Journal of the Academy of Forensic Nursing

Original Research

Comparison of Areas in the Mouth to Recover DNA Introduced Through Kissing

Joyce P. Williams, DNP, MFSA, FAAN[1]

David A. Williams, DDS, MS, MPH[1]

Received: May 12, 2025 Accepted: July 16, 2025

Corresponding author: Joyce P. Williams
10809 Stansfield Rd., Randallstown, MD 21133
Phone: (301) 992-2742
Email: JoyceWilliamsDNP@gmail.com

Affiliations: 1 - Independent Researcher, Randallstown, MD

Abstract

Sexual assault is a significant crime defined in the FBI's Uniform Crime Report as "the penetration, no matter how slight, of the vagina or anus with any body part or object, or oral penetration by a sex organ of another person, without the consent of the victim." From January 2019 to December 2024, there were 537,446 reported rape victims in the United States. Oral-genital contact occurred between 18 and 25 percent of sexual assault cases. Following a sexual assault, many victims report to a healthcare facility for a comprehensive medical evaluation including evidence collection. Obtaining DNA evidence during this exam helps establish suspected sexual contact with the victim. Case prosecution with analyzed forensic evidence (including DNA) is known to increase conviction rates; the number of cases resulting in a conviction or guilty plea improve from about 14% without DNA evidence to 75% with DNA evidence. Lacking a match results in fewer convictions or plea deals. Unless there is a scientific basis for the evidence to be admitted in court under the *Daubert* Rule and other judicial rulings, evidence that links a perpetrator to a victim may be excluded. No scientifically based protocol exists for effective collection of suspect DNA from around and in the oral cavity of a victim. The purpose of this study is to provide empirically based evidence to determine sensitive and probable areas to swab in the perioral area and within the oral cavity.

Keywords: DNA recovery, oral swabs, sexual assault, oral sex

Comparison of Areas in the Mouth to Recover DNA Introduced Through Kissing

Science has developed over the millennia. Medicine has moved from the miasma theory to the germ theory, patients are no longer bled of "ill humors" to improve health, and oxygen has been embraced over the mystical phlogiston. Forensic science has advanced over the years as well, moving from the shibboleths of the past when exposed to scientific rigor to procedures that are statistically significant, reproducible with an error rate, and to advance knowledge. Nursing is a part of that progression.

Forensic nursing science, the backbone of patient-centered care for trauma victims, has evolved as well. The mainstay of sexual assault evidence collection, the so-called "rape kit" has only been advocated since the 1970s (Fahrney, 1975) and the policies and procedures for conducting the examination of a victim have progressed as well. Practice has moved away from procedures that may inadvertently cause harm to the patient, may be irrelevant and not scientific, and have results that are not reproducible in other settings. The practice of pulling pubic hair from a victim for analysis has been largely discouraged (Campbell & Raja, 1999) because it not only is uncomfortable for the patient, but it also produces no usable forensic evidence and in modern times is immaterial as many victims present with total depilation.

It is in this environment that forensic nursing science must continue to advance to provide better care to patients who are victimized. The aim of this research is to improve the overall medical care and evidence collection in order to bring justice to victims of violence. The Sexual Assault Forensic Evidence Reporting Act of 2013 proposed the development of best practices and protocols for the collection and processing of DNA evidence in sexual assault cases (The Sexual Assault Forensic Evidence Reporting Act of 2013 (SAFER Act), P.L. 113-4, § 1002, (o). Forensic nurses complete a comprehensive medical evaluation and part of that examination is the identification of biological evidence. One such area examined is the lips and surrounding oral region where a perpetrator may deposit biological evidence. The DNA collected can link the perpetrator to the victim.

Every 68 seconds a person in the United States is sexually assaulted (Rape, Abuse & Incest National Network [RAINN], 2025). Violence-related injuries by intentional means are ones that are purposely inflicted and may include interpersonal violence, sexual assault, aggravated assault, homicide, and suicide. Prosecution of these crimes dropped from 40% to 26% between 2013 and 2022 according to the Federal Bureau of Investigation (FBI) (Gramlich, 2024). Sexual assault is a significant crime defined in the FBI's Uniform Crime Report as "the penetration, no matter how slight, of the vagina or anus with any body part or object, or oral penetration by a sex organ of another person, without the consent of the victim" (Federal Bureau of Investigation [FBI], 2017). It was not until 2013 that the definition of rape was changed, removing "forcible" from the offense name (FBI, 2025). Matching biological DNA evidence between a suspect and a victim improves the odds of a conviction.

