COLOUR ATLAS OF FORENSIC TRAUMATOLOGY

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Version 1

Hanging, including self inflicted injuries and female genital examination

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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!

Following his secondary education at Trinity College, Kandy, he entered the North Colombo Medical College, Ragama, and obtained his MBBS in 1994 with Second class honours. 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. Dinesh 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.

Dinesh has international experience working as the honorary Forensic Pathologist of the Disaster Victim Identification team in Phuket, Thailand following the tsunami and received an operations medal for his contribution by the Australian Federal Police. 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.

These unique and important e-booklets 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.

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. She obtained her MBBS in 2023 with Second class honours University of Peradeniya from the Faculty of Medicine, University of Peradeniya.

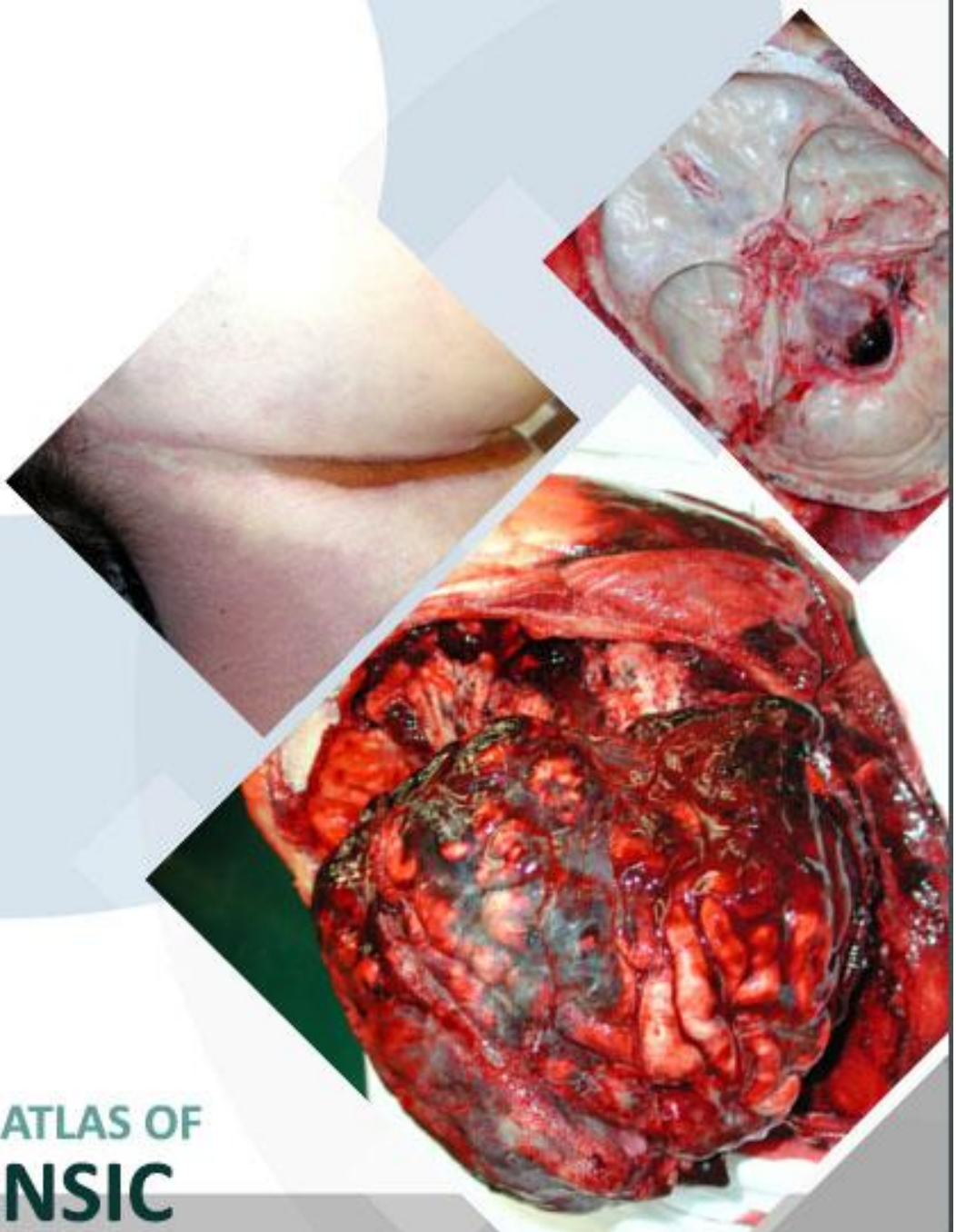
PREFACE

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 can also be seen.

History

A 15-year-old female was found hanging by a thin scarf from the bottom rail of the staircase handrail in her house. Droplets of blood were located in the corridor next to the deceased, in the kitchen, and the bathroom. Moreover, a small kitchen knife was found in the bottom of the bath and a small razor blade was found on the bathroom floor. It was revealed that the deceased had ongoing problems with her stepfather for a long time and had attempted to kill herself about a year ago. She has had counseling and has been on antidepressants and sleeping pills. On the kitchen bench, there were seven small cards and six A4-sized letters addressed to various friends and family. None of the letters gave a reason for the deceased's actions.

Even though the available evidence points more towards suicide, homicidal hanging, killing by other means, and post-mortem suspension needs to be excluded. As she was a young female, the possibility of sexual assault arises. Therefore, the examination was performed for confirmation or exclusion of sexual offenses, as well. In addition to hanging, there was evidence of self-inflicted injuries over some time.

External examination

Examination of the neck: An abraded furrow 0.5 cm in width was present around the neck with drying. Anteriorly it was present above the thyroid cartilage and extended symmetrically, posteriorly, and superiorly to end at a point below and behind the roots of the ears. There was no knot impression and there were no associated abrasions or contusions on the neck. No particular pattern was apparent on the mark.

The accompanying ligature was what appeared to be a scarf with a width of approximately 25 cm with a knot tied. The multi-colored scarf was made of a slightly rough material similar to nylon. The diameter of the scarf when twisted was approximately 1 cm.

