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The impact of deposition area and time on Touch DNA collected from fabric

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ABSTRACT

Touched items at crime scenes are frequently analysed to help link suspects to crimes, for example, Touch DNA is collected from victims' clothes in cases such as sexual assault, homicide, theft etc. Tape lifting is the preferred collection method of choice for trace DNA from clothes, fabric items and porous surfaces such as paper, therefore this study investigated the impact of deposition area and time on Touch DNA collected from fabric using minitapes. The amount of Touch DNA collected from the fabric was significantly affected by deposition area ($p < 0.05$), time ($p < 0.05$) and the interaction between the deposition area and time ($p < 0.05$), with the quantity of DNA collected decreasing over time. Also, the buttocks area of the trouser compared to the chest area is more prone to friction from an activity like repeatedly sitting on different surfaces which reduces the amount of Touch DNA available. In conclusion, it is more effective to collect trace DNA from victim clothes as soon as possible after the crime is committed.

1. Introduction

Touched items at the crime scenes are frequently analysed to help link suspects to crimes, for example, Touch DNA can be collected from victims' clothes in many cases such as sexual assault, homicide, and theft. Many factors influence the amount of Touch DNA collected [1], such as surface type and collection method or technique used [2–6], the time between the deposition and collection, as well as environmental factors [7–9]. Tape lifting is the preferred method of choice for collecting trace DNA from clothes, fabric items and porous surfaces such as paper [2,10–12]. Therefore, this study used minitapes as a collection method to investigate the impact of deposition area and time on Touch DNA collected from fabric to determine the importance of collecting trace evidence from victim clothes as soon as possible after the crime has been committed.

2. Materials and methods

2.1. Experimental setup and deposition

A female t-shirt and trousers made of 65 % polyester and 35 % cotton were selected for this study as it is a popular synthetic material used in the fashion industry [13]. A male participant previously identified as high shedder was instructed to wash his hands with antibacterial soap and refrain from doing any activity for 10 min, then charge both hands with eccrine sweat by touching his forehead to load them with biological material. The participant was then instructed to rub both hands separately on a highlighted 5 × 7 cm area for 1 min on the chest of the t-shirt and the buttocks of the trouser (Fig. 1). This procedure was replicated for each deposition, and the DNA was collected after five periods of time (1 h, 3 h, 6 h, 12 h, 24 h). The selected clothes were washed at 50 °C, dried and sterilised before use with ultraviolet radiation (UV) for 25 min. The female participant was instructed to wear the clothes during the experimental period and do normal daily activity without touching the highlighted area, clean the clothes, or do any physical activity to avoid sweating.

2.2. DNA recovery and extraction

Samples were collected using SceneSafe Fast™ minitape (K545) (MT) but no water was added to the MT, instead, to increase the amount of Touch DNA collected, each minitape was applied 16 times to the area

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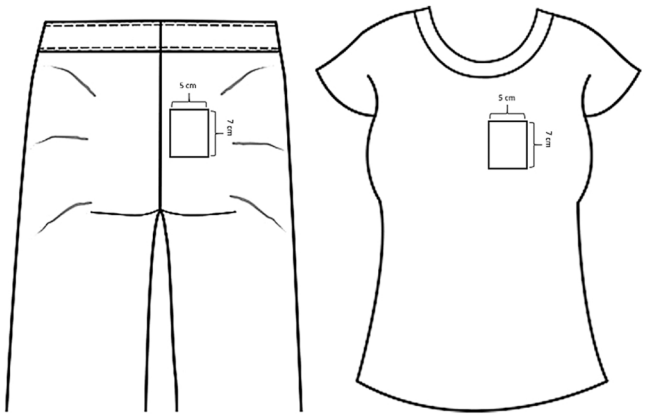

Fig. 1. Deposition area A (5 × 7 cm) on the chest area of the t-shirt and deposition area B (5 × 7 cm) on the buttocks area of the trouser.