In 1931 the National Commission on Law Observance and Enforcement, the first national commission to study crime in the United States, recommended greater use of science when

investigating and prosecuting crimes (Office of Justice Programs [OJP], 1931). The 2009 National Research Council Report, *Strengthening Forensic Science: A Path Forward*, emphasized the need for enforceable standards and promotion of best practices. This document provides a comprehensive examination of the necessity for systemic advancements including education applicable to law enforcement, criminal prosecutors and attorneys, and forensic science educators (National Research Council, 2009).

The collective work of many scientists led to the development and application of scientific methods in criminal investigations. One notable contributor to the discipline of forensic science is August Vollmer, known as the father of American policing; he was instrumental in the advancement of technology, training, and increasing knowledge of police (Kell, 2017). Later in the 1960s, there was an additional call for police to place greater reliance on physical evidence from the Presidential Crime Commission and the Supreme Court (Johnson et al., 2012).

Criminalists concentrate on forensic analysis and the processing of evidence by incorporating the scientific method during investigations. Forensic science has improved the search for potential traces left behind following an assault. DNA analysis has become a powerful tool advancing the ability to identify a suspect. According to researchers at the National Institute of Justice, DNA evidence increased conviction rates; "75% of case profile matches resulted in a guilty plea or trial" (Forrest, 2022), while less than one-third of cases without a DNA report—or about 14% of cases without a match—results in convictions or plea deals (Cross & Alderden, 2018; Cross et al., 2022) demonstrating that evidence matters and facilitates outcomes for justice. Physical evidence collection is not only part of law enforcement training but has become essential in clinical forensic nursing education and practice when examining victims of assault.

The evolution and acceptance of scientific and technical testimony in court began in 1923 with the Frye Standard that allowed expert testimony to be admitted if the scientific methods used by the expert were "generally accepted". This standard remains as the benchmark for many state courts. This was followed by the Supreme Court findings in the 1992 case of *Daubert v. Merrell Dow* where it codified the judge as the gatekeeper of evidence and that scientific techniques must have been tested, have been subject to peer review, have a known potential error rate, follow standards for the technique, and that the method is widely accepted in the scientific community. In 1997 *General Electric Co. v. Joiner* clarified the *Daubert* test in two important respects, saying the courts could evaluate the reliability of the reasoning of an expert as well as the process the expert used to develop an opinion. Further legal determinations led to *Kumho Tire Co. v. Carmichael,* extending *Daubert* requirements to include technical as well as scientific testimony. Lastly, Federal Rule of Evidence (FRE) 702 stipulates that the testimony not only be relevant but also reliable (Jordan, 2024). These last three cases and FRE 702 provide the support for scientific and technical testimony in federal courts (Bernstein & Jackson, 2004).

In addition to changes in the codified law, there has been a shift in the general public's understanding of the use of science within the judicial system, particularly in the realm of DNA collection and analysis. The so-called "*CSI* effect" has provided the general public—and, with that, potential jurors—with an often-unreasonable expectation as to the abilities of crime scene investigators to develop scientific evidence (Cole & Dioso-Villa, 2009).

According to FBI Crime Data Explorer, in the five years from January 2019 to December 2024, there were 537,446 reported rape victims in the United States. In the reported cases, 85.7% of the offenders were male, while 89.5 % of the victims were female (FBI, 2025). In sexual assault cases, as in every crime scene, the victim and his/her environment interact, transferring

evidence between them (Magalhães et al., 2015). With the increase in sensitivity of DNA analysis, identifications have increased over time, are more discriminating, and have become a critical component of crime investigation (Bond & Hammond, 2008). Sexual assaults against women involving forced oral copulation can range from 20 to 29 percent of all sexual assaults. (Marlia, 2011; Sibille et al., 2002) and Brew-Graves & Morgan found that in 12% of reported cases that oral rape was the only offence *[sic]* (Brew-Graves & Morgan, 2015). DNA match to a suspect with a victim is central for improved prosecutorial outcomes and more likely to advance in the criminal justice system ending in conviction (Cross et al., 2022).

Beginning in 1990, short tandem repeats (STRs) have been utilized in forensic investigations to link a person to a crime. Useful in male on female sexual assault casework, minute material left by a male can be analyzed by Y-STR analysis which concentrates on the "Y" male chromosome (Rower, 2019). Studies have shown the value of Y-STR analysis in the case of digital or penile penetration without the presence of semen (Owers et al., 2018; Sween et al., 2015). In an Office of Justice Programs (OJP, 1931) study, cases that present with forensic evidence analyzed in the laboratory are twice as likely to lead to a conviction and 10 times more likely to result in a conviction than those cases without evidence (Peterson & Sommers, 2010).

Identifying the gaps

Federal Rules of Evidence 402 provides that evidence is admissible unless it is specifically prohibited or is not relevant. Rule 403 states that the court may exclude relevant evidence if its probative value is substantially outweighed by a danger of being unfairly prejudiced, confusing, misleading, causes undue delay, is wasting time, or is cumulative evidence. Rule 702 covers a witness who is qualified as an expert by knowledge, skill, experience, training, or other education and may testify in the form of an opinion (Jordan, 2024).