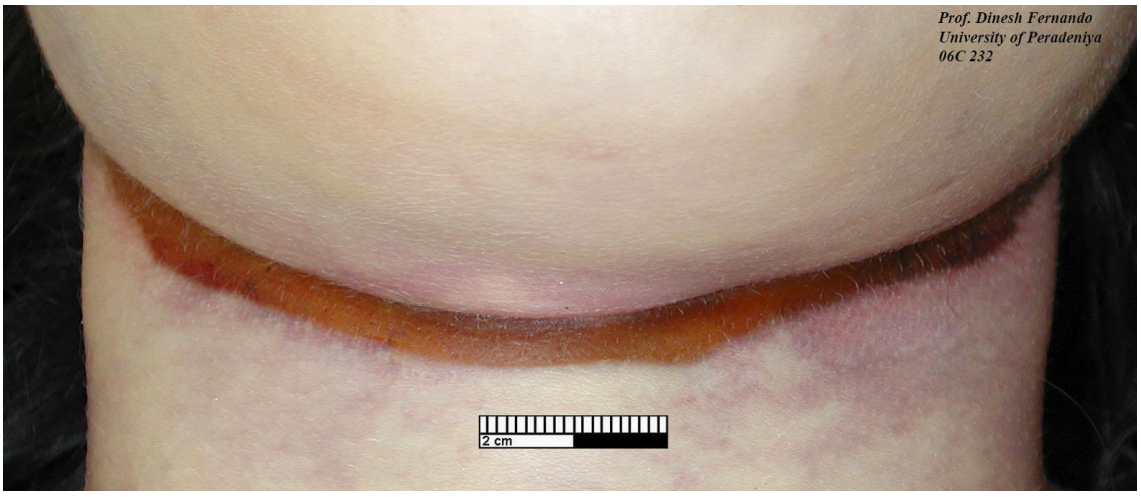


Figure 1: Ligature mark high up on the neck

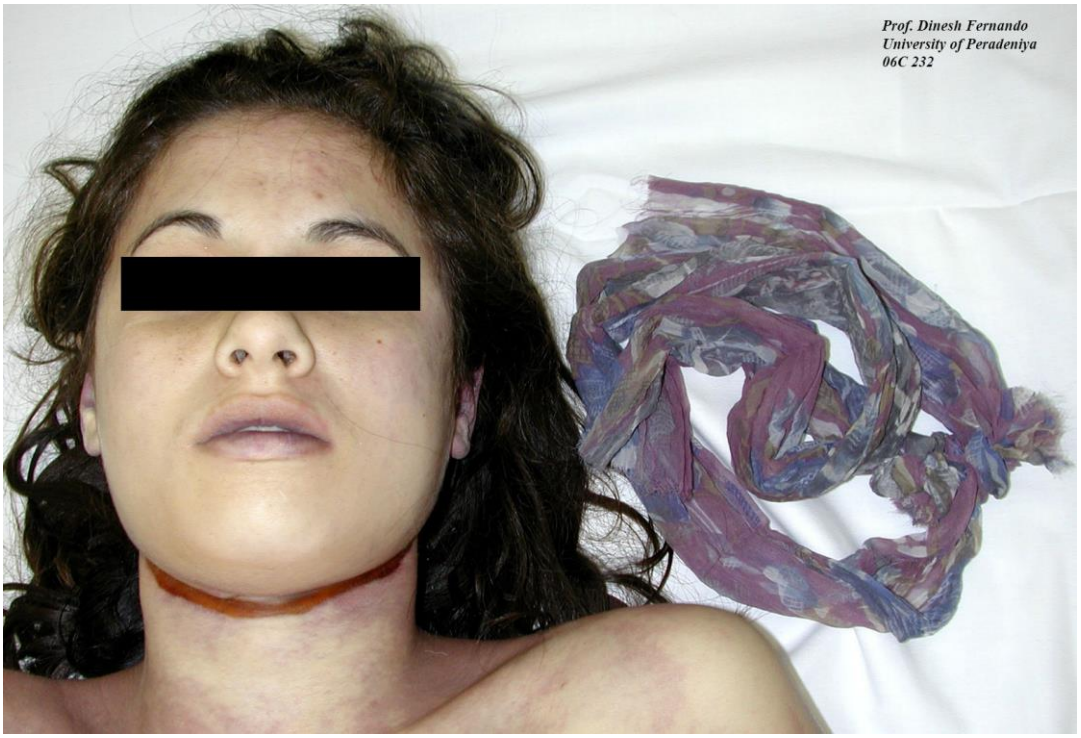


Figure 2: Alleged ligature with a knot which does not appear to be compatible with the mark on the neck

