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Fibres Retention Time on Different Type of Recipient Garments

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ABSTRACT: Fibre is one of the trace evidence that could be found in a crime scene because most crimes involve direct contact between victims and suspects. Fibres could be transferred and detected based on their composition, duration of contact between suspect and victim, and the persistence of fibre based on Locard's principle, stating that every contact leaves a trace. Three types of recipient garments which are cotton t-shirt, polo t-shirt and jersey were used in this research. The donor garment is a 100% cotton red t-shirt. Fibres were transferred from the donor garment to the recipient garment by hugging which simulated physical contact. The numbers of red fibres present on the recipient garment after eight hours determined the persistence of fibres. This research aimed to assist the forensic scientist with the interpretation of fibre evidence. Fibre was lost significantly from smooth surface t-shirt compared to rough surface. Recipient garment with relatively higher fibre persistence was the polo t-shirt.

Keywords: fibre, transfer, persistence, recipient garment, daily life activities

Introduction

Fibre is one of the trace evidence that can be found in a crime scene. Many crimes involve direct physical contact between victims and suspects [1]. When a physical contact occur, there is a possibility of trace evidence transferred such as hair and fibres. This is based on Locard's exchange principle, stating that every contact leaves a trace. Fibres can be transferred and detected based on its composition, duration of contact between suspect and victim and the persistence of fibre and the type of fabric [2].

Fibres are important evidence in crime investigation because they can link the suspect who believed to be connected to the case, based on transferred fibres [2]. When a physical contact occurs between a suspect and a victim, fibres can be transferred between them [3]. Fibres can be easily transferred and persisted on a surface after certain of time. They can be transferred between two individuals, between an individual and an object, and between two objects [2], such as in assaults, rapes, homicides, burglary and hit and run cases [1]. Fibres can be transferred from the suspect's clothes to the victim and vice versa especially in crimes involving violent body contacts such as assault and sexual offense. Other than that, fibres also can be found in crime such as breaking and entering, usually at the splintering woodwork or other objects at the crime scene [3].

An example of case related to fibres involvement was in 1995, when a young woman was murdered in Australia. The only physical evidence at the crime scene was a number of dark, coarse fibres adhering to the sole of her shoes. These fibres were originally from the carpet of a 1991 Honda CRX that belongs to the suspect who was her boyfriend. The critical question in this case was when the fibre had been deposited on the shoes and how long it persisted [4].

Many factors can affect the transfer of fibres from donor to recipient garment such as the fabrics of garments, the texture of garments, the force of contact and the numbers of contact takes place [5]. Fibre persistence is when fibres are transferred to the object and allowed to remain for successive intervals of time and the remaining fibres are counted and a decay curve is produced [1].

Based on the survey for forensic science laboratory in England, 60% of garments examined in fibre cases contained wool or acrylic fibres. This showed that most suspect or victim usually wore clothing that from wool or acrylic [3]. Level of fibre persistence in

most experiments decrease 5-10% after six to eight hours after transfer. In many instance, a suspect could not be identified immediately after crime. When they were caught, the garment worn while committing the crime could have been changed, washed or placed in wardrobe. Such activities could influence the numbers of fibres that were still present on the garments [5].

For identification of fibres, many factors are involved including the type of fibres, the colour or variation of colours in fibres, the number of fibres, the location of fibres at the crime scene or on the victim, and the number of different fibres at the crime scene or on the victim that match the suspect's clothes. A fibre is detected by the nature and duration of contact between the suspect and the victim or crime scene, the persistence of fibres after the transfer, and the type of fabric involved in contact [2].

Forensic fibres analyses include determination of fabric type, fabric source and persistence and transferable fibres. The nature of contact and multiple fibre association could influence persistence of fibres on recipient garments [2]. Stereomicroscope and comparison microscope were recommended for fibre analysis [6].

In term of fibre transfer and persistence, it is important to determine types of garments that will retain the transferred fibre in relation to time of wear. The activity of the person after the fibre transferred and the time will affect the persistency level of the fabric from the donor garment. The aim of this study is to identify the types of recipient garments that can retain fibres after physical contact with the reference fibre and to determine the persistence of fibre transferred in relation to time of wear.

