COLOUR ATLAS OF FORENSIC TRAUMATOLOGY

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Version 1

Hanging

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FOREWORD

The greatest pleasure I experience as a teacher, is to see my students excel in their chosen careers and perform even better than myself. The series of e-booklets prepared to better equip medical officers to handle common conditions likely to be encountered in their day to day forensic practice by Professor Dinesh Fernando, is a good example of one of my students doing better than me!

Dinesh is the son of Emeritus Professor of Community Medicine, Former Head, Department of Community Medicine, Former Dean, Faculty of Medicine and Vice Chancellor of the University of Peradeniya, Malcolm Fernando, who was an illustrious medical academic. Following his father's footsteps, he joined the University of Peradeniya in 2003.

Dinesh was one of my post graduate trainees at the Department of Forensic Medicine and Toxicology, Faculty of Medicine, Colombo, and obtained the doctorate in Forensic Medicine in 2003. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia, with my colleague and contemporary at Guy's Hospital Medical School, University of London, Professor Stephen Cordner. During this period, he served as the honorary forensic pathologist of the Disaster Victim Identification team in Phuket, Thailand following the tsunami, and was awarded an operations medal by the Australian Federal Police.

He has edited, and contributed chapters to, 'Lecture Notes in Forensic Medicine' authored by the former Chief Judicial Medical Officer, Colombo, Dr. L.B.L. de Alwis and contributed to 'Notes on Forensic Medicine and Medical Law' by Dr. Hemamal Jayawardena. He is the editor of the Sri Lanka Journal of Forensic Medicine, Science and Law. Continuing his writing capabilities, he has compiled an important and unique set of e-booklets which will be a great asset to undergraduate and post-graduate students of Forensic Medicine, and also to our colleagues. Its succinct descriptions of complicated medico-legal issues and clear and educational photographs are excellent. It makes it easy for the students to assimilate the theoretical knowledge of each topic as they have been augmented with histories, examination findings, macroscopic and microscopic photographs of actual cases. In some areas, photographs from multiple cases have been included, so that the students can better appreciate the subtle differences that would be encountered in their practice.

I sincerely thank my ever so grateful student Dinesh, for giving me this great honour and privilege to write the foreword.

Professor Ravindra Fernando

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About the authors.....

Dr Dinesh Fernando is a merit Professor in Forensic Medicine at the Faculty of Medicine, University of Peradeniya and honorary Judicial Medical Officer, Teaching Hospital Peradeniya. He obtained his MBBS in 1994 with Second class honours from the North Colombo Medical College, Sri Lanka, and was board certified as a specialist in Forensic Medicine in 2004. He obtained the postgraduate Diploma in Medical Jurisprudence in Pathology from London in 2005, and possesses a certificate of eligibility for specialist registration by the General Medical Council, UK. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia. He has also worked at the Wellington hospital, New Zealand, as a locum Forensic Pathologist and as an Honorary Clinical Senior Lecturer at the Wellington School of Medicine and Health Sciences, University of Otago, New Zealand. He was invited to visit and share experiences by the Netherlands Forensic Institute in 2019. He was conferred a Fellowship by the College of Forensic Pathologists of Sri Lanka in 2021.

Dr Sarangi Amarakoon is a Temporary Research Assistant at the Department of Forensic Medicine, Faculty of Medicine, University of Peradeniya. She obtained her MBBS in 2023 with Second class honours from the Faculty of Medicine, University of Peradeniya.

PREFACE

Forensic Medicine in Sri Lanka encompasses, both, examination of patients for medico-legal purposes and conducting autopsies in all unnatural deaths, in addition to those that the cause of death is not known. In the eyes of the justice system in Sri Lanka, all MBBS qualified medical officers are deemed to be competent to conduct, report and give evidence on medico-legal examinations of patients and autopsies conducted by them, as an expert witness. However, during their undergraduate training, they may not get the opportunity to assist, nor observe, a sufficient variety of representative of cases that may be encountered in the future.

Therefore, a series of e-booklets has been prepared to better equip medical officers to handle common conditions that are likely to be encountered in day to day forensic practice. The case histories, macro and micro images are from cases conducted by Prof. Dinesh Fernando. Ms. Chaya Wickramarathne did a yeomen service in the initial designing of lay out and formatting the booklet. The compilation of the case and photographs for publication was initiated by Dr. Deshani Herath, continued by Dr. Shashika Weerasinghe and finalized by Dr. Sarangi Amarakoon.

The content herein may be used for academic purposes with due credit given. Any clarifications, suggestions, comments or corrections are welcome.

COLOUR ATLAS OF

FORENSIC TRAUMATOLOGY

ILLUSTRATIVE CASES

Hanging

HANGING

Hanging is a form of ligature strangulation in which the force applied to the neck is derived from the gravitational drag of the weight of the body or part of the body resulting in asphyxia. In complete suspension no part of the body is in contact with the ground. However, in incomplete suspension part of the body (toes, feet, knees, buttocks etc.) is in contact with the ground. Hanging is almost always suicidal. It may be accidental on some occasions. Homicidal hanging is very rare, since for one person to hang another, there must be a disparity in their size and strength or the victim should be incapacitated.

There are many mechanisms by which hanging can lead to death. These mechanisms can act independently or in combination to cause death. These mechanisms include stretching or pressure on the carotid sinus causing reflex cardiac arrest, occlusion of the carotid and vertebral arteries, venous occlusion, airway obstruction (caused by direct compression, by pushing the base of the tongue against the roof of the pharynx or from the disruption of the larynx or trachea) and spinal cord-brainstem disruption.