DNA evidence is known to increase conviction rates in court, but without a scientific basis for the evidence to be admitted under the *Daubert* Rule and Federal Rules of Evidence, evidence that links a perpetrator to a victim may be excluded. Victims subjected to oral rape may have foreign DNA deposited in the mouth but currently there is no scientific evidence-based protocol for the effective collection of a suspect's DNA from the oral cavity (Marlia, 2011) whether by a forensic practitioner, other medical provider, or law enforcement. This study addresses the gap in forensic nursing evidence collection from the mouth and lips. Currently the only oral swabbing of the mouth is to establish a known reference sample which is collected from the victim or suspect to compare with evidence found at the scene or on the victim's body.

Evidence collection rules may vary among jurisdictions. The following are current examples of protocols for obtaining potential evidence that when analyzed fails to provide specific locations whereby a more robust DNA sample may be obtained.

1. Procedure for oral swabbing provided by the International Association of Forensic Nurses (International Association of Forensic Nurses [IAFN], 2024):
    a. Oral evidence collection (for oral penetration)—Rub around gum line and buccal area with two cotton swabs held together. Prepare smear slide, air dry, label and seal in holder. Dry swabs utilizing a swab dryer. Place in envelope, seal, and label. Patients should rinse the mouth after this step and wait 15 minutes prior to buccal swabs for controls.

2. Guidance is provided on the collection of oral samples in the National Best Practices for Sexual Assault Kit (Department of Justice [DOJ], 2016):
    a. Oral cavity—Use two dry swabs to swab/rub over the oral cavity (e.g., around teeth, cheeks, and gums). Dentures and body jewelry from the mouth and lips of the victim can be removed and swabbed if they can't or won't be collected.
3. 3rd Edition of the National Protocol for Sexual Assault Medical Forensic Examinations (U.S. Department of Justice Office on Violence Against Women, 2024) in the form of:
    a. Oral sample
        i. Use two dry swabs to swab/rub over the oral cavity (e.g., around teeth, cheeks, and gums)
        ii. Dentures and body jewelry from the mouth and lips of the patient can be removed and swabbed if they are not collected
        iii. Dry swabs
        iv. Package swabs, place in envelope, label, seal, and initial the seal
        v. Dental floss is not recommended secondary to concerns about infection risk for patients
4. Royal College of Pathologists of Australia (Royal College of Pathologists Australia, 2022) recommends:
    a. A swab is used to sample the upper and lower mouth, around the teeth and gingival recesses, under the tongue, and back of the throat. Some services will use a single swab to sample both the upper mouth and the lower mouth. Other services may use two swabs: one for the upper and one for the lower mouth.
5. National Best Practices for Sexual Assault Kits: A Multidisciplinary Approach (National Institute of Justice [NIJ], 2017):
    a. Use two dry swabs to swab/rub over the oral cavity (e.g., around teeth, cheeks, and gums). Dentures and body jewelry from the mouth and lips of the victim can be removed and swabbed if they can't or won't be collected.

Literature review

There is a dearth of recommendations regarding specific perioral areas and inside the mouth that may yield a greater amount of perpetrator's DNA than others. The research team concentrated on relevant literature that scrutinized DNA recovery within and around the oral region and determined that studies by Banaschak et al. (1998) and Kamodyova et al. (2013) could be modified to suit the focus of our study. An analysis of each research study provided the following information. The concentration of Banaschak's study was to determine if there was a difference in DNA recovery using cotton wool swabs, filter paper, and liquid saliva following intense kissing. This provided the research team with a method in which DNA could be transferred from male to female subjects. Kamodyova and colleagues focused on the time that DNA was measured by Y-STR analysis following consenting couples kissing intimately.

However, none of the research concentrated in the areas to be swabbed; therefore the researchers concluded that this was a gap in knowledge that should be investigated.

The objective of this research study was to determine if there are perioral areas or locations within the mouth that may yield a greater amount of DNA information specifically the presence of male DNA. The outcome would support improvements in evidence collection to target the recovery of DNA. This would provide the forensic nurse with the potential to concentrate on areas which may be more abundant in obtaining the perpetrator's DNA, thus saving the time of the forensic nurse as well as laboratory costs and efforts. These efforts would improve the procedure for forensic practitioners and also provide a better opportunity to link a suspect with a victim, and advancement of policies and procedures specific to sample collection.

Intimate kissing was selected as the method of DNA transfer for the project based on the literature available. This included using Y-STR analysis to identify the more robust areas for sampling. Utilizing kissing as a means of biological transfer contributed to the convenience in recruiting volunteers as well as potentially foregoing issues with an Institutional Review Board (IRB) at a previously religious university.

