Sexual Assault: Forensic Examination in the Living and Deceased

Catherine Ann Lincoln

ABSTRACT

The forensic examination of a person suspected of having been sexually assaulted encapsulates the breadth of forensic medicine possibly more completely than any other situation in forensic practice. Whether in the living or deceased, detection of injury and biological material to support or exclude sexual activity requires a careful, methodical approach to ensure robust evidentiary value and an understanding of genito-anal anatomy and sexual physiology to interpret its significance for the courts. This paper is not intended as an exhaustive guideline but aims to provide a general overview of the key components of forensic sexual assault examination highlighting the common and different aspects in living and deceased persons. *Acad Forensic Pathol.* 2018 8(4): 912-923

AUTHOR

Catherine Ann Lincoln MBBS MForensMed PhD FFCFM(RCPA) FFFLM(RCP UK) AFRACMA, Gold Coast Forensic Medicine - Emergency Department, Gold Coast Hospital and Health Service

Roles: Project conception and/or design, data acquisition, analysis and/or interpretation, manuscript creation and/or revision, approved final version for publication, accountable for all aspects of the work.

CORRESPONDENCE

Catherine Ann Lincoln MBBS M Forens Med, PO Box 377 Miami, Queensland 4220, Australia, catherinelincoln@bigpond.com

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INTRODUCTION

The available literature on the forensic medical aspects of sexual assault, as with all areas of medicine, is written from the perspective of the various authors' experience and, as a consequence, varies widely depending on whether it emanates from an environment with a primary care, emergency medicine, trauma, surgical, or pathology focus. Injuries seen by clinicians working in rape crisis centers will differ from those seen by their forensic pathologist colleagues, and persistence and ability to retrieve biological material will vary in different scenarios. The area of sexual assault medicine has derived great benefit from interaction and collaboration between forensic clinicians and pathologists whether it be at the hospital bedside, in the mortuary, or in court. Jurisdictions where forensic pathologists perform both autopsies and clinical forensic examinations are responsible for key research in the field (1-3).

Despite jurisdictional variation in sexual offense law, clinical and laboratory practice, and service resources, the development of standardized protocols for forensic examination and evidence collection kits has facilitated sexual offense investigation and increased the likelihood that medical evidence will be relied upon (4). While injury can provide evidence of penetration, it cannot determine consent because injuries may occur as a result of consensual sexual intercourse. Biological material such as semen, sperm or saliva may provide evidence of contact (eg semen on skin, saliva on genitalia) or sexual penetration (eg semen in vagina or anus). Lawyers involved in sexual assault cases will vary their dependence on the probative value of injury and biological evidence depending on case characteristics, whether it be proving sexual contact or corroborating a physical struggle (5). Because a forensic examination is usually conducted early in the investigative process, often before witness interviews and scene processing has occurred, the likely issues of a case are still unclear and as such, the responsibility to perform a thorough examination and collect all evidence of potential value rests with the forensic medical examiner.

Poor quality or insufficient forensic medical evidence has been identified as a common barrier to the prosecution of sexual assault cases (6).

Although sexual assault does not always result in injury (7, 8), the presence of injury has been found to influence decisions at all stages of the legal process including investigation, prosecution, conviction, and sentencing; even minor injury may be of significance depending on the nature of a case (9). Furthermore, the multidisciplinary nature of criminal investigation teams means that the quality of communication between police, medical examiners, laboratory professionals, lawyers, and judges significantly influences how forensic medical evidence is used in sexual assault cases (5, 10).

Most jurisdictions will have developed their own, or have access to, forensic examination protocols that meet local legal and laboratory requirements and there exist many reputable forensic texts that address the full scope of this topic. This paper does not seek to supplant these but is intended to provide a general overview with points for consideration in relation to examination of body surfaces and openings (i.e., mouth, vagina, and anus), relevant to both clinician and pathologist forensic examiners. The specialized nature of pediatric and geriatric sexual assault requires separate consideration and will not be covered in this paper. Similarly, internal pelvic dissection is an important adjunct to external/clinical genito-anal examination at autopsy but will not be addressed in this paper.

