteen of the twenty-two samples (72.7%), the motion of direction was identified correctly. This included three questionable swipes (i.e., swipes in which no conclusion would have been attempted in an actual case because of the configuration of the swipe).

Conclusions

Using the orientation of the five identified characteristics, determination of direction of motion is possible in some swipe patterns. The recurring pattern evident across all surfaces is the presence of the irregular demarcation on the contact side, accompanied by the presence of one or more of the four other characteristics (feathered demarcation, striations, diminished volume, welling) on the departure side of the stain.

Of the four departure side characteristics, striations in the stain are the least valid characteristic to consider, although diminished volume appears to be the most valid characteristic.

As with all bloodstain patterns, determination of motion is not always possible by the analyst. Situations in which both departure and contact edges share common characteristics (e.g., both have irregular demarcation) are common. In such instances, it would be inappropriate to attempt to identify the direction of motion.

Postscript:

At the 2001 IABPA Training Conference in Tucson, Arizona, the author, along with Jeff Gurvis, discussed the study results and observations regarding the consideration of welling. Gurvis suggested that macro-welling of blood, that which is evident to the eye (as was considered in this study), may also be accompanied by micro-welling of blood. This micro-welling occurs on the edge of the swipe and may be an even better indication of motion. This is an area requiring further evaluation and study.

For further information, please contact:

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References

1. MacDonell, H. L. *Bloodstain Patterns*; Golas Publishing Inc.: Elmira Hts, NY, 1993; p 83.
2. Ostermeyer, D. Bloodstain Pattern Identification Subcommittee Annual Report. *J. For. Ident.* **1994**, *44* (2), 214.
3. James, S. et. al. *Scientific and Legal Applications of Bloodstain Pattern Interpretation*; CRC Press: Boca Raton, FL, 1998, p 170.
4. Bevel, T., Gardner, R. M. *Bloodstain Pattern Analysis With an Introduction to Crime Scene Reconstruction*, CRC Press: Boca Raton, FL, 1997, pp 115-116.
5. Homeyer, J. M. IAI Bloodstain Pattern Workshop, Slide 31, unpublished.
6. Gurvis, J. B., Smith, M. L. IAI Bloodstain Pattern Workshop Abstract. 86th IAI Training Conference Announcement, 2001.