Design and Methods

A quantitative method design consisting of a convenience sample for the population was used. Sample size was calculated using the techniques of Pourhoseinghoi and colleagues (2013) and it was determined that the proposed sample of 20 couples was adequate to provide potentially statistically significant results. After a full IRB review and approval, subjects were recruited through flyers, personal contacts, and electronic media at a local university and followed a strict protocol for eligibility. This included the following exclusion/inclusion criteria:

Exclusion Criteria:

1. Chronic medical issues: Diabetes Mellitus, Hypertension, Immunocompromised
2. Fewer than three or more teeth within 2 mm of each other in four quadrants
3. Inability to read/understand English
4. Allergy to materials used
5. Inability to complete the study
6. Pregnancy
7. Observable intra-oral or peri-oral pathology
8. Under the age of 18

Inclusion Criteria:

1. Male/female consenting couple
2. Age 18 years or older
3. Able to give consent to participate in the study
4. Complete both medical history and informed consent forms
5. Have a screening examination of each of their mouths prior to commencement of clinical portion of study

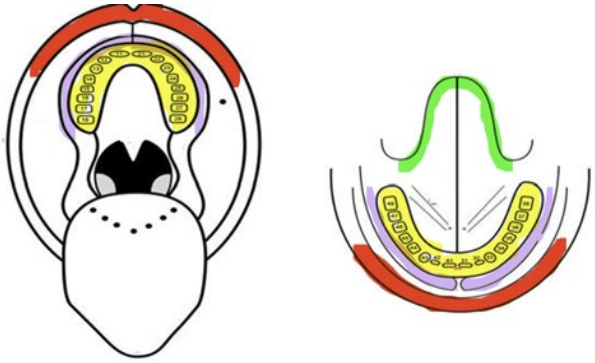
Figure 1 shows the five areas selected to collect the samples from females. The researchers chose areas that they postulated could provide the greatest DNA harvest, due to proximity of the male skin and saliva (wet/dry lips) as well as areas that present the most likely areas to trap saliva (internal and external surfaces of the teeth) and where saliva typically pools within the mouth (posterior ventral border of tongue and buccal vestibule).

- Wet perioral area (lips wet)
- Dry perioral area (lips dry)
- Internal and external (buccal and lingual) surfaces of the teeth (I/O teeth)
- Post ventral border of the tongue (LB tongue)
- Buccal vestibule (vestibule)

Once the participants met the inclusion criteria, each participant and specific sample area was assigned a random number using a random number generator to decrease bias in the analysis (Urbaniak, 2025).

Figure 1.

Anatomy of the Mouth



Red – lip area, Yellow – buccal and lingual surfaces of teeth, Green – Posterior ventral border of tongue, Violet – buccal vestibule. Tareck A. (2024).

Clinical procedure

Participants began the process by signing the consent form, completing the medical history and HIPAA forms, and were assessed regarding the inclusion/exclusion criteria. The dental professional reviewed the completed forms, verified that the participants met the inclusion criteria, and conducted a screening exam of the perioral area and mouth to rule out the presence of visible oral pathology of both individuals of the couple.

The participants went to a separate, private room where they were instructed to "intimately kiss" for a period of five minutes to maximize DNA transfer from the male to the female. Since the participants were college students, they were advised of the type and depth of kissing that could be performed. Language for the instructions included terms that young adult individuals would understand. An example of that language is regarding intimate kissing: It was stated that to "French kiss—you may massage the tongues together, exploring the inside of each other's mouth."

Subsequent to kissing, one investigator immediately swabbed the female partner's mouth in five areas: around the lips with wet and dry swabs, inside and outside the upper and lower teeth, the back and side of the tongue and between the cheeks and gums on the upper and lower portions of the mouth. Swabs were assigned random numbers to decrease potential bias (Urbaniak, 2025). The examiner followed recommended Centers for Disease Control (CDC) infection control guidelines (CDC, 2025) throughout the clinical procedures. After the conclusion of the clinical portion of the study, the swabs were labeled and packaged according to the laboratory instructions, using the assigned unique identifier, and sent by FedEx to the laboratory for processing. The AmpFLSTR Yfiler PCR Amplification Kit (Life Technologies Corporation, a Thermo Fisher Scientific company) was used in the processing of the samples. PCR analysis was completed using the manufacturer's suggested 30-cycle procedure (Thermo Fisher Scientific, 2025). Raw results were returned to the investigators for analysis. The following analyses were employed to assess the results among the sites where the DNA was swabbed using the corresponding number of alleles per swabbed area as well as the Mann-Whitney (Socscistatistics, 2025) and ANOVA calculations (Statskingdom, 2025).