DISCUSSION

Role of Information in Directing Examination

Although forensic sexual assault examination in a clinical setting will be directed by the complainant's account of events to some extent, the effects of recent trauma, altered consciousness, or intoxication may mean such information is not always available. They may be unaware of minor injuries of forensic relevance and unable to tell whether penetration or ejaculation occurred or whether a condom was used (2, 11). Use of a standardized protocol for examination and collection of samples ensures all potential evidence is collected, even when there is limited information available. In a deceased person, the absence of a per-

sonal account of events increases the importance of the standardized approach. In using standardized protocols, however, it should be acknowledged that the varied nature of sexual assault scenarios may require examiner discretion to, for example, collect additional swabs or use a different examination technique to maximize evidence collection.

Identifying General Bodily Injury

In the clinical setting, detection of injury on the body is used to corroborate or exclude a complainant's account of events, whereas at autopsy it may be the only indication of what has occurred at or around the time of death. In both situations, minor injuries may be crucial. Finger pad bruising on the limbs or neck, suction-type bites, circumferential bruising to wrists or ankles, bruising to the inner lips or behind the ear pinna, petechiae in the eyes or on the palate, finger nail abrasions on the neck, and brush abrasions on the knees or bony prominences of the back (12) will shed light on events associated with the death and should be recorded carefully by written description, diagrams, and photography. Equally, the absence of bodily injury may be informative, allowing exclusion of certain scenarios.

Where it may not be possible to say definitively whether findings in a clinical setting are traumatic in origin or not, in a deceased person their nature can be accurately identified, if necessary, by dissection and histology. Similarly, traumatic bruising that is not visible on the surface of the body can be located by dissection.

Identifying Oral, Genital, and Anal Injury

The detection of injury in the mouth, vagina, or anus requires good lighting and in the case of vaginal and anal forensic examination, the use of transparent plastic speculae and anosopes to avoid obscuring sites of potential injury (**Figure 1**). Use of a swab or Foley balloon catheter to display hymenal edges may improve injury detection. In clinical practice, sex-related injuries to the vaginal walls and cervix are not commonly seen; this may relate to the difficulty associated

with visualizing the vaginal fornices by speculum and the entire mucosal surface due to rugae. At autopsy, dissection will allow comprehensive inspection of all mucosal surfaces for injury.

Oral injuries due to penile penetration, whether consensual or nonconsensual, may be seen on the frenula, palate, gums, buccal surface of cheeks, tongue, and lips and include abrasions, bruises, and petechiae (13).

Taking into account legal definitions of the vagina and anus, and in the absence of other recent nonsexual penetrative events such as tampon use or speculum examination including injury during the forensic examination itself (14), the presence of recent injury in the vagina or ano-rectum will corroborate penetration. The absence of injury, however, will not exclude it.

Genito-anal appearance varies widely and familiarity with the normal noninjured genitalia and ano-rectum is essential to avoid over-identification of injury in these parts of the body. Lacerations, abrasions, and bruises are seen after both vaginal and anal penetration. The most likely genital areas to be injured during vaginal sex are the posterior fourchette, fossa navicularis (**Images 1 and 2**), labia minora, and hymen/hymenal remnant (1, 15-19). Of the more severe sex-related vaginal injuries, the most commonly described is a posterior wall/posterior fornix laceration thought to occur during sex because these parts of the vagina are more firmly connected to pelvic musculature and, therefore, less flexible (20, 21). **Table 1** describes the various types of blunt force injury which may occur during sexual penetration of the female genitalia.

Detecting sex-related genital injuries, which are usually small and superficial, on the female genitalia, with its many creases and rugae, can be difficult, but examination enhancement techniques such as magnification (colposcopy), staining with toluidine blue (22), or the use of ultraviolet light (23) will increase the likelihood of detection. Toluidine blue is said not to compromise biological evidence but false negatives may occur if any barrier overlies the lesions and false positives may occur in some genital skin conditions (e.g., vulvitis, herpes) (**Image 3**). Ultraviolet light was

Figure 1: Insertion of a vaginal speculum. Created under contract by professional medical illustrator Diana Kryski.