Materials and Method

Textile material for transference

A 100% cotton t-shirt red in colour was used as donor garment. New donor garment was used for each participant. The recipient garments are cotton t-shirt, polo t-shirt and jersey t-shirt as shown in Table 1. The reason for choosing these textile materials is an arbitrary decision.

Table 1: Textile material for recipient garments

Garments	Type of material	Texture surface
Polo t-shirt	Cotton / spandex	Rough
Jersey t-shirt	Polyester/microfibre	Smooth
Cotton t-shirt	Cotton/ polyester	Smooth

Donor garment transfer

The donor garment was put on a mannequin. There were 30 respondents and each respondent wore one type of recipient garment either a cotton t-shirt, polo t-shirt or jersey t-shirt. Samples from the donor garment and the recipient garments (on the front part of garments) were taped before experiment using cellophane tape. Sample from the donor garment acted as control/ reference fibres. The respondent was then hugged the mannequin for a minute, simulating an actual crime scene where the victim and the perpetrator were involved in violent body contacts, especially during assault and sexual offense. Therefore, the respondent moved while hugging the mannequin and only the front part of recipient garment was in contact with the front part of donor garment. The respondent wore the same garment for eight hours while doing their daily life activities. This study only focussed on fibres retention time on different type of recipient garments, therefore, force or pressure of contact, friction or contact after initial contact and state of environment retaining fibre were not taken into ocnsideration.

Fibre persistence

After eight hours, fibre samples were firstly taped on the front part of recipient garments. Re-taping was done on the same site of the recipient garment. All collected fibres were examined under stereomicroscope. The presence of the fibre were analysed with magnification of 10x and 30x lenses to count the number of fibre present. The cellophane tape was divided into five grids measuring 4 cm x 2.25 cm to count the number of fibre present as in Fig. 1. The persistence of fibres is determined by the number of the fibres that present on the recipient garments after eight hours.

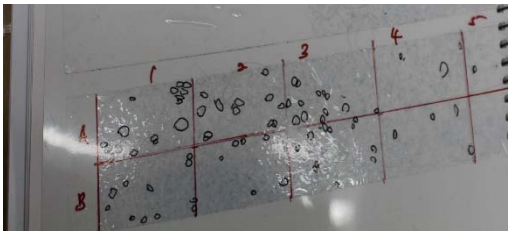

Fig. 1: The cellophane tape was divided into 5 grids measuring 4cm x 2.25cm

Results and discussion

Fibres were observed and counted under stereomicroscope after eight hours. Fig. 2 shows the red fibres as the reference. The red fibres on recipient garment were counted and circled as in Fig. 3, 4 and 5 using a stereomicroscope, based on the reference on Figure 2.

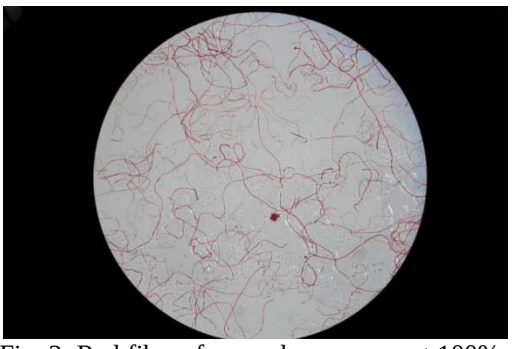

Fig. 2: Red fibres from a donor garment 100% cotton (red fibres)

Fig. 3: The red fibres were identified and circled. This is a polo t-shirt

Fig. 4: The red fibres were identified and circled. This is a jersey t-shirt

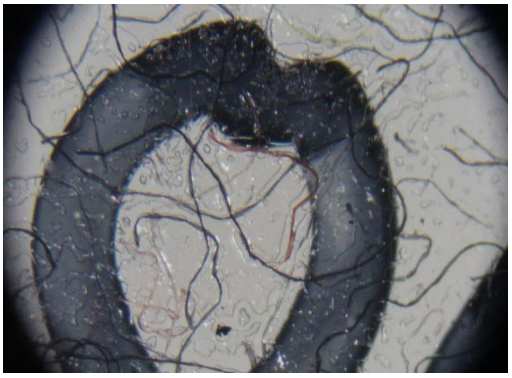

Fig. 5: The red fibres were identified and circled. This is a cotton t-shirt

The types of activities that the respondent involved during eight hours after in contact with the donor garments are listed as follows:

Types of activities

- ✓ Minimal activity: sleeping, eating and rest in the room
- ✓ Moderate activity: meeting friends, attending classes, praying
- ✓ Lots of activities: exercising, cleaning the room, taking sample in the forest

Tables 2, 3 and 4 show the respondent activities within eight hours after fibres transferred, respectively. Activities were divided into three categories based on extent of movement. For example, sleeping, eating and resting are considered minimal activities due to minimal body movement as compared to exercising, cleaning and sampling in the forest.