Results

DNA Recovery by Subject and Area are presented in Table 1. Each subject is listed with the corresponding number of alleles per swabbed area. Of the 320 possible alleles from 100 possible sites, only 225 alleles were captured from 25 sites, with lips wet and lips dry having both the largest number of alleles and sites.

Table 1.

DNA Recovery by Subject and Area

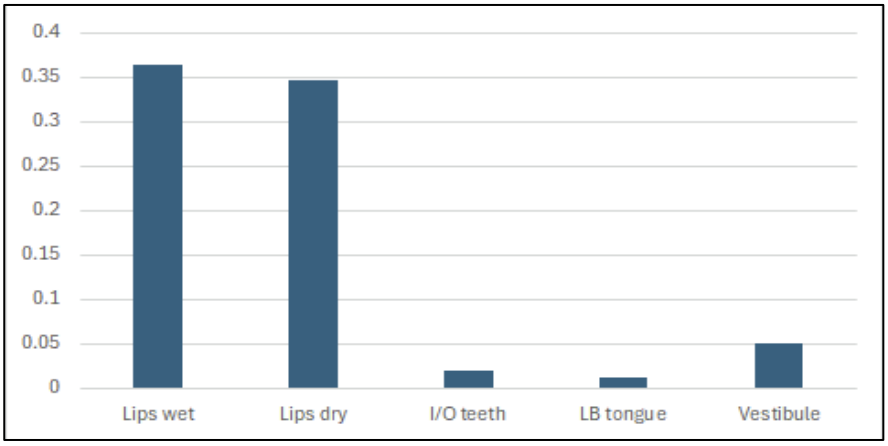
Set	Lips wet	Lips dry	I/O teeth	LB tongue	Vestibule
Set 1					
Set 2					
Set 3	16				
Set 4				2	
Set 5	16	16	1		
Set 6		16			
Set 7		16			
Set 8	16				
Set 9	16	16		1	
Set 10	4		2		
Set 11					

Set	Lips wet	Lips dry	I/O teeth	LB tongue	Vestibule
Set 12		15			
Set 13		16			
Set 14		16			
Set 15	16		1		
Set 16					
Set 17	15				16
Set 18	16		2		
Set 19	2		1		

Figure 2 specifies the percent of alleles collected per area. The calculations demonstrate that the lips, both wet and dry, have a collection rate of over 35% while the other three areas are below 5%. This clearly shows that the area of the lips, both wet and dry, provide a much more robust collection of donor DNA.

Figure 2.

Percent of Alleles Collected Per Area



The Mann-Whitney U Test was used to determine the statistical significance at the 0.05 level. This non-parametric test was used because researchers did not assume that the data had a normal distribution (Table 2). This further identifies the lips wet area is not significantly different from lips dry, but they are significantly greater than the inner/outer areas of the teeth. Using the 0.05 for statistical significance, there was insufficient data either from the lateral border of the tongue or the vestibule for analysis.

Table 2.

Mann-Whitney U TEST

Mann- Whitney U test	**.05 significance on 2 tails**
Lips	
Lips wet/dry lips	The U-value is 24.5. The critical value of U at p < .05 is 15. Therefore, the result is not significant at p < .05. The z-score is -0.68803. The p-value is .2451. The result is not significant at p < .05.
Lips wet/IO teeth	The U-value is 1. The critical value of U at p < .05 is 7. Therefore, the result is significant at p < .05. The z-score is 2.8. The p-value is .00512. The result is significant at p < .05.
Lips wet/LB tongue	Insufficient data points to determine significance
Lips wet/Vestibule	Insufficient data points to determine significance
Lips Dry	
Lips dry lips/lips wet	The U-value is 24.5. The critical value of U at p < .05 is 12. Therefore, the result is not significant at p < .05 The z-score is -0.68803. The p-value is .4902. The result is not significant at p < .05.
Lips dry/IO teeth	The U-value is 0. The critical value of U at p < .05 is 5. Therefore, the result is significant at p < .05. The z-score is 2.76079. The p-value is .00578. The result is significant at p < .05.
Lips dry/LB tongue	Insufficient data points to determine significance
Lips dry/vestibule	Insufficient data points to determine significance
I/O Teeth	
I/O teeth/lips wet	The U-value is 1. The critical value of U at p < .05 is 7. Therefore, the result is significant at p < .05.
I/O teeth/lips dry	The z-score is 2.8. The p-value is .00512. The result is significant at p < .05.
I/O teeth/LB tongue	Insufficient data points to determine significance
I/O teeth/vestibule	Insufficient data points to determine significance
LB Tongue	
LB tongue/lips wet	Insufficient data points to determine significance
LB tongue/lips dry	Insufficient data points to determine significance
LB tongue/I/O teeth	Insufficient data points to determine significance
LB tongue/vestibule	Insufficient data points to determine significance

Mann- Whitney U test	**.05 significance on 2 tails**
Vestibule	
Vestibule/lips wet	Insufficient data points to determine significance
Vestibule/lips dry	Insufficient data points to determine significance
Vestibule/I/O teeth	Insufficient data points to determine significance
Vestibule/LB tongue	Insufficient data points to determine significance

Table 3a.