Table 1: Blunt Force Injury To Female Genitalia

Mechanism	Injury type	Site
Stretching of genital tissue due to penetration	“Split-type” lacerations, radially orientated	Hymenal tissue Labia minora Posterior fourchette Fossa navicularis
	Bruising, circumferential or interrupted	Hymenal tissue
Direct impact	Bruising Abrasions Lacerations	Any site
Frictional force	Abrasions, circumferential or interrupted	Any site
Compression of tissue against bony pelvis	Bruising “Crush-type” lacerations	Labia Hymenal tissue Vaginal wall
Shearing/tearing of fixed or “tethered” tissue (e.g., perineal body)	Bruising Lacerations	Posterior fourchette Perineum
Adhesion of non-lubricated surface followed by movement	Bruising	Free edge of labia or hymen
	Lacerations	Between labia major and minor (inter-labial)

Image 1: Fossa navicularis lacerations (18).

Image 2: Posterior fourchette lacerations seen with separation (19).

Image 3: Lacerations shown in **Image 1** highlighted with toluidine blue dye uptake (24).

noted to be particularly useful for detection of submucosal hemorrhage and scar tissue, not easily seen in normal light (23).

Genital injury may or may not result from vaginal penetrative sex, whether it is consensual or not. It is, however, seen more commonly as a result of nonconsensual sex than consensual sex. A review of key studies in this area demonstrated how variation in study methodology gives rise to prevalence rates ranging from 0%-73% for consensual groups and 4%-89% for non-consensual groups depending on type of examination performed (e.g., macroscopic, colposcopic, staining, or combinations of these). Serious genital injury is excluded from these studies that were largely based in primary care environments. More recent prospective primary care research studies that endeavoured to minimize confounding variables found macroscopically detected consensual group injury rates of 10-34% and nonconsensual group rates of 55% (1, 16). Attempts to identify patterns of injury

which distinguish sex-related genital injury occurring in a consensual setting from injury occurring in a non-consensual setting have not yielded definitive results. However, the most common injury from consensual vaginal penetration has been consistently identified as a single laceration at the posterior aspect of the vaginal opening (20), whereas nonconsensual vaginal penetration is more likely to result in more than one injury, more than one type of injury, and more than one site of injury (15, 16).

Less information is available with respect to injuries resulting from anal penetration and published research focuses almost exclusively on nonconsensual study groups; in a recent study, 27% of 174 women reporting nonconsensual completed anal penetration sustained injury, most commonly perianal lacerations (7). Perianal lacerations due to anal penetration are commonly radial, not limited to the midline, and frequently extend into the anus (**Image 4**) (22).

Image 4: Perianal lacerations and redness (25).

There is little information available with respect to sex-related male genital injury in consensual or non-consensual settings or in sex offenders.

Documenting Injury

Comprehensive recording of injuries descriptively, diagrammatically, and photographically maximizes evidentiary and interpretive value. The inclusion of specific diagram templates for documentation of internal oral, vaginal, and ano-rectal mucosal surface findings in forensic examination protocols and the use of “clock-face” position references allow the forensic examiner to record injuries as they are seen and avoid ambiguity.

Genito-Anal Pain

The question of consent cannot be answered with medical evidence. Variation in individual responses to pain and the existence of consenting sexual practices that involve the purposeful infliction of painful injury on participants reduce the weight of injury evidence with respect to consent. In the clinical setting, a complainant can describe to investigators/courts any pain experienced during a sexual act, while a deceased person cannot.

An understanding of female genito-anal sensorio-neural supply and the degree of sensation and extent of sensitive clitoral tissue in various parts of the genitalia can assist with advice in relation to the likelihood that an injury was painful or explain why a woman may have been unaware of a serious vaginal injury or retained foreign body (26). It is not well understood that the upper part of the vaginal canal is not sensitive to touch or pressure and has significantly less free nerve endings than the lower vagina and external genitalia (27).