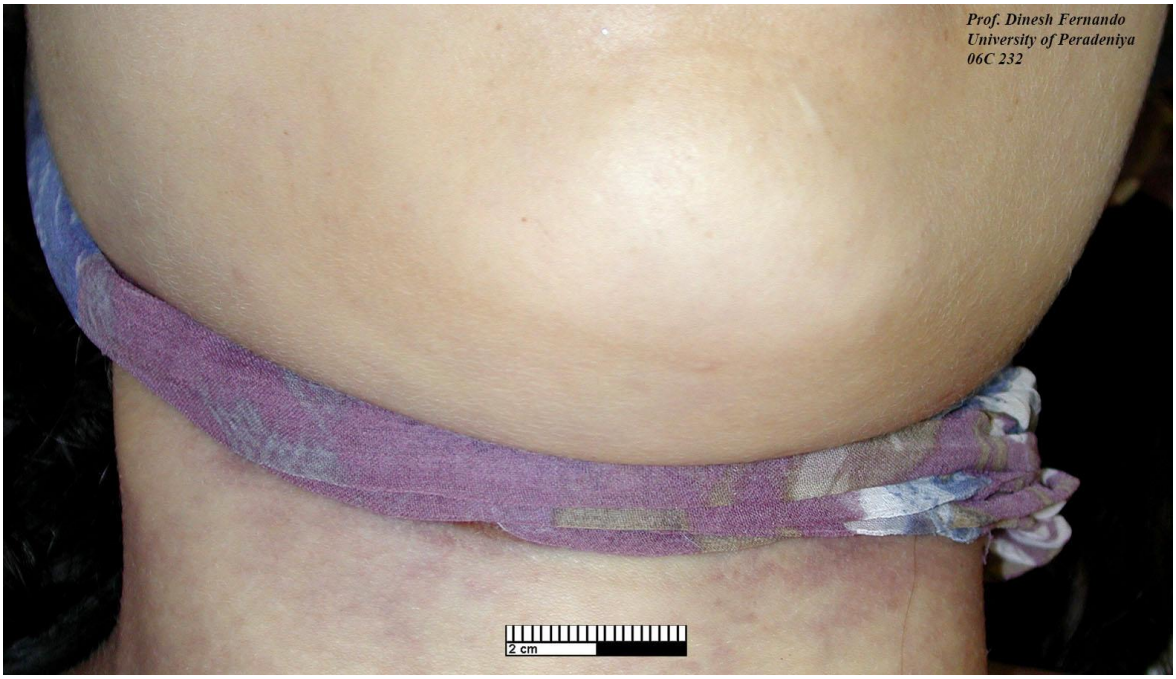


Figure 3: Rolled-up scarf compatible with the ligature mark. Note the healed scar measuring approximately 0.5 cm in length on the left side of the chin

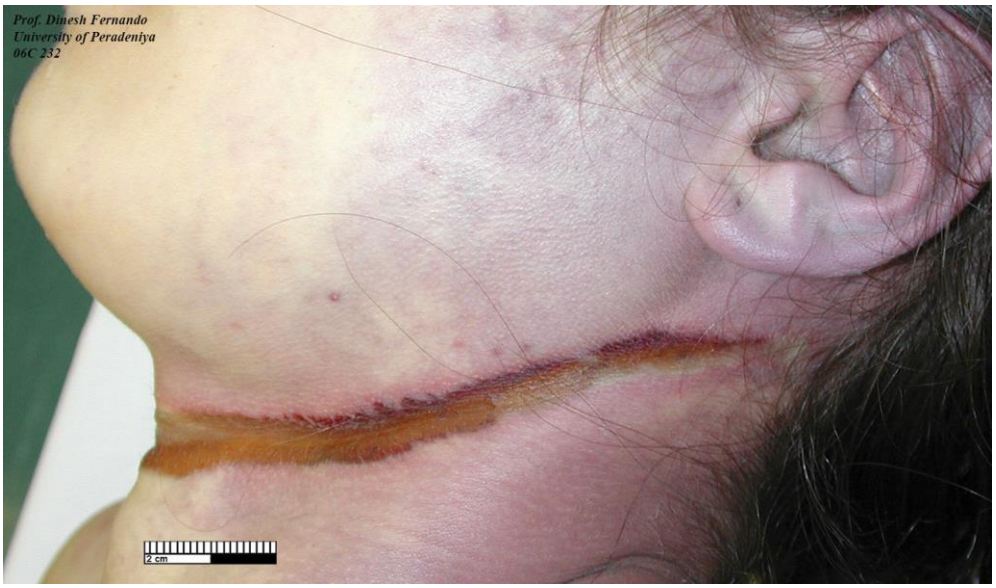


Figure 4: Left side of the neck showing ligature mark extending obliquely upwards towards the ear. A ligature mark is not present on the back of the neck due to hair being interposed between the neck and ligature

The following image is from another case to depict the nature of the ligature mark, if no intervention of hair has occurred.

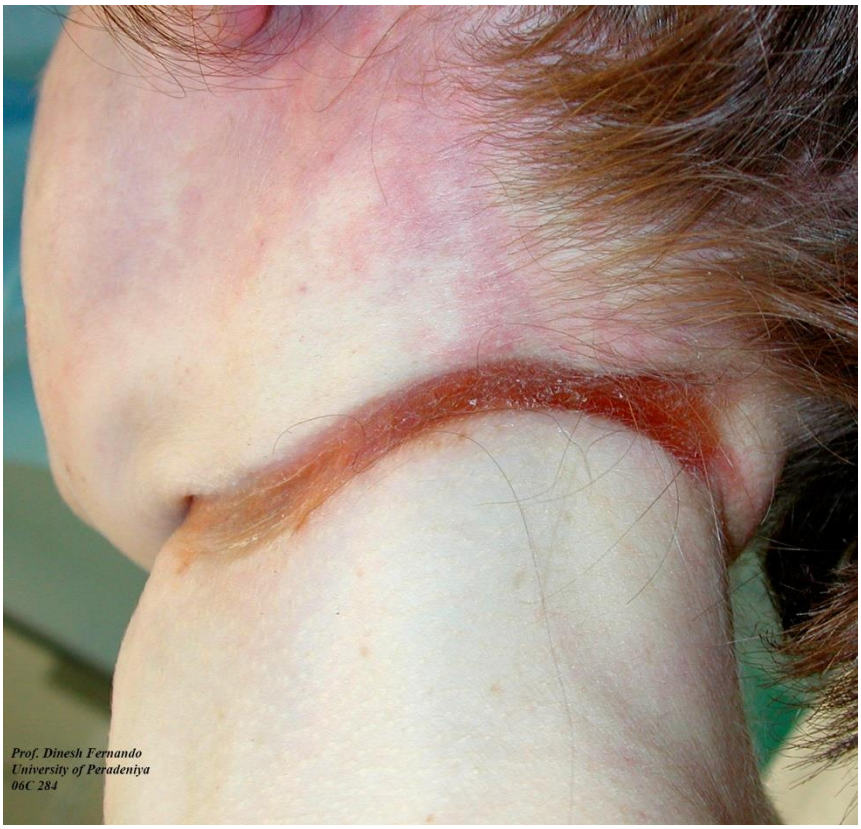


Figure 5: Presence of ligature mark on the back of the neck due to no interposition of hair