ANOVA Calculations

Groups:	Lips wet	Lips dry	I/O teeth	LB tongue
Data:	16 16 16 16 4 16 15 16 2	16 16 16 16 15 16 16	1 2 1 2 1	2 1
Skewness:	-1.639424	-2.645751	0.608581	1.732051
Excess kurtosis:	0.932544	7	-3.333333	NaN
Normality	0.0004071	0.0002153	0.01875	0.1305
Outliers	2, 4	15		
Mean	13	15.85714	1.4	1.33333
S	5.70088	0.37796	0.54772	0.57735

ANOVA was also used at the 0.05 level to determine and verify the differences among the areas tested (Table 3a and 3b). This provides us with further significance of the lips wet and lips dry over the other sites that were studied with the Tukey HSD/Tukey Kramer analysis, shown in Table 4, providing further support for the superiority of collecting samples from the lips over other areas. Table 5, the comparison of the difference to the critical means, conveys that the difference between lips wet and lips dry falls below the critical value, but both lips wet, and lips dry exceed the critical value for inner/outer teeth and the vestibule.

Table 3b.

ANOVA Results

Source	DF	Sum of Square	Mean Square	F Statistic	p-value
Groups (between groups)	3	916.2346	305.4115	23.2496	9.978-7
Error (within groups)	20	262.7238	13.1362		
Total	23	1178.9584	51.2491		

One Way ANOVA test, using F distribution df(3,20) (right tailed)

1. H_0 hypothesis

Since p-value<α, H_0 is rejected.

Some of the groups' averages consider to be not equal.

In other words, the difference between the sample averages of some groups is big enough to be statistically significant.

2. P-value

p-value equals **9.97794e-7**, [p(x ≤ F) = 0.999999]. It means that the chance of type1 error (rejecting a correct H_0) is small: 9.978e-7 (0.0001%)

The smaller the p-value the stronger it support H_1

3. The statistics

The test statistic F equals **23.249627**, which is not in the 95% region of acceptance: [0 : 3.0984]

4. Effect size

The observed effect size f is **large** (1.87). That indicates that the magnitude of the difference between the averages is large.

The η^2 equals 0.78. It means that the **group** explains 77.7% of the variance from the average (similar to R^2 in the linear regression)

5. Tukey HSD / Tukey Kramer

The means of the following pairs are significantly different: **x1-x3, x1-x4, x2-x3, x2-x4**.

Table 4.

Tuley HSD/Tukey Kramer

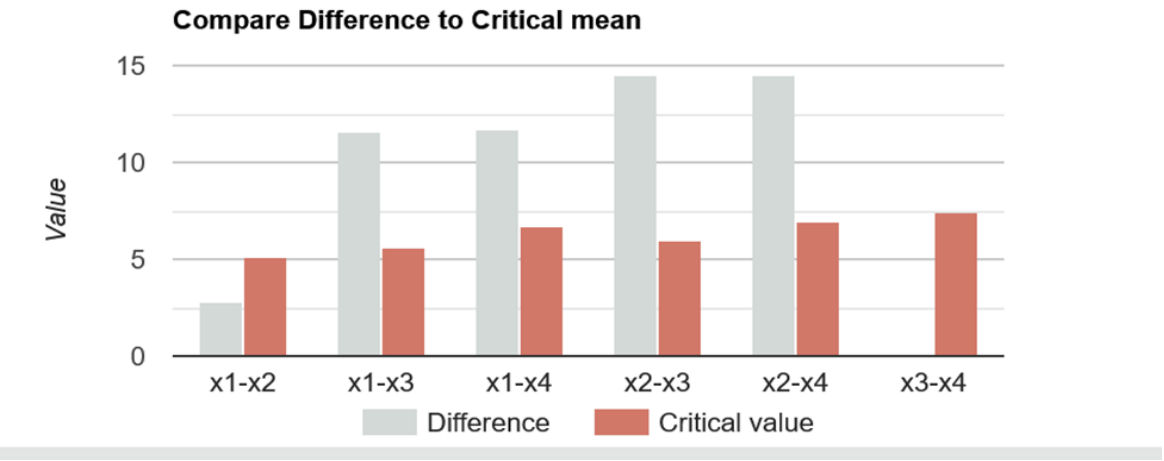
Tukey HSD / Tukey Kramer

Pair	Difference	SE	Q	Lower CI	Upper CI	Critical Mean	p-value
x1-x2	2.8571	1.2915	2.2122	-2.2552	7.9695	5.1123	0.4203
x1-x3	11.6	1.4295	8.1149	5.9417	17.2583	5.6583	0.00007112
x1-x4	11.6667	1.7086	6.8284	4.9037	18.4296	6.763	0.0005471
x2-x3	14.4571	1.5006	9.634	8.5172	20.3971	5.94	0.000007116
x2-x4	14.5238	1.7685	8.2124	7.5235	21.5241	7.0003	0.00006111
x3-x4	0.06667	1.8716	0.03562	-7.3418	7.4751	7.4084	1