Severity of Injury

In the deceased, sexual assault is considered in the context of cause of death; did the sexual assault contribute directly to death, as in the case of severe hemorrhage from a vaginal laceration; did it occur as part

of an assault that lead to death without the sexual act being causative, as in fatal blunt trauma or strangulation; or is evidence of sexual activity unrelated to the circumstances of death, having occurred at some time before or after death? In comparison to the clinical setting where most injuries, if detected, will be minor, forensic sexual assault examination in the mortuary can involve the full spectrum of general and genito-anal injury severity.

A recent large primary care study found that with respect to general body injuries, 29% of women reporting an acute sexual assault sustained no visible injury and 52% only mild injury (7). Most sex-related genito-anal injury research is conducted in primary care settings and describes its prevalence and typology without addressing the issue of severity. Some researchers have explored the validity of a genital injury severity scale in an effort to distinguish between injuries sustained during consensual and nonconsensual sex (28). However, considerable practical challenges must be addressed if the whole spectrum of sex-related injury seen in primary care, surgical gynecology, and at autopsy is to be acknowledged.

Biological Evidence

In 2009, an Australian man was wrongly convicted and jailed for rape as a result of biological evidence contamination (29). A UK review of 20 mortuaries in the late 1990s found that 50% had quantifiable DNA on instruments and mortuary surfaces (30). The serious implications of environmental DNA contamination and contamination during collection of biological material necessitate rigorous attention to pre- and post-examination cleaning protocols, collection of examination surface control swabs to assist with identifying where contamination may have occurred, and single use equipment where possible. Double non-sterile gloves should be worn throughout the sampling process and when handling specimens (31).

Detection of spermatozoa or semen may be highly significant depending on the issues of an investigation, providing a means of perpetrator identification, proof of sexual activity and sexual contact between a

complainant and perpetrator, as well as the potential to corroborate sexual penetration. The failure to detect sperm/semen, however, does not exclude sexual activity or penetration.

Different jurisdictions will vary in laboratory practice using sperm microscopy, detection of seminal biomarkers, and DNA/RNA markers; local protocols and persistence data will usually determine guidelines for collection. Male DNA detection using Y-short tandem repeat (STR) methods have improved outcomes and extended detection times (32-35). In the clinical setting, time scale recommendations for sample collection are based on maximum times in published persistence data, but case-by-case discretion is required (31). While there is a large amount of information published in relation to persistence of sperm on sexual assault kit vaginal samples, less work has been done on oral or anal samples; even less has been published about postmortem recovery of sperm/semen in cases of rape-homicide. One study found little value in use of postmortem prostate specific antigen (PSA) and acid phosphatase (AP) screening to detect sperm in males (36). After death, sperm appear to survive for longer; the cessation of biological processes that disperse sperm/semen from the body and the supine position of deceased persons likely contribute to the ability to detect sperm/semen for longer intervals (37, 38).

In a study of sperm persistence after consensual vaginal sex, sperm were best recovered from the posterior fornix, access to which requires speculum examination. Though present in lesser quantities, sperm were consistently found on the external genitalia as well when detected in the posterior fornix (2). Other studies have confirmed the posterior fornix as superior to external genital and cervical samples for sperm recovery, but that a combination of these sample sites yields the best results (34).

Sperm or semen from vaginal sex may drain to peri-anal and anal sites in the supine position and during genital examination care should be taken with interpretation of semen positive anal swabs. Sampling the ano-rectal area prior to internal vaginal examination is recommended for this reason. The ideal order for geni-

to-anal examination and sampling is firstly external genital, then peri-anal, anal and rectal via anoscope, followed by internal vaginal via speculum. Swabs should be labelled in the order they are taken. In the clinical setting, the full sequence of genital sampling is recommended in addition to ano-rectal swabs when only anal penetration is reported in an effort to identify semen transfer between sites; two swabs from each site is recommended (31).