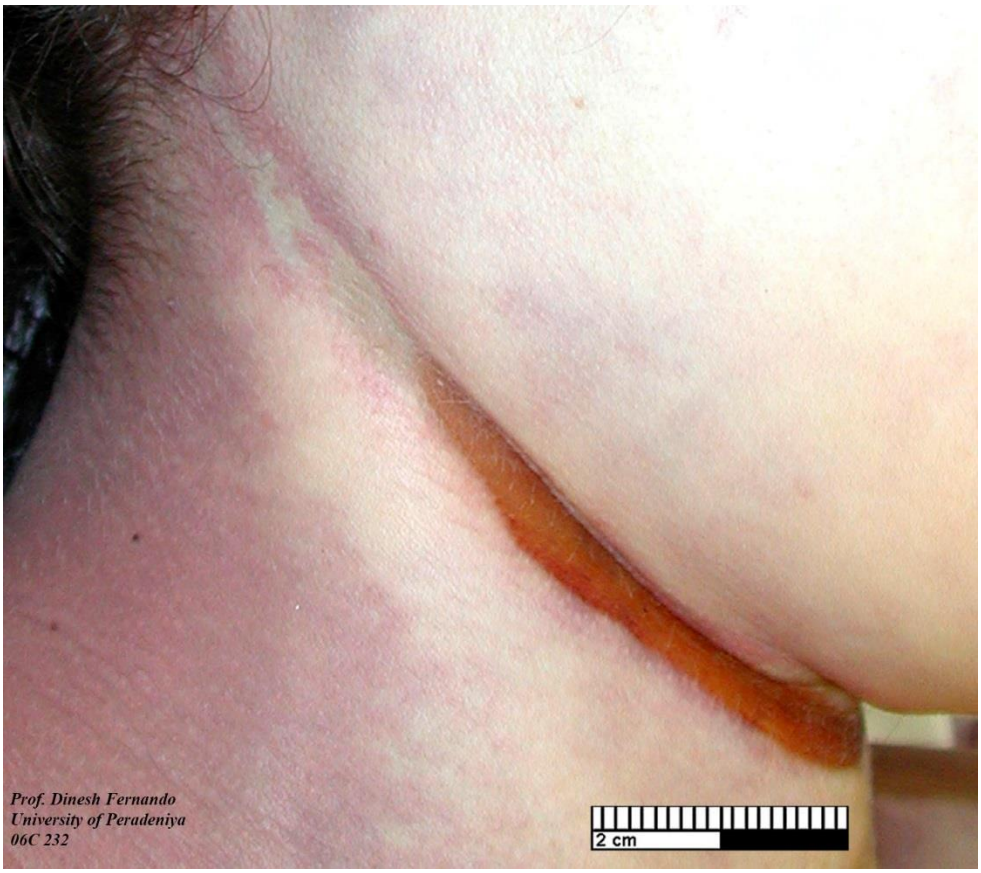


Figure 6: Note the ligature mark extending posteriorly and superiorly with an unmarked area on the right side of the neck; the ligature being pulled away from the neck at the point of suspension

Self-inflicted injuries may be suicidal, or non-suicidal acts for secondary gains. For eg. insurance fraud, sympathy, attention. It may also be seen amongst soldiers, prisoners, psychiatric patients and those who wish to implicate others for simulated offenses.

The differentiation of self-inflicted stab wounds from homicidal wounds may be difficult or even impossible. Suicidal knife wounds are commonly seen in specific sites like the throat, front of the chest and the wrists. These suicidal cuts are usually multiple with preliminary trial cuts called 'tentative cuts' also known as 'hesitation marks'. These cuts are deeper at the origin and eventually tail off into shallow surface cuts at the other end. These tentative incisions may be superimposed by deeper cuts. However, deep incisions may be made without tentative cuts. When the incision is made on loose skin, the ends of the incision become jagged, compared to straight-edged incisions made over stretched skin.

In suicidal cut throats, the pattern typically observed, especially for right-handed individuals, starts high on the left side of the neck and moves across the front of the neck in an oblique line, ending lower on the right side. For left-handed people, this pattern is reversed. These incisions are usually deeper at their origin and become more superficial as they traverse the throat, sometimes ending in minor surface cuts. However, some self-inflicted throat injuries may display horizontal cuts, with no variation in depth from one end to the other. Death could result from severe bleeding from the jugular veins, or, less commonly, the carotid arteries. If the larynx or trachea is compromised, even a small amount of bleeding can block the airways. Many individuals with such injuries do survive, however. An uncommon but possible cause of death is air embolism, which can occur when the jugular veins draw in air while the victim's level of the neck is elevated above the thorax eg; sitting, standing).

Suicidal injuries to the chest predominantly involve stab wounds. At times, linear incisions are made on the precordium or the entire front of the chest, but these generally cause minimal harm. Such incisions may be numerous, parallel, or intersecting. The majority of stab wounds are located on the left side of the chest, where it's commonly known that the heart is situated. However, these injuries may also be adjacent to the sternum or even on the right side of the chest. These wounds often occur singularly, but it's not unusual to observe multiple wounds.

Self-inflicted cuts on wrists are commonly seen in females. Deliberate cut injuries on the wrist, a common type of self-inflicted injury, are rarely effective as the sole method of suicide. Usually, these cuts are seen on the flexor surface of the wrist, at the level of flexor skin creases. Since the majority of the population shows right-handed dominance, these cuts are commonly seen on the left wrist. The radial artery may move under the lower end of the radius, if the wrist joint is hyperextended. As a result, major blood vessels may be left undamaged, merely dividing the flexor tendon. Self-inflicted cut injuries to the wrist may be accompanied by other life-threatening injuries. Non-suicidal, self-inflicted injuries are also a common occurrence. Non-suicidal cut injuries are usually superficial and are not life-threatening. They have an equal depth at both the origin and the termination. These cuts are multiple and parallel, avoiding vital areas like the eyes, lips, and nose. They are commonly found on the sides of the neck, chest, forearms and thighs and are seen on the non-dominant side of the body. If these injuries are made on areas covered with clothes, there will not be corresponding cuts on the clothes.