Group	x2	x3	x4
x1	2.86	11.6	11.67
x2	0	14.46	14.52
x3	14.46	0	0.067

Table 5.

Comparison of the Differences to the Critical Means



Discussion

A comprehensive medical-forensic exam should be performed by a forensic health care professional specifically educated in scientific principles who is also trained in the collection of evidence relating to sexual assault cases (a sexual assault nurse examiner, physician, or physician's assistant) (NIJ, 2017). In cases of oral sexual assault, perpetrator DNA may be left on the victim in the form of ejaculate or sloughing of epithelium cells. Since the vast majority of offenders are male (85.7%) and the vast majority of victims are female (89.5%) (FBI, 2025) the use of Y-STR analysis of the resulting admixture would yield results in over 76% of cases. The ability to obtain a DNA match is a critical part of trial preparation (Cross et al., 2022).

Considering the vast array of research on sexual assault cases, a review of the literature revealed a surprising amount of detail regarding recovery of evidence from the genital area but nearly no detail regarding recovery in the perioral area and mouth. The study, designed as a modification of two previous studies by Banaschak et al. (1998) and Kamodyova et al. (2013), substituted consenting couples deep kissing for actual victim/offender contact. For practical reasons, ease of recruiting subjects, ease of obtaining IRB approval, and to add fidelity with previous studies, we substituted oral-to-oral for penile-oral contact. Other studies (Marlia, 2011) used actual fellatio. A convenience sample that had the potential to yield statistically significant results was employed. A certified laboratory that performed second-generation Y-STR was used; later generations may yield more robust results but that does not preclude the potential for laboratory errors.

The researchers selected areas that they postulated could provide the greatest DNA harvest, due to proximity of the male skin and saliva (wet/dry lips) as well as areas that present the most likely areas to trap saliva (internal and external surfaces of the teeth) and where saliva typically pools within the mouth (posterior ventral border of tongue and buccal vestibule).

During the pilot study performed by the research team, a number of issues were identified. First was that swabbing of the oro-pharynx was included in the pilot, since it was an area hypothesized to be in the general area of an ejaculation as well as having an undulating surface that could harbor DNA for a longer period of time. This area was rejected in the current study because there was no ejaculate, and the swabbing of the area was particularly uncomfortable for

the subject. A second and potentially more important change was the previous investigator did not swab vigorously or for a more sustained period and therefore there was no DNA recovered from any of the swabs as in the current study. The importance of firm pressure while swabbing and rotation of the swab cannot be overstated. In this study, the swabs were pressed aggressively against the tissues and rotated, which may have improved transfer. Lastly, there was difficulty in recruiting subjects in the pilot, since there was no external incentive. This was rectified by providing gift cards to each participant. With the incentive, we were able to recruit enough participants to meet the calculated minimum requirements for statistical analysis (Williams & Williams, 2019).

In the current study, samples were taken from the female immediately following the DNA transfer with no intention of determining the length of time the DNA may remain in the areas of study. Using the technique established by Sweet & Shutler (1999) it was demonstrated that the swabbing of the lips, either using dry or wet technique, was statistically more significant in areas yielding greater male DNA than the surfaces of the teeth (internal and external) posterior of the ventral surface of the tongue or the buccal vestibule. This correlates strongly with the postulated hypothesis that during deep kissing, the lip-to-lip contact with the sloughing of epithelial cells and saliva yields greater ability to the transfer DNA from epithelial cells and saliva. In actual cases involving fellatio, the penis could penetrate the oral cavity at a greater depth than the male tongue. For this reason, the study may or may not simulate actual fellatio. This research adds incentive to future expansion to recover DNA within the lips and oral regions.

The data from this study show that the lips, when either wet or dry swabbed, produce statistically significantly more DNA than any of the other areas of the mouth and perioral areas. There were not enough entries for the tongue and vestibule to calculate critical values.

Of particular interest, subject 17 yielded 15 alleles for “lips wet” and 16 for “vestibule” which was the only capture of DNA material for the vestibule. This high rate could be due to an increased harvest in this area, or it could be the result of an undetected misidentification of the area during the analysis. It is possible that the “lips dry” was misidentified as the “vestibule”, but that would have happened at the time of swabbing or perhaps at the laboratory. In any case, this outlier would not have changed the overall conclusion.