Forensic sampling should be done as soon as practicable; in the clinical setting, the risk of negative genital swab results after sexual intercourse increases by approximately 3% every hour (34). International recommendations for routine sampling from the vagina and cervix vary from three to ten days post vaginal intercourse; from the mouth (including oral rinse and peri-oral swab) up to 48 hours post oral penetration; and from the ano-rectum up to 72 hours post anal penetration, dependent on laboratory resources (e.g., ability to analyse fluid samples and availability of Y-STR testing) (31, 39).

Male genital swabs, if indicated in complainants or offenders, should be taken from the penile shaft and external foreskin, if present; the coronal sulcus and internal foreskin; and the penile glans; sampling is recommended up to 72 hours post-intercourse (31).

Dry swabs can be used for sampling moist skin or mucosa and swabs moistened with sterile water for sampling dry skin; the "double-swab" technique using first a wet then a dry swab has been shown to improve retrieval of material. Rolling of the swab to ensure all parts come into contact with the skin is preferable to rubbing (40). Swabbing of skin for saliva in sites where contact with a perpetrator's mouth has occurred is worthwhile, even after showering (41). When bite marks are evident, sampling can be focused on these areas but otherwise is essentially a "blind" process. Current research in this area is exploring means of directing surface sampling (e.g., use of alternative light sources) or sampling large areas of the body (e.g., tape-lifts or vacuum devices). Foreign hairs or other material found during the course of an examination should be retrieved and labelled carefully. Due to background

DNA, fingernail scrapings or clippings are thought to be of value only when they have been in contact with body fluids (e.g., the fingers of a perpetrator after digital penetration) rather than after reported scratching (30). Consideration should be given to the potential for transfer of a range of biological material in different sexual contact scenarios (see **Table 2**).

Collection of clothing worn at the time of or since the incident, in particular underpants into which semen may have drained, should be separately bagged in paper. A recent study using alternative light source, acid phosphatase testing, and sperm microscopy demonstrated that sperm persisted on some fabric (cotton and terry towel) after six wash cycles (42).

CONCLUSION

Forensic examination in sexual assault reflects many of the core principles of forensic medicine from injury interpretation to Locard's principle. However, the interpretation of medical evidence relies upon experience and knowledge gleaned from a range of medical disciplines including sexual health, fertility medicine, dermatology, gynecology, and surgery.

Interaction between primary care clinicians, hospital professionals, and forensic pathologists within or outside the mortuary has significant potential to improve understanding of the complete spectrum of sexual assault medicine. The combined knowledge and experience of all involved in this field together with collabora-

tion to optimize the quality of patient care, medical evidentiary value, and medicolegal death investigation, has the potential to improve understanding of the forensic aspects of sexual assault to the benefit of all.