Examination of the injuries:

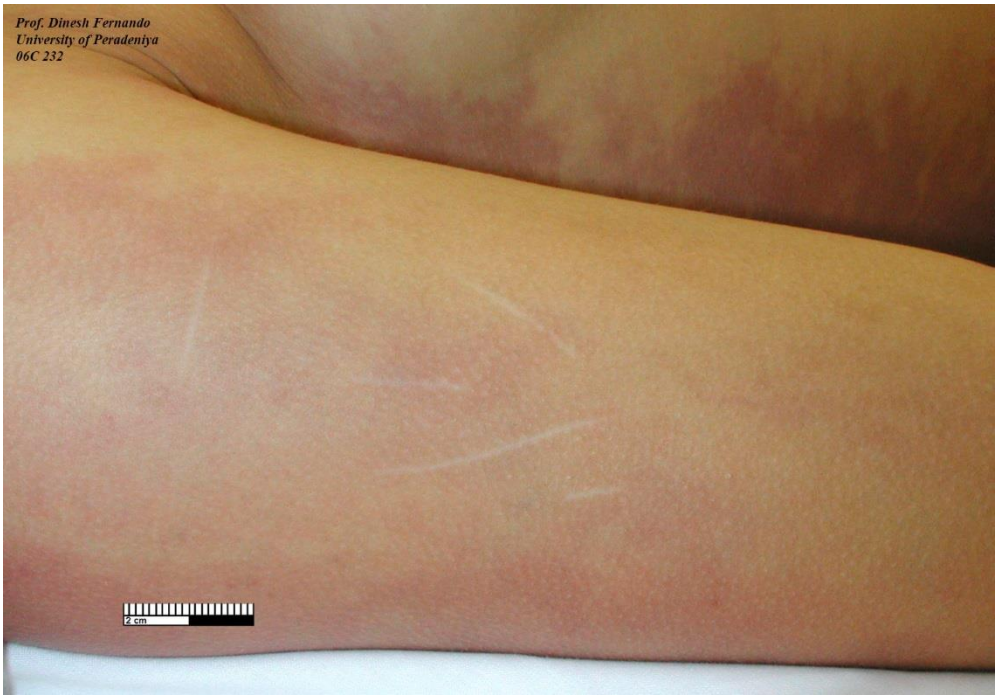


Figure 7: Five healed linear scars ranging from 0.8 cm to 4 cm in length situated on the lateral aspect of the right arm. The superior one is transversely placed while the other four are obliquely placed

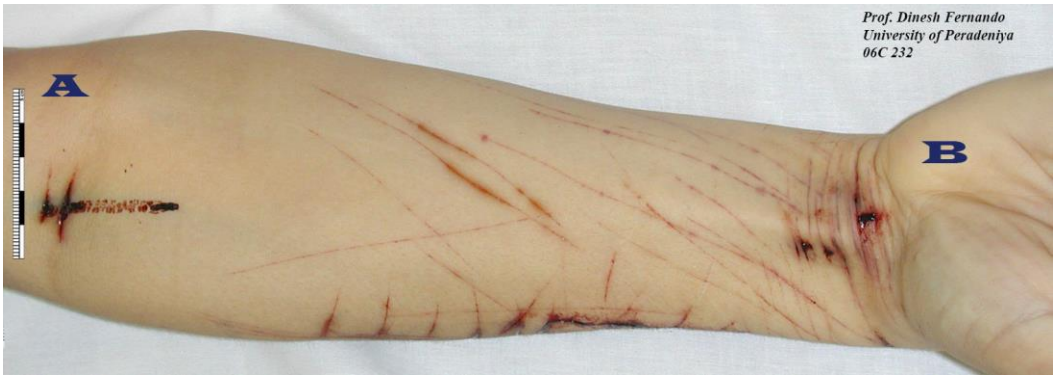


Figure 8: Approximately 13 to 15 superficial incisions ranging from 6 cm to 10 cm in length on the anterior aspect of the right forearm in the middle and lower thirds. These are roughly parallel and extend obliquely downwards and laterally except for one which is extending downwards and medially. This is 9 cm in length and extends from the upper forearm to the junction between the middle third and lower third of the forearm.

(A in figure 8): Two parallel superficial incisions each measuring 1.5 cm in length and separated from each other by a distance of 0.5 cm were present on the anterior aspect of the right antecubital fossa with dried fresh blood around the margins. Note the drip mark of dried blood vertically downwards

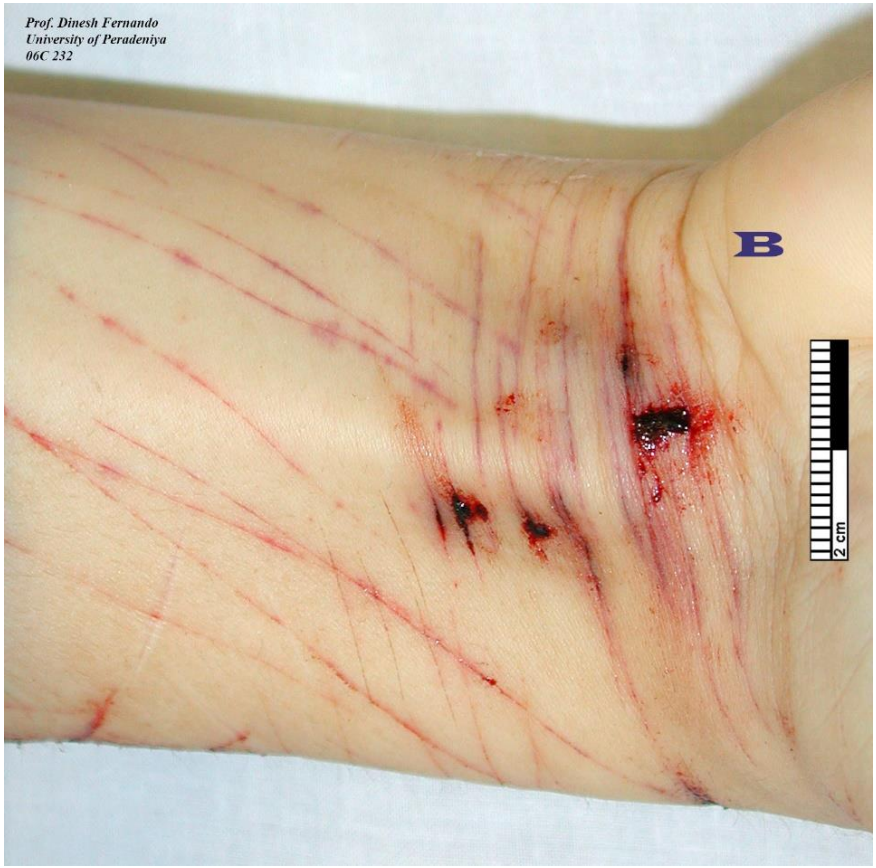


Figure 9: (close-up of B in Figure 8): A group of approximately 12 superficial parallel incisions ranging from 2 cm to 4 cm in length transversely placed on the lower anterior aspect of the right forearm just superior to the wrist joint in an area of 5 cm x 2 cm. Note the presence of healed scars and healing pink scars underlying the fresh injuries