In suicidal hangings, various materials can be used as a ligature, including thin ropes, wires, belts, clothes, etc. This ligature can cause a ligature mark on the neck, which may be distinguished from that caused by ligature strangulation. In hanging, the ligature mark rarely encircles the neck completely (except when a slip knot is used) and the gap in the mark usually indicates the point of suspension. The most common point of suspension is the side of the neck, followed by the back and the front. The mark can be abraded, brown, and dried to a parchment-like consistency. There can be a narrow red zone, either above, or below the ligature mark. The mark may be poorly defined, pale, and devoid of abrasions if the ligature is of soft material. The mark appears higher on the neck, usually located directly under the chin anteriorly, passing backward closer to the jawline and eventually ascending at the sides of the neck to reach the gap under the knot. If a soft noose is used and the body is taken down quickly after death, no ligature may be seen on the neck. The width of the furrow will depend on the material used as the ligature. Rarely, there can be injuries around the ligature mark, indicating the struggle of the victim to relieve the knot.

Apart from the ligature mark, the autopsy findings of hanging may include many other features. If the body had been in a vertical position for a few hours, hypostasis may be visible in the legs and hands. Hydrostatic rupture of the vessels can lead to the formation of punctate haemorrhages and Tardieu spots. The face is usually found to be pale, but may be congested in some cases. There can be blood-stained discharge from the nostrils and petechial haemorrhages, frequently in the absence of congestion. On internal examination of the neck, in most of the cases, there are no injuries. Strap muscle haemorrhages, fractures of the hyoid or thyroid may be seen in some cases. On careful dissection, damage to the intima of the carotid arteries may also be seen.

History

A 17-year-old boy who had recently separated from his girlfriend, was found hanging from a rope which was tied around the top of a fence post and looped around his neck. When Police arrived on the scene the body was cold to touch and rigor mortis had set in. No suicide note was found.

External Examinations

Face: A few petechial haemorrhages were present in the upper sclera of both eyes. Petechial haemorrhages were absent from both conjunctivae and around eyelids and face. The face was congested above the ligature mark.

Neck: The ligature mark measuring approximately 2 cm in width encircled the neck, except, at a point inferior to the right ear. It crossed the midline above the thyroid cartilage and ended in an inverted 'V' shape directly below the right ear. The imprint was consistent with the weave pattern of the ligature which accompanied the body. A linear abrasion horizontally placed measuring 7 mm in length was situated 0.5 cm below the ligature mark on the left side of the neck.

Ligature: A three stranded light yellow nylon cord measuring 1.5 cm in diameter with a rough external surface was present.

Figure 1: Petechial haemorrhages in the upper sclera

Figure 2: Ligature mark measuring approximately 2 cm in width encircling the neck, except at a point inferior to the right ear. Ligature mark ends in an inverted 'V' shape directly below the right ear

Figure 3: Ligature mark with horizontal linear abrasion below

History

A 25-year-old female with known psychiatric illness was hanging with both knees resting on the concrete floor of the garage and the rope appeared to be wrapped around the neck four times. The other end of the rope had been looped over the automatic door opener chain assembly in the centre of the garage and a small knot was present at the base of where the rope was wrapped around the chain assembly.

External Examination

Neck: A three-stranded nylon ligature measuring 0.5 cm in diameter was in-situ around the neck. The knot was situated 2 cm to the left of the midline anteriorly (there was no fixed or sliding knot but the ligature had been slipped under several of the loops similar to a clove hitch). The ligature encircled the neck and the furrow was pale and bore the imprint of the weave of the ligature. The lower ligature mark was at the level of the thyroid cartilage. An area of drying of skin with indentation measuring approximately 1.5 cm x 1 cm was present just below the mandible, the midpoint being 3.5 cm to the left of the midline in the floor of the mouth. This mark coincided in position with the free end of the ligature going upwards to the point of suspension and was possibly caused by the ligature.

Figure 4: There were three encirclements of the neck on the left side and four on the right