REFERENCES

- 1) Astrup BS, Ravn P, Lauritsen J, Thomsen JL. Nature, frequency and duration of genital lesions after consensual sexual intercourse—implications for legal proceedings. *Forensic Sci Int*. 2012 Jun 10; 219 (1-3):50-6. PMID: 22192579. <https://doi.org/10.1016/j.forsciint.2011.11.028>.
- 2) Astrup BS, Thomsen JL, Lauritsen J, Ravn P. Detection of spermatozoa following consensual sexual intercourse. *Forensic Sci Int*. 2012 Sep 10; 221(1-3):137-41. PMID: 22607978. <https://doi.org/10.1016/j.forsciint.2012.04.024>.
- 3) Astrup BS, Ravn P, Thomsen JL, Lauritsen J. Patterned genital injury in cases of rape—A case-control study. *J Forensic Leg Med*. 2013 Jul; 20(5):525-9. PMID: 23756527. <https://doi.org/10.1016/j.jflm.2013.03.003>.
- 4) Du Mont J, White D. The uses and impacts of medico-legal evidence in sexual assault cases: a global review [Internet]. Geneva: World Health Organisation; 2007 [cited 2018 Sep 1]. 80 p. Available from: <http://www.svri.org/sites/default/files/attachments/2016-01-19/medico.pdf>.
- 5) Alderden M, Cross TP, Vlajnic M, Siller L. Prosecutors perspectives on biological evidence and injury evidence in sexual assault cases. *J Interpers Violence*. 2018 Jun 1:886260518778259. PMID: 29862932. <https://doi.org/10.1177/0886260518778259>.
- 6) Kennedy KM. The relationship of victim injury to the progression of sexual crimes through the criminal justice system. *J Forensic Leg Med*. 2012 Aug; 19(6):309-11. PMID: 22847045. <https://doi.org/10.1016/j.jflm.2012.04.033>.
- 7) Zilkens RR, Smith DA, Kelly MC, et al. Sexual assault and general body injuries: A detailed cross-sectional Australian study of 1163 women. *Forensic Sci Int*. 2017 Oct; 279:112-20. PMID: 28863402. <https://doi.org/10.1016/j.forsciint.2017.08.001>.
- 8) Zilkens RR, Smith DA, Phillips MA, et al. Genital and anal injuries: A cross-sectional Australian study of 1266 women alleging recent sexual assault. *Forensic Sci Int*. 2017 Jun; 275:195-202. PMID: 28407560. <https://doi.org/10.1016/j.forsciint.2017.03.013>.
- 9) Gray-Eurom K, Seaberg DC, Wears RL. The prosecution of sexual assault cases: correlation with forensic evidence. *Ann Emerg Med*. 2002 Jan; 39(1):39-46. PMID: 11782729. <https://doi.org/10.1067/mem.2002.118013>.
- 10) Kelty SF, Julian R, Bruenisholz E, Wilson-Wilde L. Dismantling the justice silos: Flowcharting the role and expertise of forensic science, forensic medicine and allied health in adult sexual assault investigations. *Forensic Sci Int*. 2018 Apr; 285:21-8. PMID: 29427705. <https://doi.org/10.1016/j.forsciint.2018.01.015>.
- 11) Hook SM, Elliot DA, Harbison SA. Penetration and ejaculation; forensic aspects of rape. *N Z Med J*. 1992 Mar 11; 105(929):87-9. PMID: 1545946.
- 12) Crane J. Interpretation of non-genital injuries in sexual assault. *Best Pract Res Clin Obstet Gynaecol*. 2013 Feb; 27(1):103-11. PMID: 23200739. <https://doi.org/10.1016/j.bpobgyn.2012.08.009>.
- 13) Brew-Graves E, Morgan L. Injuries and allegations of oral rape: A retrospective review of patients presenting to a London sexual assault referral centre. *J Forensic Leg Med*. 2015 Aug; 34:155-8. PMID: 26165676. <https://doi.org/10.1016/j.jflm.2015.06.004>.

Table 2: Potential Biological Material Transfer In Different Sexual Contact Scenarios

Penile to genito-anal	Semen/sperm Epithelial cells Blood Hairs Feces Saliva, if used as lubricant
Hand/fingers to genito-anal	Epithelial cells Semen/sperm (if prior masturbation) Blood Feces Saliva, if used as lubricant
Mouth to genito-anal, breasts, other	Saliva