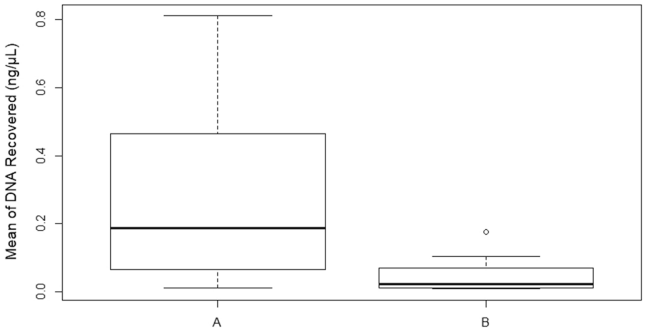

Fig. 2. Mean amount of DNA collected (n = 30) from chest area of the t-shirt (Area A – 5 × 7 cm) and the buttocks area of the trousers (Area B – 5 × 7 cm).

[2]. The samples were cut directly into the extraction tube and the DNA was extracted using the PrepFiler Express BTA™ kit with AutoMate Express, using 460 µL of lysis buffer instead 230 µL to increase the DNA yield [2]. The lower sticky part of the minitape was used for the extraction in a final elution volume of 50 µL.

2.3. DNA quantification, amplification and analysis

Extracted samples were quantified using the Quantifiler® Trio DNA Quantification Kit, QuantStudio 5 Real-Time PCR (qPCR) and HID Real-Time PCR analysis software v1.3 (Thermo Fisher Scientific) according to the manufacturer's instructions. Amplification of the samples was performed using the GlobalFiler™ PCR amplification Kit on an ABI GeneAmp® 9700 PCR System (Life Technologies) for 30 cycles, then the amplified products were size-separated and detected on an ABI 3500 Genetic Analyzer (Life Technologies) using 1 µL PCR product, 9.6 µL Hi-Di™ formamide, and 0.4 µL GeneScan™ 600 LIZ® Size Standard v2.0 (Thermo Fisher Scientific). Statistical analysis was performed with RStudio using factorial analysis of variance (ANOVA) and Microsoft Excel.

3. Results and discussion

The amount of collected Touch DNA from the fabric was significantly affected by deposition area ($p < 0.05$), time ($p < 0.05$) and the interaction between the deposition area and time ($p < 0.05$). More DNA was recovered from the chest area of the t-shirt (A) than the buttocks area of the trousers (B) over 24 h (1 h, 3 h, 6 h, 12 h, 24 h) (mean Area A = 0.28 and Area B = 0.05 all in ng/µL) (Fig. 2). The amount of collected DNA decreased over time but the number of alleles observed was not affected by time for the t-shirt, whereas full mixture profiles were obtained from the trouser samples but no alleles were observed from the minor contributor after 6 h (Fig. 3). Blanks were taken from clothes after sterilisation and negative controls for the collection and extraction methods, all of which were DNA free when quantified and amplified.

4. Conclusion

Deposition area, time and other factors such as the person's activity can influence the amount of Touch DNA collected from clothes. The buttocks area of the trouser compared to the chest area of the t-shirt is more prone to friction from an activity like repeatedly sitting on different surfaces which reduces the amount of Touch DNA available. Based on the finding of this study, it is more effective to collect trace DNA from victim clothes as soon as the crime is committed.