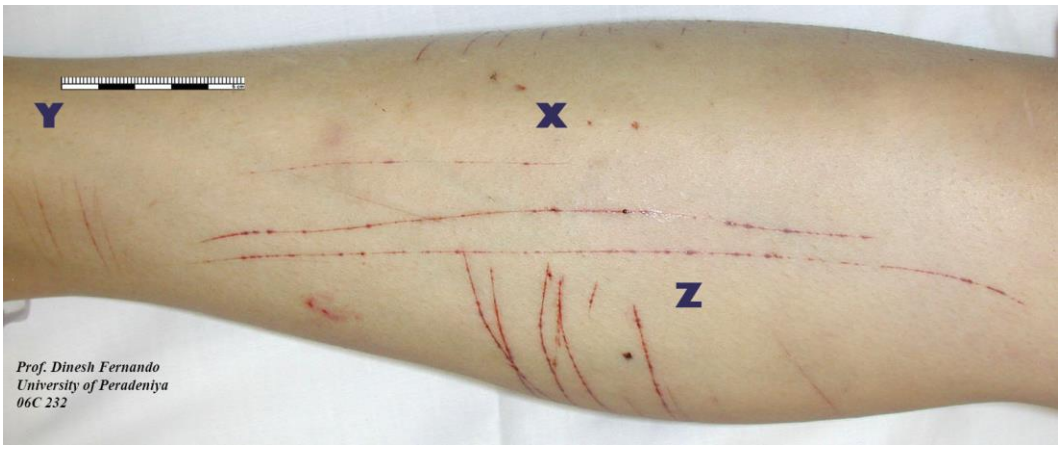


Figure 10: Group of three abrasions (X) vertically placed on the anteromedial aspect of the right leg, the longest being 23 cm and the shortest 9 cm. In addition, approximately six transversely placed superficial abrasions measuring approximately 3 cm in length in an area of 3 cm x 3 cm on the medial aspect of the lower right leg (Y)

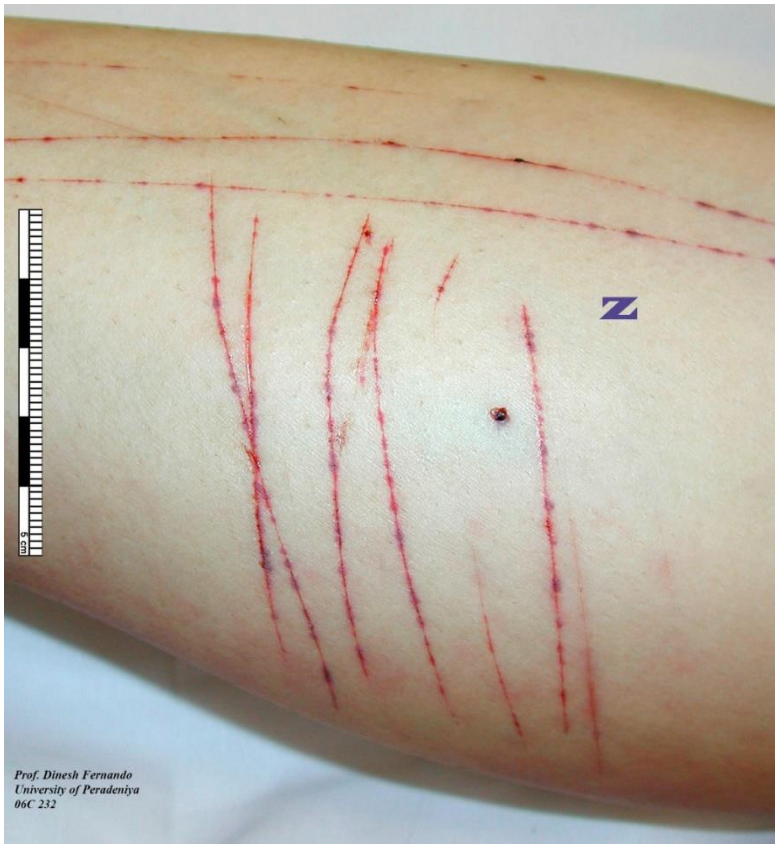


Figure 11: (Close-up of Z in figure 10): Ten superficial incisions (abrasions) ranging from 4 cm to 7 cm in length transversely placed and parallel to each other on the medial aspect of the middle third of the right leg in an area of approximately 10 cm x 6 cm

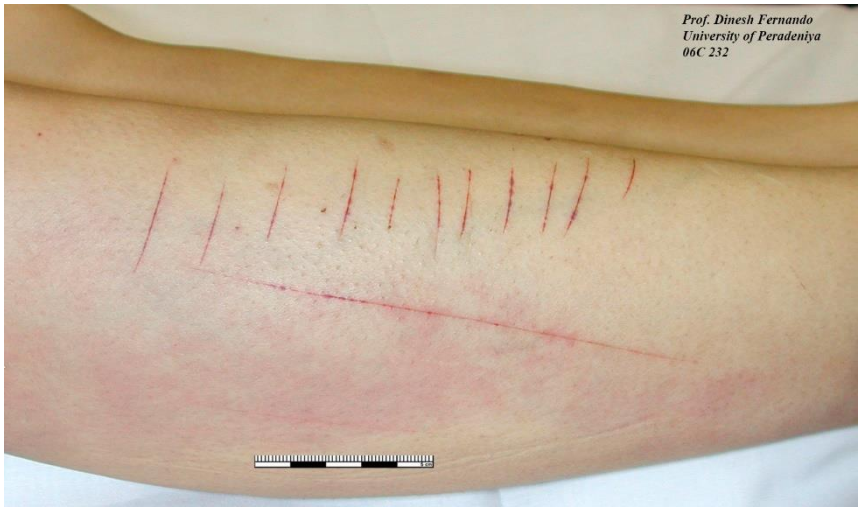


Figure 12: Eleven transversely placed parallel superficial abrasions ranging from 1.5 cm in length to 3 cm in length on the anterolateral aspect of the middle third of the right leg in an area of 13 cm x 4 cm. In addition, an abrasion measuring 14 cm in length placed vertically on the middle third of the right leg