- 14) Fraser IS, Lähteenmäki P, Elomaa K, et al. Variations in vaginal epithelial surface appearance determined by colposcopic inspection in healthy, sexually active women. *Hum Reprod.* 1999 Aug; 14(8): 1974-8. PMID: 10438412. <https://doi.org/10.1093/humrep/14.8.1974>.
- 15) Slaughter L, Brown CR, Crowley S, Peck R. Patterns of genital injury in female sexual assault victims. *Am J Obstet Gynecol.* 1997 Mar; 176(3):609-16. PMID: 9077615. [https://doi.org/10.1016/s0002-9378\(97\)70556-8](https://doi.org/10.1016/s0002-9378(97)70556-8).
- 16) Lincoln C, Perera R, Jacobs I, Ward A. Macroscopically detected female genital injury after consensual and non-consensual vaginal penetration: a prospective comparison study. *J Forensic Leg Med.* 2013 Oct; 20(7):884-901. PMID: 24112341. <https://doi.org/10.1016/j.jflm.2013.06.025>.
- 17) McLean I, Roberts SA, White C, Paul S. Female genital injuries resulting from consensual and non-consensual vaginal intercourse. *Forensic Sci Int.* 2011 Jan 30; 204(1-3):27-33. PMID: 20570068. <https://doi.org/10.1016/j.forsciint.2010.04.049>.
- 18) Girardin BW, Faugno DK, Seneski PC, et al. Color atlas of sexual assault. St. Louis: Mosby; c1997. Figure 2-15, Fossa navicularis lacerations; p. 32.
- 19) Girardin BW, Faugno DK, Seneski PC, et al. Color atlas of sexual assault. St. Louis: Mosby; c1997. Figure 4-20, Posterior fourchette lacerations seen with separation; p. 103.
- 20) Schmidt Astrup B, Lykkebo AW. Post-coital genital injury in healthy women: a review. *Clin Anat.* 2015 Apr; 28(3):331-8. PMID: 25346095. <https://doi.org/10.1002/ca.22476>.
- 21) Faix A, Lapray JF, Caldele O, et al. Magnetic resonance imaging (MRI) of sexual intercourse: second experience in missionary position and initial experience in posterior position. *J Sex Marital Ther.* 2002; 28 Suppl 1:63-76. PMID: 11898711. <https://doi.org/10.1080/00926230252851203>.
- 22) Kotze JM, Brits H. Do we miss half of the injuries sustained during rape because we cannot see them? An overview of the use of toluidine blue tissue stain in the medical assessment of rape cases. *S Afr Fam Pract.* 2018; 60(2): 37-40. <https://doi.org/10.1080/20786190.2017.1386868>.
- 23) Joki-Erkilä M, Rainio J, Huhtala H, et al. Evaluation of anogenital injuries using white and UV-light among adult volunteers following consensual sexual intercourse. *Forensic Sci Int.* 2014 Sep; 242:293-8. PMID: 25161122. <https://doi.org/10.1016/j.forsciint.2014.06.005>.
- 24) Girardin BW, Faugno DK, Seneski PC, et al. Color atlas of sexual assault. St. Louis: Mosby; c1997. Figure 2-16, Lacerations shown in Figure 2-15 highlighted with toluidine blue dye uptake; p. 33.
- 25) Girardin BW, Faugno DK, Seneski PC, et al. Color atlas of sexual assault. St. Louis: Mosby; c1997. Figure 2-31, Peri-anal lacerations and redness; p. 42.
- 26) O'Connell H, Eizenberg N, Rahman M, Cleeve J. The anatomy of the distal vagina: towards unity. *J Sex Med.* 2008 Aug; 5(8):1883-91. PMID: 18564153. <https://doi.org/10.1111/j.1743-6109.2008.00875.x>.
- 27) Krantz KE. Innervation of the human vulva and vagina: a microscopic study. *Obstet Gynecol.* 1958 Oct; 12(4):382-96. PMID: 13590651.
- 28) Larkin HJ, Cosby CD, Kelly D, Paolinetti LA. A pilot study to test the differential validity of a genital injury severity scale, in development for use in forensic sexual assault examinations. *J Forensic Nurs.* 2012 Mar; 8(1):30-8. PMID: 22372396. <https://doi.org/10.1111/j.1939-3938.2011.01124.x>.