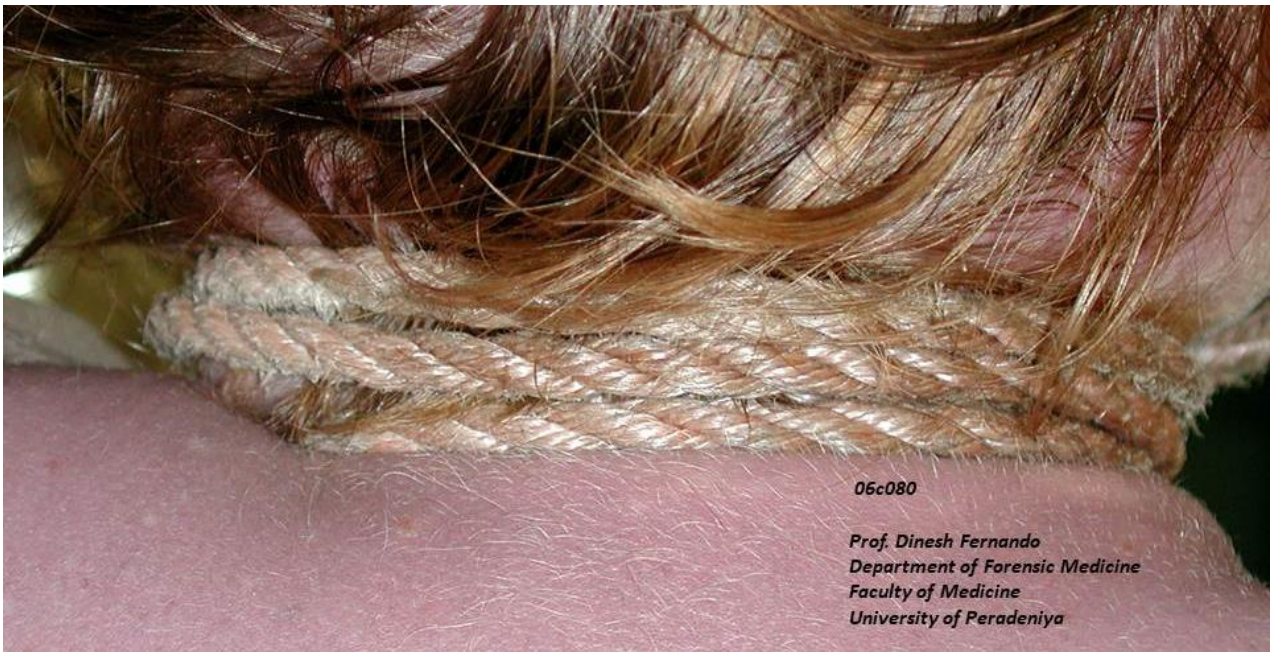

Figure 5: Posteriorly, the ligature was over the hair and was horizontally around the neck

Figure 6: Anterior view after removal of ligature. Note the two deep grooves, each measuring 0.5 cm in width, with a congested erythematous fold of skin between, which is approximately 2 cm in width. There is an abrasion of the skin in this fold of skin

Figure 7: Ligature mark lateral view. Note the imprint of the weave of the ligature on the skin

History

A 25-year-old female had used a length of phone cord and yellow nylon washing line to hang herself from an apple tree in the back yard.

External Examination

Neck: A ligature mark with no obvious pattern, measuring approximately 4 mm in width was present encircling the neck. Anteriorly two ligature marks were present above the thyroid cartilage. One ligature mark encircled the neck completely, while the other ligature mark extended symmetrically, posteriorly, and superiorly from the anterior aspect of the neck. Drying of the ligature furrow was present and minimal abrasion was seen on the right side.

Figure 8: Anterior view of ligature marks with a very thin segment of skin between the two ligature marks

Figure 9: One ligature mark encircled the neck completely almost horizontally

Figure 10: The other ligature mark extended symmetrically, posteriorly, and superiorly from the anterior aspect of the neck

Figure 11: Note the inverted "V" in the posterior aspect of the neck

Ligature:

1. A section of grey electric cord was attached to a limb of the branch. One end had a two pin plug whilst the other was approximately 30 cm long and had the free ends of wires.

2. A yellow three-stranded nylon cord approximately 0.5cm in diameter was tied to the branch and also a separate piece approximately 60 cm long with a knot was present. Entangled in the knot was hair that was similar in colour and texture to that of the deceased.

3. Two core flat plastic wire which measured approximately 4 mm in width was attached to the branch as well as a separate piece measuring approximately 45 cm. The two cores of this wire were coloured gold and silver. The ligature mark on the neck corresponded to this wire in size and the lack of a weave pattern.

Figure 12: A section of a branch with three ligatures around it accompanied the body

History

A 47-year-old male was found hanging from a roofing beam in the garage. At the time he was found, he was in a state of rigor.

External Examination

Eyes: The sclera and the conjunctivae were free of petechial haemorrhages.

Neck: A grey, two core electric cord was in-situ around the neck. The cord was round with a diameter of 8 mm. A double ligature mark was present on the neck with a total width of 20 mm and a very thin area of skin in the middle of the ligature mark. The ligature mark extended upwards and backwards to the back of the neck. On the right side of the neck just below the ligature mark, there was an area of abrasion and drying of skin which measured 6 cm x 0.5 cm and was parallel to the ligature mark. The face was congested above the ligature mark. No other injuries were present on the body.

Figure 13: The ligature mark was above the thyroid cartilage anteriorly

Figure 14: The ligature mark was situated 5 cm below the root of the ear on the left side

Figure 15: The ligature mark was situated 10 cm below the root of the ear on the right and there was an area of abrasion and drying of skin parallel to ligature mark