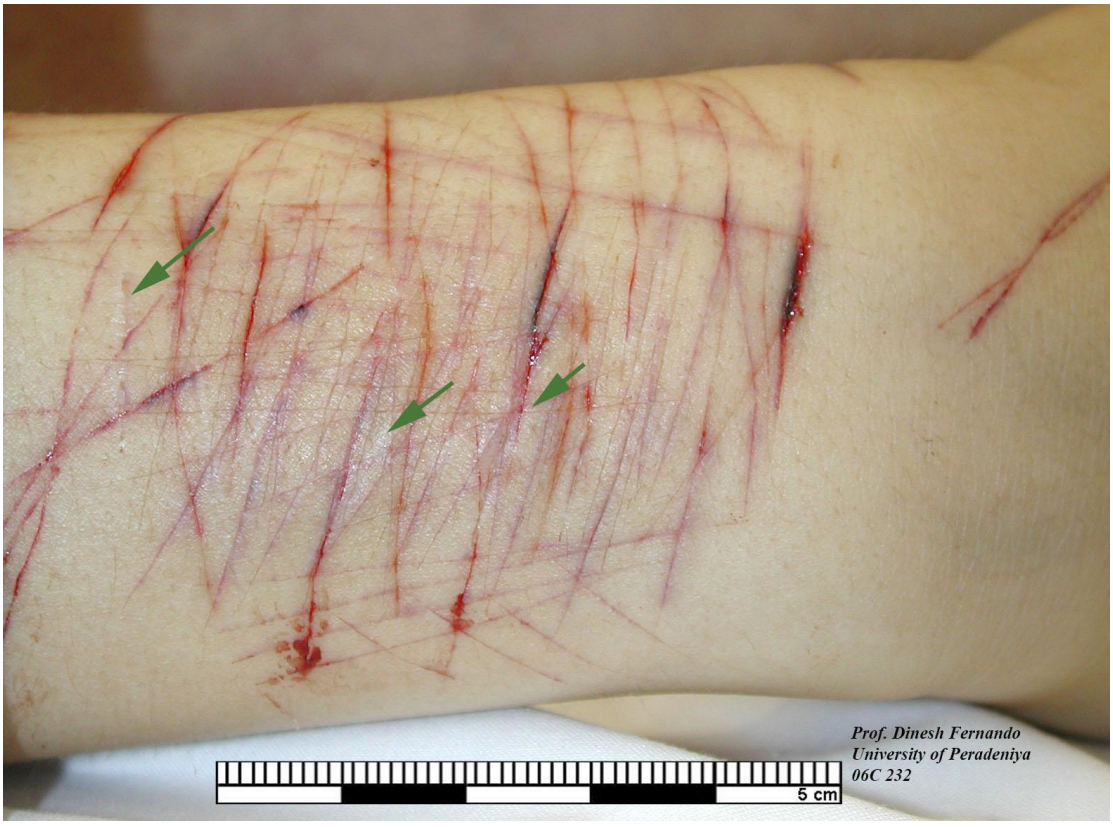


Figure 13: Note the old scars (green arrows) and healing pink scars underlying the fresh injuries

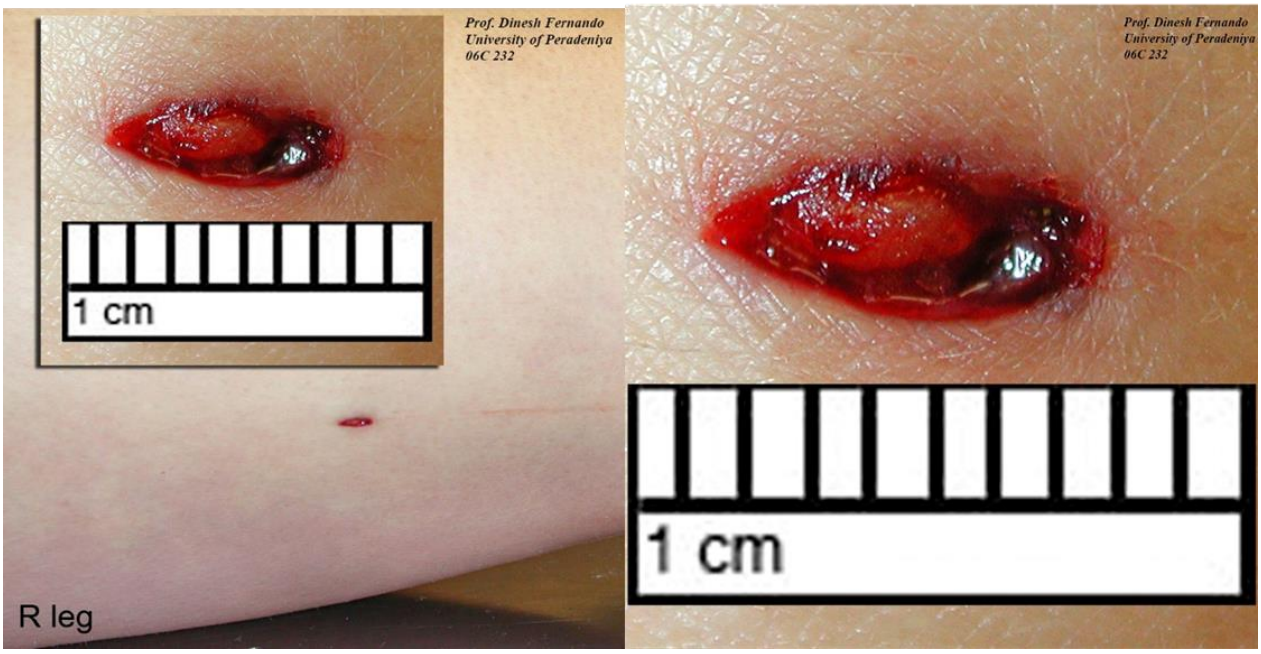


Figure 14: Oval puncture mark measuring 0.6 cm in length vertically placed on the lateral aspect of the lower third of the right thigh. The superior end appeared sharp and pointed while the inferior end was rounded. Note the absence of marginal abrasion.