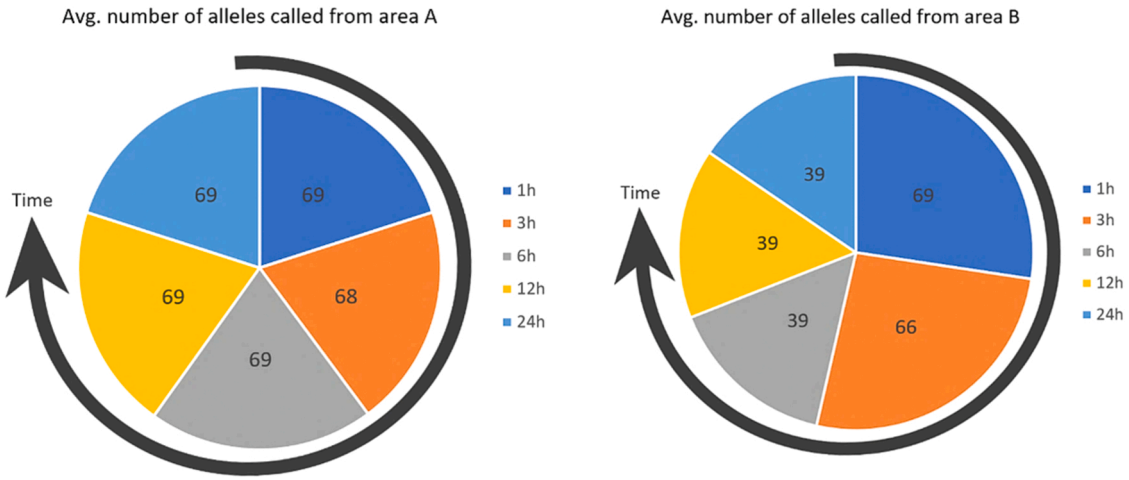

Fig. 3. Mean number of alleles observed (n = 30) from the chest area of the t-shirt (Area A – 5 × 7 cm) and the buttocks area of the trousers (Area B – 5 × 7 cm) over 24 h (1 h, 3 h, 6 h, 12 h, 24 h).

Conflict of interest

None.

Acknowledgements

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References

[1] S.K. Alketbi, The affecting factors of touch DNA, J. Forensic Res. 9 (3) (2018) 424.
[2] S.K. Alketbi, W. Goodwin, The effect of surface type, collection, and extraction methods on touch DNA, Forensic Sci. Int. Genet. Suppl. Ser. 7 (1) (2019) 704–706.
[3] S.K. Alketbi, W. Goodwin, Validating Touch DNA collection techniques using cotton swabs, J. Forensic Res. 10 (2019) 445.
[4] S.K. Alketbi, W. Goodwin, Touch DNA collection techniques for non-porous surfaces using cotton and nylon swabs, J. Sci. Tech. Res. 36 (3) (2021) 28608–28612.
[5] S.K. Alketbi, S. Alsoofi, Dual Recovery of DNA and Fingerprints using Minitapes, J. Forensic Sci. Crim. Investig. (2022), 16555929.
[6] S.K. Alketbi, An innovative solution to collect Touch DNA for direct amplification, J. Forensic Sci. Crim. Investig. 16 (1) (2022), 555928.
[7] S.K. Alketbi, W. Goodwin, The effect of time and environmental conditions on Touch DNA, Forensic Sci. Int. Genet. Suppl. Ser. 7 (1) (2019) 701–703.
[8] S.K. Alketbi, W. Goodwin, The effect of sandy surfaces on Touch DNA, J. Forensic Leg. Invest. Sci. 5 (2019) 034.
[9] S.K. Alketbi, Collection of Touch DNA from rotten banana skin, Int. J. Forensic Sci. 5 (4) (2020), 000204.
[10] B. Stoop, et al., Touch DNA sampling with SceneSafe FastTM minitapes', Leg. Med. 29 (2017) 68–71.
[11] S.K. Alketbi, The impact of collection method on Touch DNA collected from fabric, J. Forensic Sci. Crim. Investig. 15 (5) (2022), 555922.
[12] S.K. Alketbi, W. Goodwin, The impact of area size and fabric type on Touch DNA collected from fabric, J. Forensic Sci. Crim. Investig. 16 (1) (2022), 555926.
[13] Textile Exchange, Preferred Fiber Material Market Report (⟨http://www.textileexchange.org⟩), 2017.