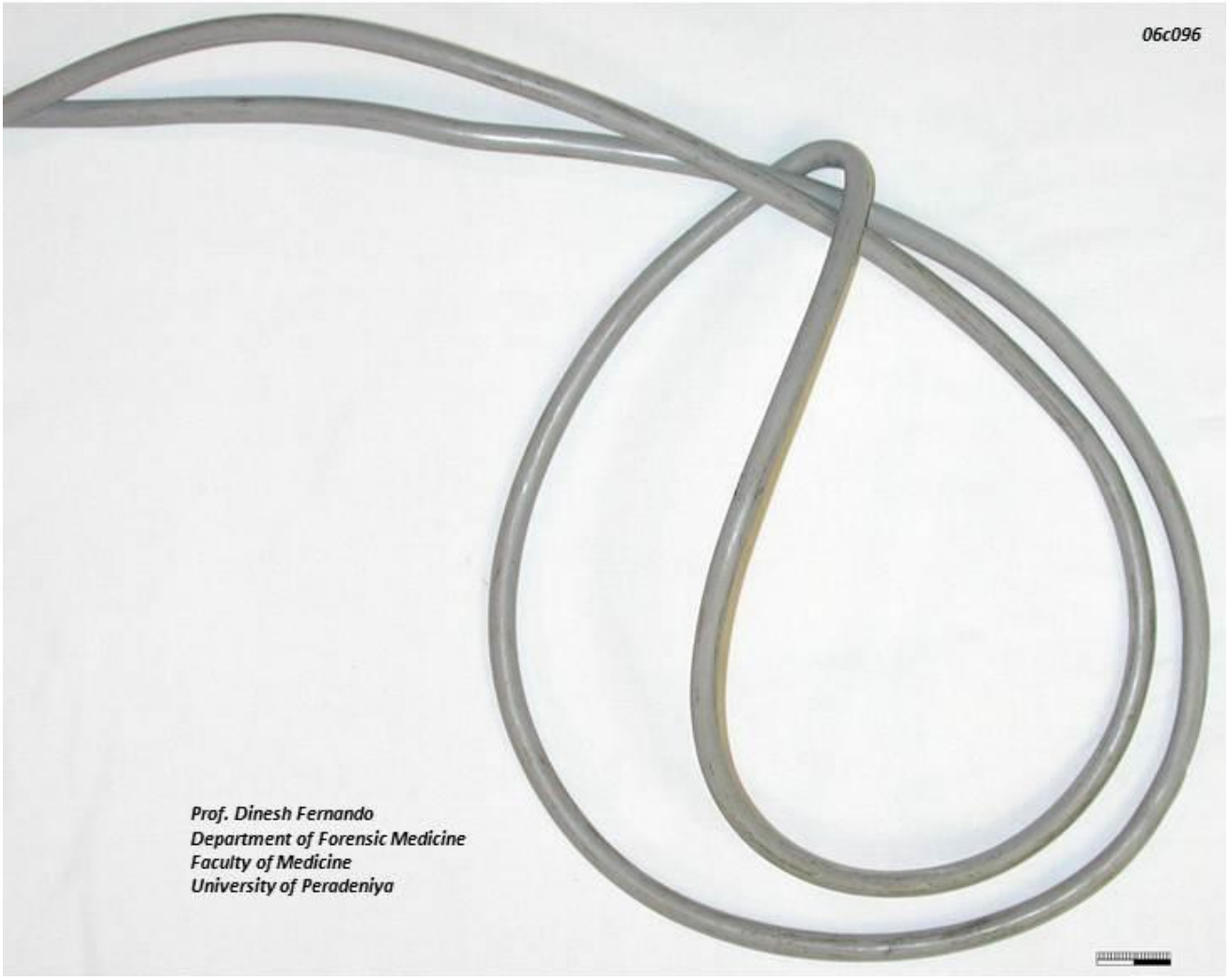

Figure 16: The cord was looped into two and both ends of the cord had been passed through the loop and situated at the back of the head

History

A 20-year-old male was found hanging from the top of his bunk bed in his bedroom. A computer cable had been tied around the top bar of the top bunk.

External Examination

Neck: The ligature mark with a width of approximately 1 cm situated around the neck anteriorly above the level of the thyroid cartilage, extends backwards and upwards, almost symmetrically to the back of the neck, where the ligature mark is not apparent due to hair.

The accompanying ligature was a grey, three core electric wire with a diameter of approximately 8 mm and is compatible with the mark on the neck.

No other injuries were present on the body.

Figure 17: Anterior view of the ligature mark

Figure 18: The ligature mark extends backwards and upwards almost symmetrically to the back of the neck. The ligature was compatible with the ligature mark

History

A 60-year-old female, who had lost her job a few years back and unsuccessfully attempted to reclaim it through a court case, was found hanging by a rope from the eave of the house.

External Examination

Neck: An abraded furrow measuring 1 cm in width was present around the neck. Anteriorly it was above the level of the thyroid cartilage and extended symmetrically, posteriorly and superiorly 6 cm below the roots of the ears to end at the back of the neck, where there was an abrasion which was vertically placed and measured 5 cm x 1.5 cm. No other associated injuries noted.

Figure 19: Anteriorly the ligature mark was above the level of the thyroid cartilage

Figure 20: Ligature mark on the lateral aspect of the neck


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Figure 21(a)

Figure 21(b)

Figure 21(a) & (b): An abrasion which was diagonally placed and measured 5 cm x 1.5 cm

Ligature: The ligature was a white, 3 stranded nylon cord with a diameter of approximately 1 cm and the knot made up of eight coils of rope and measured 7 cm in length.

Figure 22: The knot was similar to a hangman's knot

History

A 20-year-old was found hanging by an electrical wire which was secured to a beam that went from the ceiling to the roof and was tied in a double knot. There was a noose at the other end. The wire was cut in three places to remove it from the deceased.

External examination

Neck: Ligature mark encircling the neck which measured approximately 0.7 cm in width. Anteriorly it was situated across the thyroid cartilage, extended posteriorly and superiorly to be 10 cm below the root of the right ear and 4 cm below the root of the left ear. Ligature mark on the right side extended to the posterior midline whilst on the left side it ended directly inferior to the root of the left ear. No impression of a knot was evident. No associated abrasion was present. The area between the posterior midline and directly inferior to the root of the left ear was free of a ligature mark.

Ligature: The ligature was a white electric cord with three wires side by side and had a width of 1 cm. The impression on the neck was consistent with the ligature.