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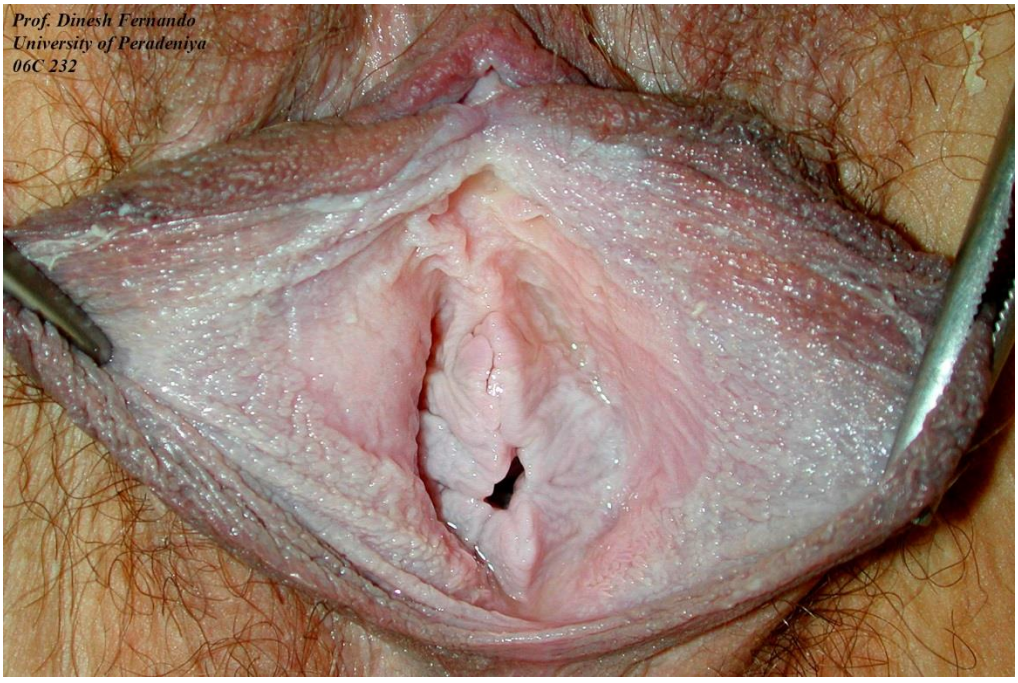
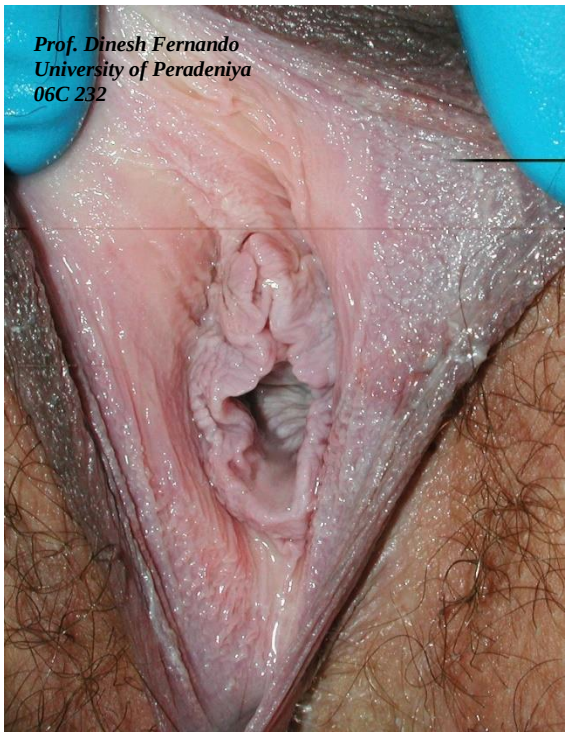
When conducting an autopsy on a female, features of sexual violence should always be looked for. External examination of the body may reveal abrasions, contusions, and lacerations on the lips, bite marks on the neck, shoulders, breasts, and buttocks, intradermal petechial hemorrhages caused by sucking the skin into the mouth, and discoid and linear abrasions on the breasts, thighs, and buttocks.

External examination of the genitals may reveal clear signs of trauma, such as perineal tears and lacerations of the margin of the vaginal introitus or anus. Internal examination of the body may show a variety of injuries from reddening or swelling to complete disruption of the vaginal canal. These vaginal injuries may extend to the abdominal cavity through the posterior fornix of the vagina or the lateral vaginal walls.

Examination of genitalia: Presence of secondary sexual charachteristics noted. No injuries were seen in the perineum, labia majora, labia minora, and lower vagina. The hymen was annular, with multiple folds (fimbriae), and was intact.



(a)



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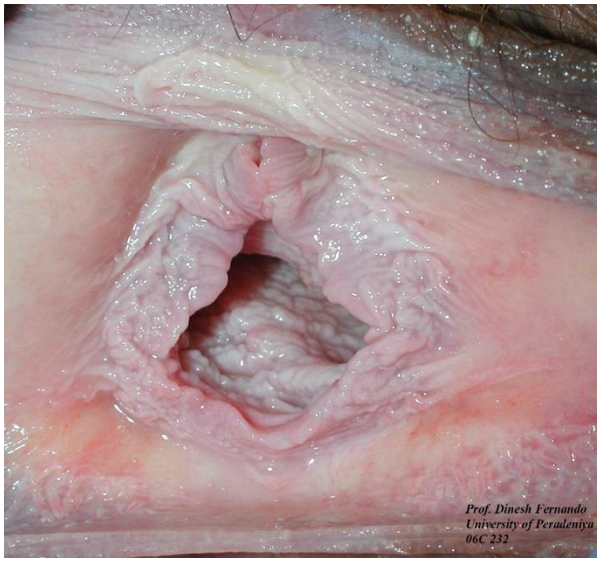

(c)

Figure 15 (a, b & c): Absence of injuries on the genitalia and presence of multiple transverse rugae in the vagina

Cause of death

Hanging.

The multiple self-inflicted injuries of different ages indicates that these have been caused over a period of time.

No medical evidence of sexual assault was detected.

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