Table 1: Respondent with cotton t-shirt activities within 8 hours after fibres transferred.

Respondent	Number of fibres presence after 8 hours	Activities while wearing the recipient garments
A1	20	Moderate activity
A2	22	Moderate activity
A3	29	Moderate and lots of activity
A4	123	Moderate activity
A5	27	Moderate activity
A6	92	Minimal and moderate activity
A7	35	Minimal and moderate activity
A8	66	Minimal and moderate activity
A9	57	Minimal activity
A10	73	Moderate activity

Total fibres = 544
Mean = 54.4

Table 2: Respondent with polo t-shirt activities within 8 hours after fibres transferred

Respondent	Number of fibres presence after 8 hours	Activities while wearing the recipient garments
B1	210	Minimal activity
B2	114	Minimal activity
B3	77	Minimal activity
B4	86	Minimal and moderate activity
B5	77	Minimal , moderate and lots of activities
B6	38	Minimal and lots of activity
B7	124	Moderate activity
B8	97	Minimal activity
B9	72	Minimal and moderate activity
B10	62	Minimal activity

Total fibres = 957
Mean = 95.7

Table 3: Respondent with jersey t-shirt activities within 8 hours after fibres transferred

Respondent	Number of fibres presence after 8 hours	Activities while wearing the recipient garments
C1	68	Moderate activity
C2	30	Minimal activity
C3	14	Minimal and lots of activities
C4	11	Minimal activity
C5	42	Minimal and moderate activity
C6	18	Minimal activity
C7	31	Minimal and moderate activity
C8	20	Minimal and lots of activities
C9	107	Minimal activity
C10	21	Minimal activity

Total fibres = 362
Mean = 36.2

Based on Table 2, respondent A4 has the highest fibre count after eight hours, a total of 123 red fibres were found even after 8 hours. This may be due to moderate activity that has been carried out and relatively rougher surface texture of the garments. The rough surface texture can retained more fibre than other cotton t-shirt. The highest fibre count for polo t-shirt is 210 fibres on respondent B1 and for jersey t-shirt is 107 on respondent C9 (refer Table 3 and Table 4). Respondent B1 and Respondent C9 had minimal activities within eight hours post fibre transferred such as seating, sleeping and sitting in the room. Those activities do not require a lot of movements as compared to carrying out sports activities.

Based on the mean results from Table 2 to 4, polo t-shirt can retain most fibres after eight hours post fibres transferred (mean value was the highest, 95.7 number of fibres were retained after eight hours of contact with donor garment). The texture surface of polo t-shirt is rough as compared to cotton and jersey that are smoother. This result supported by Pounds and Smalldon (1975b) findings in which fibres lost more rapidly from smooth surface garments than the rough surface garment. The activity of an individual does

affect the fibre loss and the persistence of the fibre after eight hours. The results showed even if the respondent do similar daily life activities the number of fibres retained after eight hours could be different, due to variations in movement and contact of the individual.

Conclusion

This research showed the lost of fibres following transfer after contacted with donor garments. The rate of fibres loss with time depends on a number of factors, including the surface texture of the recipient garments, either smooth or rough surface or the type of daily life activities of the respondent while wearing the garments.

The garment that can retain most fibres after contact with donor garment is polo t-shirt as compared to cotton t-shirt and jersey t-shirt. Other than using the stereomicroscope, scanning electron microscope can be used to observe the cross section of a fibre and gas-chromatography mass spectrophotometer (GC-MS) which can analyse the material of the fibres.

This experiment is reproducible and can be improved for future study such as using similar respondents for different types of recipient garments and synchronise the daily life activities for each respondent, which limit to activities such as staying in the room, attending classes and exercising. Number of fibres retained post contact with donor garment should be re-taped in triplicate to ensure maximum number of fibres collected for analysis.

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