Figure 23: Ligature mark which was approximately 0.7 cm in width encircling the neck, anteriorly across the thyroid cartilage

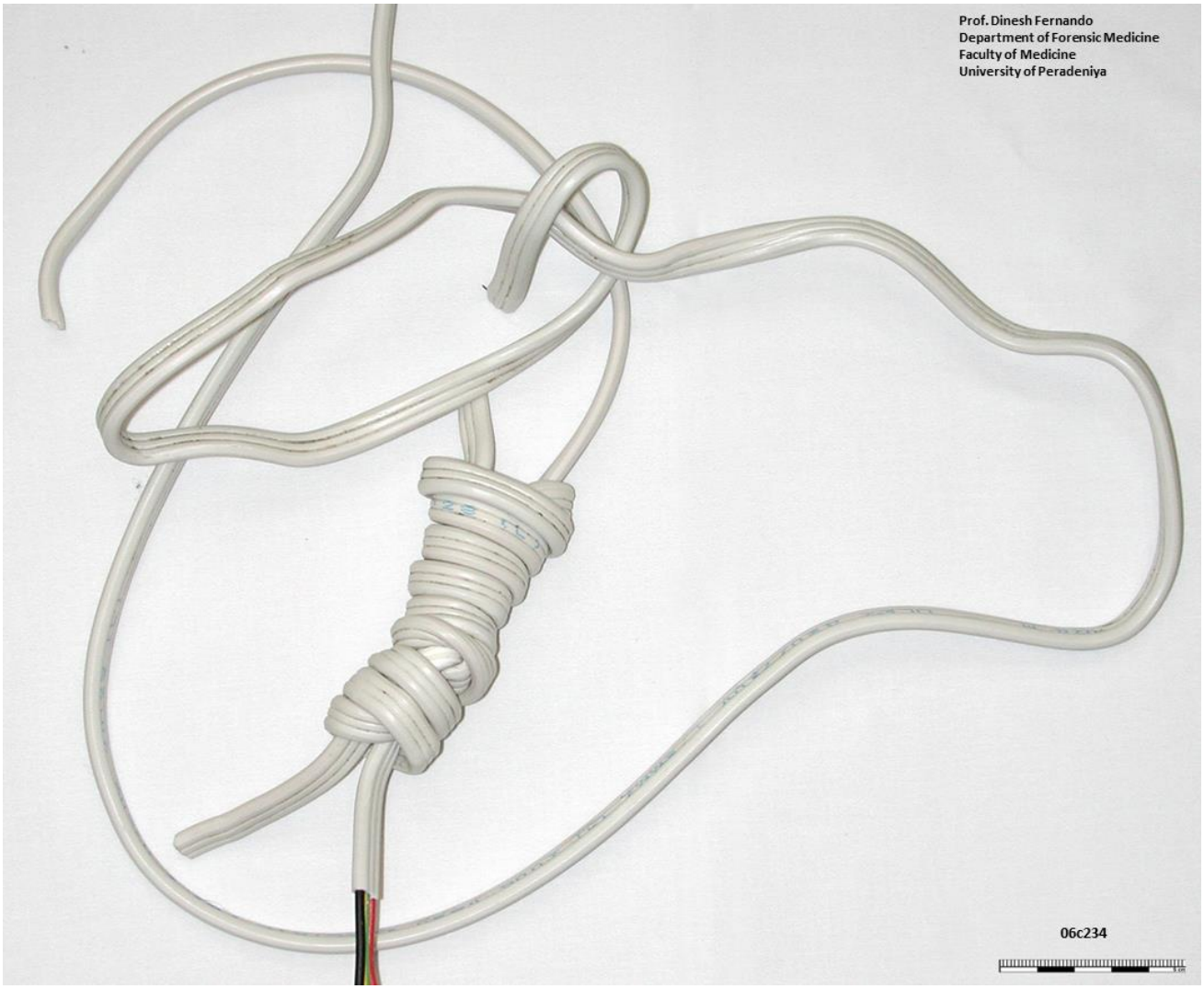

Figure 24: The ligature was a white electric cord with three wires side by side and with a width of 1 cm

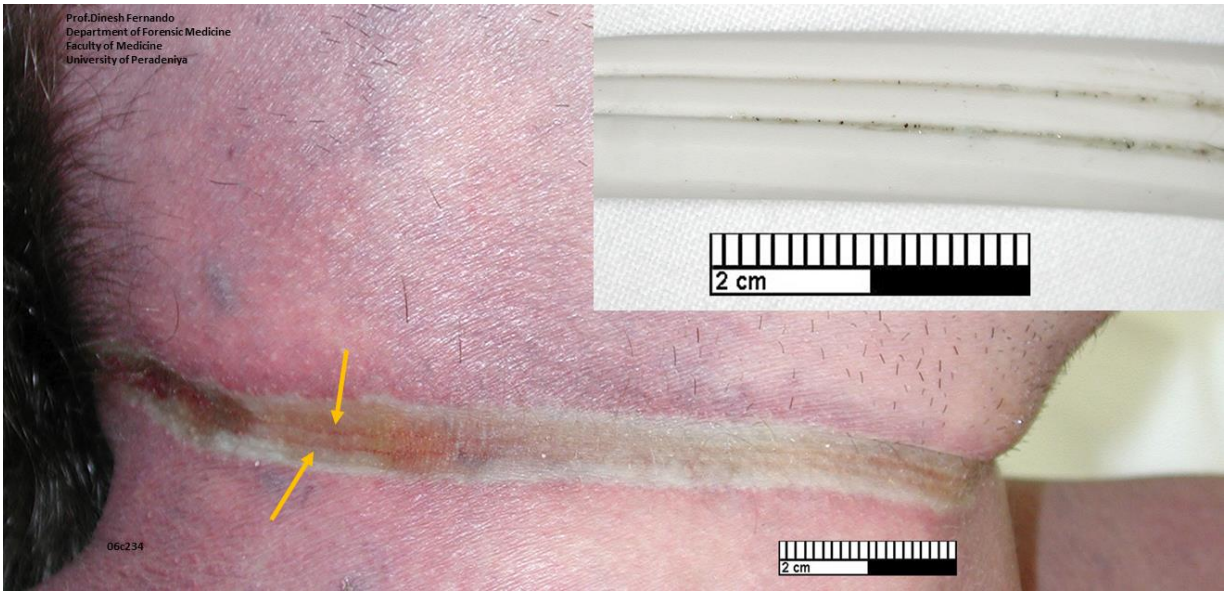

Figure 25: The ligature mark on the neck with associated intradermal contusions (yellow arrows) that align with the grooves of the ligature

Internal examination

Neck: A contusion overlying the body of the thyroid cartilage was present but no underlying fracture was present. The right superior horn of the thyroid cartilage was fractured with associated blood staining of the fractured ends. A contusion measuring 0.5 cm in diameter was present in the surrounding muscle. No fractures were present in the left superior horn of the thyroid cartilage, the cricoid cartilage or the hyoid bone.