- 29) Report: inquiry into the circumstances that led to the conviction of Mr. Farah Abdulkadir Jama [Internet]. Melbourne: Victorian Government Printer; 2010 [cited 2018 Sep 1]. 81 p. Available from: <https://www.parliament.vic.gov.au/papers/govpub/VPARL2006-10No301.pdf>.
- 30) Meakin G, Jamieson A. DNA transfer: review and implications for casework. *Forensic Sci Int Genet.* 2013 Jul; 7(4):434-43. PMID: 23623709. <https://doi.org/10.1016/j.fsigen.2013.03.013>.
- 31) Recommendations for the collection of forensic specimens from complainants and suspects. London: Faculty of Forensic and Legal Medicine of the Royal College of Physicians; 2018 Jan [cited 2018 Sep 1]. 7 p. Available from: <https://fflm.ac.uk/wp-content/uploads/2018/01/Recommendations-for-the-collection-of-forensic-specimens-from-complainants-and-suspects-FSSC-Jan-2018.pdf>.
- 32) Casey DG, Domijan K, MacNeill S, et al. The persistence of sperm and the development of time since intercourse (TSI) guidelines in sexual assault cases at Forensic Science Ireland, Dublin, Ireland. *J Forensic Sci.* 2017 May; 62(3):585-92. PMID: 28008604. <https://doi.org/10.1111/1556-4029.13325>.
- 33) Morrison AI. Persistence of spermatozoa in the vagina and cervix. *Br J Vener Dis.* 1972 Apr; 48(2):141-3. PMID: 5032772. PMID: PMC1048291. <https://doi.org/10.1136/sti.48.2.141>.
- 34) Joki-Erkilä M, Tuomisto S, Seppänen M, et al. Clinical forensic sample collection techniques following consensual intercourse in volunteers – cervical canal brush compared to conventional swabs. *J Forensic Leg Med.* 2014 Oct; 27:50-4. PMID: 25287800. <https://doi.org/10.1016/j.jflm.2014.08.007>.
- 35) Suttipapit P, Wongwittayapanich S. Detection of prostate specific antigen and semenogelin in specimens from female rape victims. *J Forensic Leg Med.* 2018 Feb; 54:102-8. PMID: 29413950. <https://doi.org/10.1016/j.jflm.2017.12.017>.
- 36) Weitzig L, Schroeder AS, Augustin C, et al. Diagnostic value of PSA and AP tests for the detection of spermatozoa in postmortem swabs from the genital and anal region in males. *J Forensic Sci.* 2015 Jan; 60(1):41-4. PMID: 25387394. <https://doi.org/10.1111/1556-4029.12632>.
- 37) Nittis M, Franco M, Cochrane C. New oral cut-off time limits in NSW. *J Forensic Leg Med.* 2016 Nov; 44:92-7. PMID: 27697690. <https://doi.org/10.1016/j.jflm.2016.09.006>.
- 38) Collins KA, Bennett AT. Persistence of spermatozoa and prostatic acid phosphatase in specimens from deceased individuals during varied postmortem intervals. *Am J Forensic Med Pathol.* 2001 Sep; 22(3):228-32. PMID: 11563728. <https://doi.org/10.1097/00000433-200109000-00004>.
- 39) Hanson E, Ballantyne J. A Y-short tandem repeat specific DNA enhancement strategy to aid the analysis of late reported (≥ 6 days) sexual assault cases. *Med Sci Law.* 2014 Oct; 54(4):209-18. PMID: 24526669. <https://doi.org/10.1177/0025802413519761>.
- 40) Sweet D, Lorente M, Lorente JA, et al. An improved method to recover saliva from human skin: the double swab technique. *J Forensic Sci.* 1997 Mar; 42(2):320-2. PMID: 9068193. <https://doi.org/10.1520/jfs14120j>.
- 41) Williams S, Panacek E, Green W, et al. Recovery of DNA from the skin after showering. *Forensic Sci Med Pathol.* 2015 Mar; 11(1):29-34. PMID: 25534825. <https://doi.org/10.1007/s12024-014-9635-7>.
- 42) Nolan A, Speers SJ, Murakami J, Chapman B. A pilot study: The effects of repeat washing and fabric type on the detection of seminal fluid and spermatozoa. *Forensic Sci Int.* 2018 Aug; 289:51-6. PMID: 29857287. <https://doi.org/10.1016/j.forsciint.2018.05.021>.