B133 The Forensic Evaluation of Cut and Torn Duct Tape Fractures: A Validation Study to Quantify the Quality of a Physical Match

Meghan Prusinowski*, Morgantown, WV 26505; Tatiana Trejos, PhD, West Virginia University, Morgantown, WV 26506

Learning Overview: After attending this presentation, attendees will understand the process for a physical evaluation of duct tape fracture edges and the features that are observed on the tapes. In addition, attendees will understand the developed method for reporting the quality of the fit of the tape edges and the statistical methods by which the reported scores are assessed.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating a quantitative method for assessing and reporting the quality of fit between known and questioned tape edges. This method and the use of score likelihood ratios offer additional support for examiners performing tape comparisons.

Duct tape is a common type of evidence found at multiple types of crime scenes such as sexual assaults, kidnappings, and bombings. Performing a physical examination has been shown to have high discrimination power between different duct tape samples. For similar tapes, the highest degree of association that can be determined is through a physical fit between two tape pieces. The conclusion of a fit between edges relies on the examiner's opinion to identify distinctive features across the tape ends. However, there are currently no standard methodologies and criteria for making those decisions. This study aimed to establish mechanisms to qualify and quantify tape end match features and evaluate if experimental data support the assumption that random tape physical fits are unlikely. Over 1,800 blind tape end comparisons (hand-torn and scissor-cut duct tape samples, stretched and pristine samples) were evaluated by two independent examiners and the occurrence of false positives and false negatives was calculated. The sets were utilized to assess the effects of the separation method and stretching on the examiner accuracy and distribution of match scores.

Moreover, a mock kidnapping case consisting of 288 end-tape comparisons was used to test the proposed models under extreme tape-stretching conditions. The victim was restrained and gagged with tape, and the tapes were severely stretched and folded during the sample recovery to simulate worst case scenarios. Match scores were systematically calculated as a relative ratio of observed matching sections per scrim area. The more distinctive features seen along the tape ends, the closer the match score was to 100%. Utilizing the frequency distribution of true positives and true negatives by match scores, score likelihood ratios were calculated. Score likelihood ratios represent a ratio of the probability of observing a match score given the fractured edges came from the same source versus the probability of observing a match score given the fractured edges came from different sources. The higher the score likelihood ratio value, the higher the probability the score resulted from a fracture pattern left after separation from the same source (~SLR 10-10,000) while lower scores resulted from tape ends originating from different sources (0.1 to <0.0001). Receiving Operating Characteristic (ROC) curves were used to visualize the sensitivity and selectivity of the methods. The overall accuracy of the examinations was 99.6% for hand-torn tapes and 99.8% for scissor-cut tapes, with 0% false positives and 1-2% false negatives. The calculated score likelihood ratios indicated strong support for the conclusion of a fracture fit when the match score was 80% or higher, and strong support for the conclusion of a non-fit when the match score was 25% or lower. Although extreme stretching of the tape in the mock case did not increase the false positive rates, it decreased the ability to identify true positives. The results of this study are anticipated to offer an effective strategy to qualify and quantify distinctive features in tape end examinations and to serve as a scientific foundation to develop standard methods that complement and substantiate the examiner's opinions.

Duct Tape, Physical Match, Score Likelihood Ratios