Figure 26: Note the soft tissue haemorrhage around the fracture site (yellow arrow)

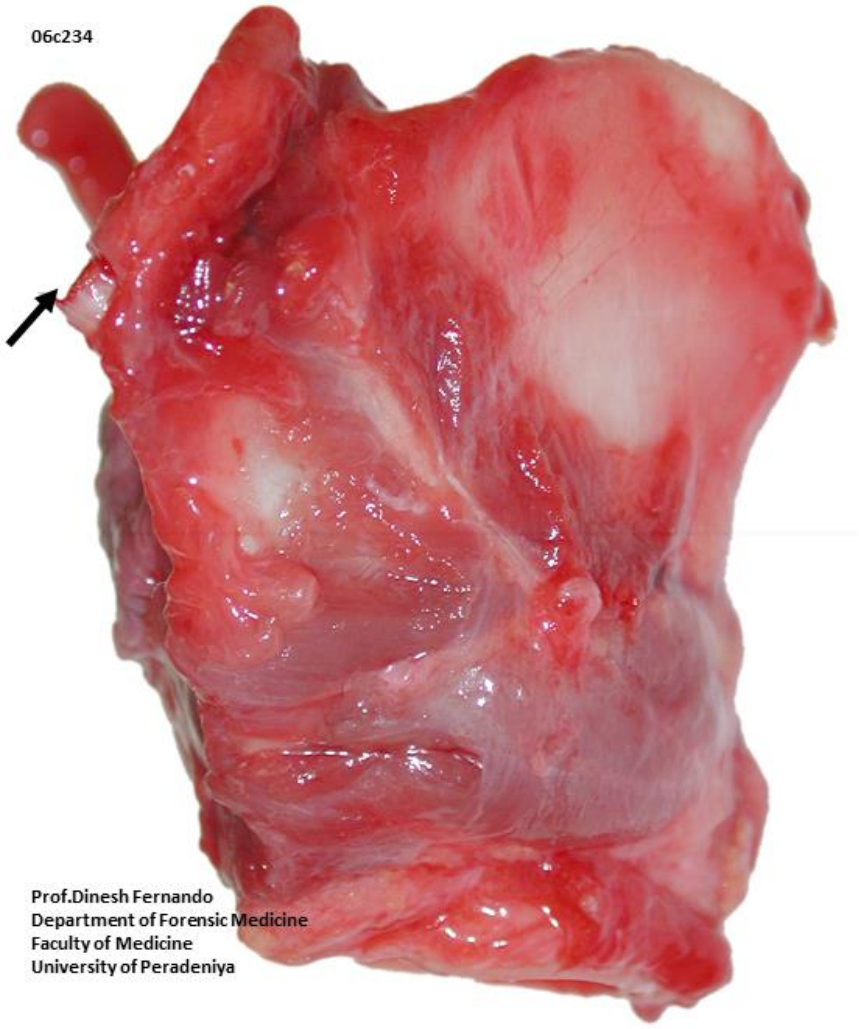

Figure 27: Note the fractured right superior horn of the thyroid cartilage (black arrow)

Figure 28: No fractures were present on the hyoid bone

History

A 45-year-old male was found hanging from a beam inside the garage. The feet of the deceased were touching the garage floor. The other end of the rope was tied about six times around a heavy horizontal wooden beam.

External Examination

Neck: A furrow measuring approximately 1.4 cm in diameter which completely encircled the neck was present. Anteriorly it was placed just below the thyroid cartilage and extended superiorly and posteriorly to the back of the neck. The impression of the weave pattern was present and the impression of the knot was present. There was no inverted V underlying the knot. No evidence of slippage of the ligature was present. Drying in the depths of the furrow on the left side of the neck was present.

Ligature: A green synthetic cord measuring 1.2 cm in diameter was present around the neck and a sliding knot was present on the right side of the neck. Several half hitches were present around the knot.

Figure 29: A furrow measuring 1.4 cm in diameter which completely encircled the neck, placed just below the thyroid cartilage anteriorly

Figure 30: The ligature was a green synthetic cord measuring 1.2 cm in diameter. Note the sliding knot

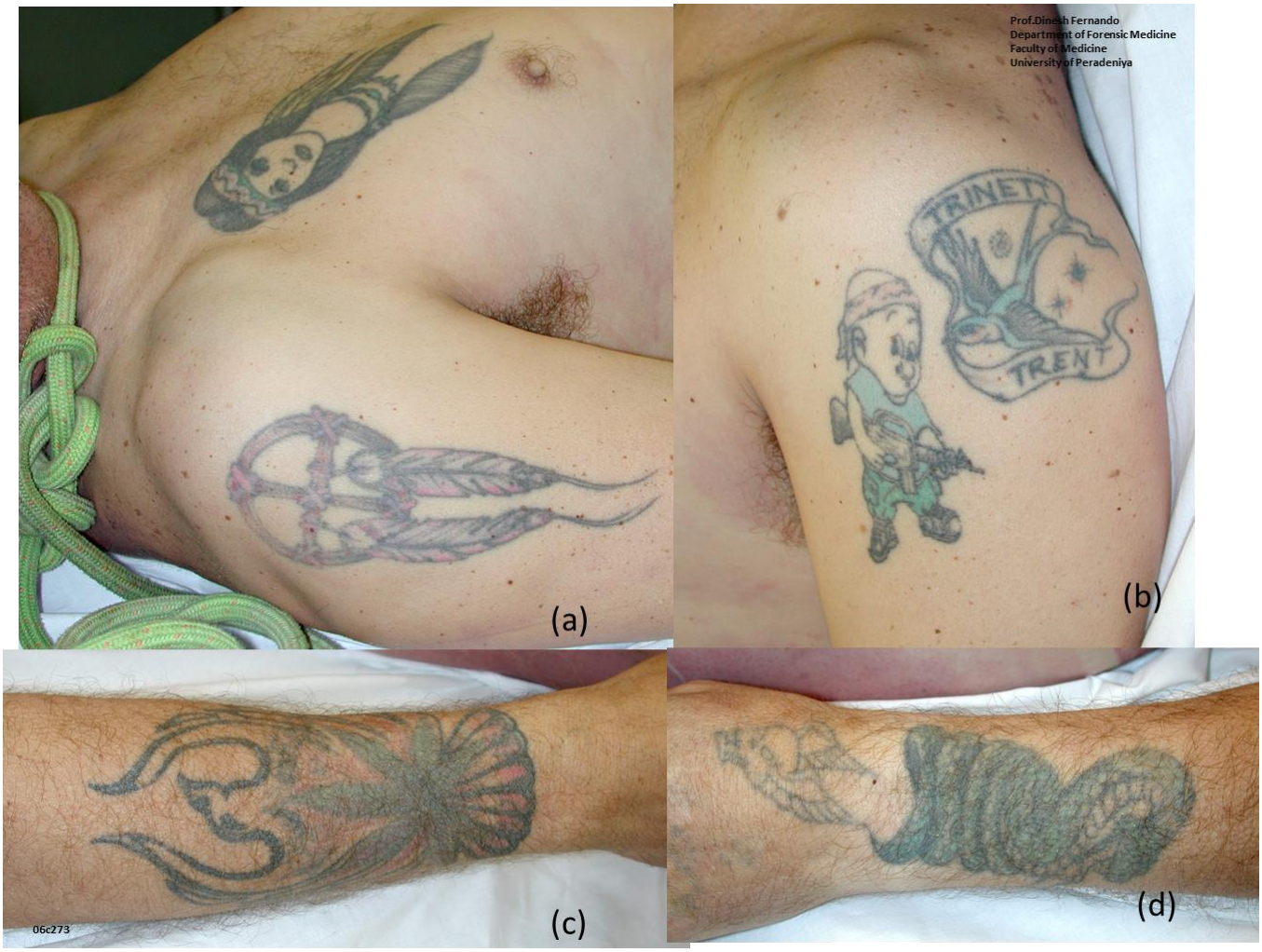

Figure 31: Tattoos were present on the (a) right arm, (b) left arm and (c) right forearm, and (d) left forearm and the right side of the upper chest

History

A 28-year-old female was found hanging approximately a foot off the ground from the door of a wardrobe. The ligature was a rolled up scarf. A small stool was nearby. Presumably, she had stood on it to reach the point of suspension.

External Examination

Neck: A ligature mark was present around the neck and the width varied from 0.5 cm to 1 cm. It was situated above the thyroid cartilage anteriorly and extended superiorly and posteriorly and was 8 cm below the root of the left ear. The apex of the inverted 'V' was at the root of the right ear. Below the right ear there was an area on the skin which was free of the ligature mark.

Figure 32: Even though, initially, it appears that the ligature mark does not seem to be compatible with the ligature seen (scarf), if the scarf was rolled up tightly, it would be compatible. This also explains the varying width of the ligature mark

Figure 33: Below the right ear there was an area on the skin which was free of the ligature mark

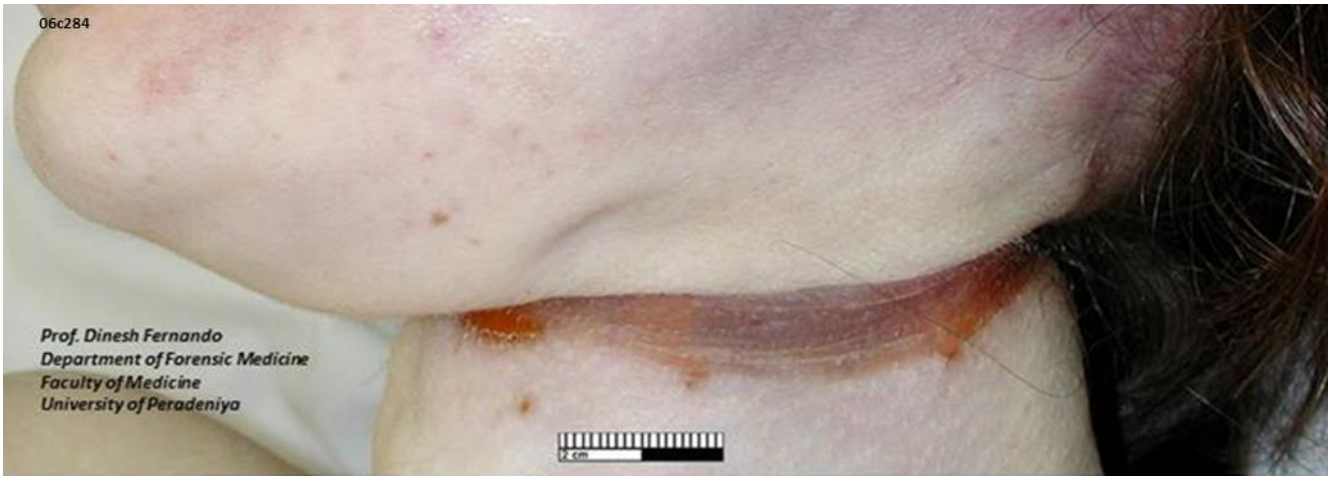

Figure 34: The ligature mark was dry and there were no associated abrasions or contusions

Figure 35: Ligature mark extended superiorly and posteriorly. Note the ligature mark on the posterior aspect of the neck indicating position under the hair

Scene Examination

A 46-year-old man was found hanging at home. According to the history given by the relatives, he lived alone and was an alcoholic. He had a past history of two suicidal attempts.

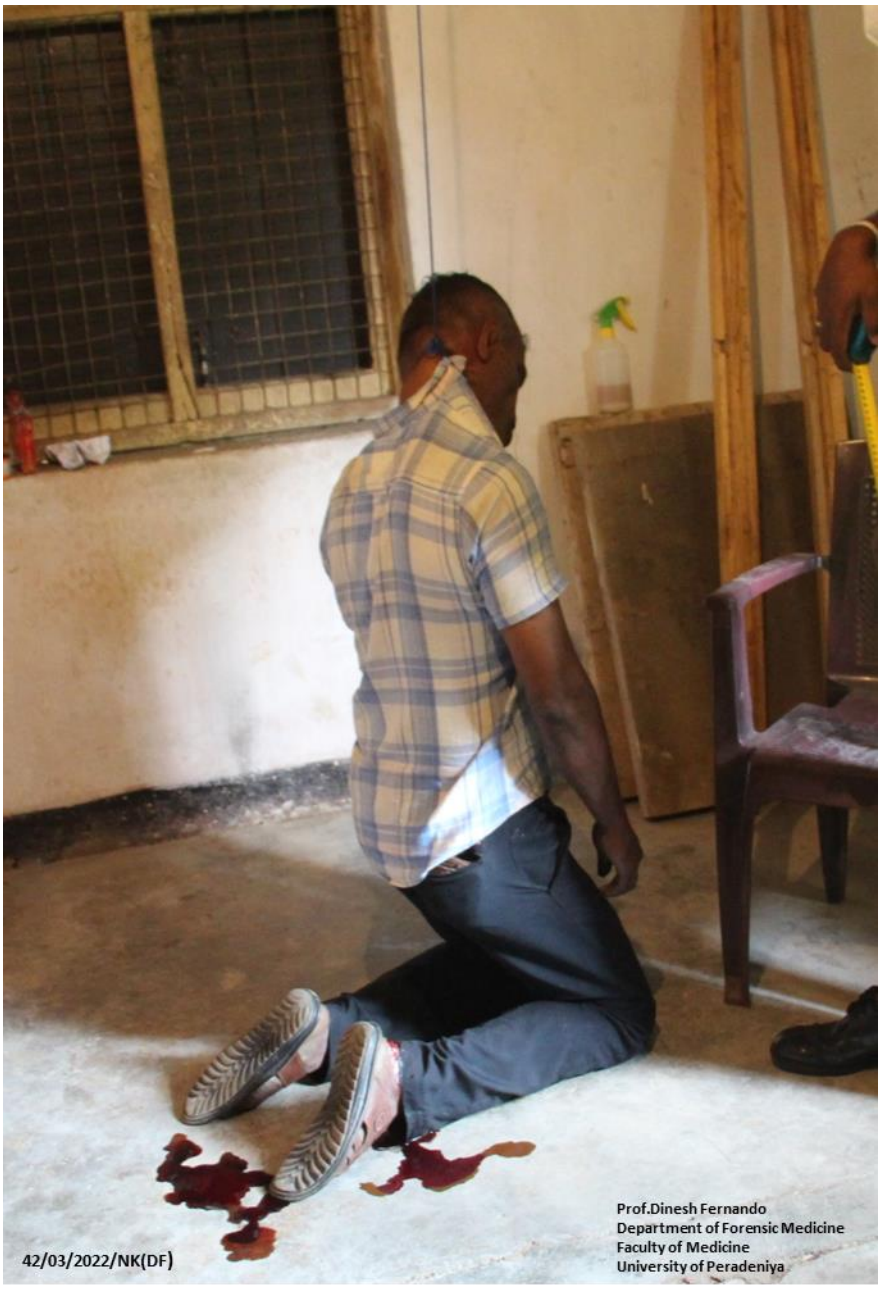

Figure 36: Feet were touching the ground indicating partial hanging. Note the chair used to reach the point of suspension

Figure 37: Half consumed bottle of arrack was found at the place where the incident took place

Figure 38: Multiple abrasions on the right side of the neck and behind the right ear due to ant bites; Note the ants on the back of the neck and around the ear in the inset

Figure 39: Hypostasis is not seen over the area of the straps of the footwear; Pallor is more prominent in the right foot as it had been bent more than the left foot

Figure 40: Strap muscle contusions were found during special neck dissection

Figure 41: Pattern of the sole of the footwear is similar to the pattern of the foot print on the chair indicating that the victim had stood on the chair to reach the beam

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