Summary and Interpretation

This study demonstrates that there are differences among areas that are swabbed for DNA following kissing, simulating sexual assault oral penetration, and these differences should inform clinical practice and procedures. Past research has noted that “matching DNA evidence was related to case progression and directly influences a) the prosecutor’s decision to carry the case forward and not dismiss it, b) the suspect’s decision to plead guilty versus seek an acquittal at trial, and/or c) the jury’s verdict if the case went to trial” (Cross et al., 2022, p.3926).

This study provides the framework for future studies and a basis for the collection of DNA in the clinical setting. Simple battery with non-consensual lip to lip contact, which may not qualify as sexual assault, may still be investigated and DNA recovered from both the assailant and the victim, which could corroborate a history.

There were limitations in the study, including whether kissing is an adequate substitute for actual fellatio. The focus for locations became the perioral region and within the mouth where biological samples could be recovered and whether there were differences in yield.

Future studies could use actual fellatio instead of kissing, review time from deposition to collection to see if there is a reasonable amount of time to pursue collection, what behaviors, such as tooth brushing, oral rinse, or eating may influence the recovery of DNA materials available for collection, and fellatio with and without ejaculation. Of particular importance is time from deposition of materials to collection. A study by McCall-Hosenfeld (McCall-Hosenfeld, 2009) found that the median time to presentation was 16 hours; 95% presented within 72 hours. Marlia (2011) concluded that DNA is recoverable at a 24-hour period following eating, drinking, brushing of teeth, and rinsing or gargling. And Fonneløp and colleagues found that epithelial cells could be observed up to 43 h after deposition. A high success rate was observed from penile swabs collected within 24 h of the incidence demonstrating the importance of collecting and analyzing such samples in cases where no semen is detected (Fonneløp et al., 2019).

Speck (2015) determined that DNA could be recovered from the cervix and posterior fornix at a rate of 60% 9 days following intercourse. Understanding the differences in the oral cavity and the female genitalia, it begs the question, what is the length of time after which oral swabbing would be unlikely to produce results.

These questions have not been researched thoroughly and in the place of scientific decisions, jurisdictions currently have arbitrary cut-off times for attempting to recover trace following oral sexual assault (Nittis, 2016). These arbitrary limits may negatively impact the identification, prosecution, and conviction of a perpetrator. Additional queries to advance the research are expanding the sample population; advancements in DNA analysis; increasing the contact time between couples and/or varying post contact intervals; examining additional oral locations; and what victim confounders interfere with DNA recovery.

Implications for Practice

Forensic nursing knowledge is advancing with the help of improved scientific techniques. Biological evidence analysis obtained by licensed medical forensic practitioners provides the opportunity to improve judicial outcomes (Alderden et al., 2018). This research study successfully showed DNA profiles from foreign subjects using enhanced Y-STR methods.

Providing quality comprehensive forensic medical examination cannot be underestimated and is essential to obtain biological traces that can establish the relationship between a suspect and a victim. Practitioners must understand the predominant areas to swab for DNA material post sexual assault as well as time limitations for survival of DNA evidence and adjust clinical practice as scientific knowledge advances.

The results of oral DNA analysis from a victim and connecting it to a suspect provides prosecutors confirmatory evidence to use during prosecution of a sexual assault case, strengthening the case. This research indicated that failure to sample for biological foreign evidence in the perioral/lip regions may result in loss of probative evidence. Without appropriate sampling details by forensic practitioners during the investigation is detrimental to the prosecution. The outcome of this study improves evidence-based practice and indicates the need for additional research. Changes in practice from this study can advance evidence collection techniques and protocols including training and standards for law enforcement and laboratories but more importantly to educate forensic practitioners and prosecutors.

Forensic nurses, the backbone of the patient-centered care of trauma victims, have advanced in many ways. The mainstay of sexual assault evidence collection and the policies and procedures for conducting the examination of a victim have progressed as well. It is in this

environment that forensic nursing knowledge and education must continue to strengthen and provide better care to patients who are victimized. This study is significant to advance the overall medical care and evidence collection and to improve the overall judicial outcome for victims of violence.

References

Alderden, M., Cross, T. P., Vlajnic, M., & Siller, L. (2021). Prosecutors' perspectives on biological evidence and injury evidence in sexual assault cases. *Journal of Interpersonal Violence, 36*(7–8), 3880–3902. https://doi.org/10.1177/0886260518778259

Banaschak, S., Moller, K., & Pfeiffer, H. (1998). Potential DNA mixtures introduced through kissing. *International Journal of Legal Medicine, 111*(5), 284–285. https://doi.org/10.1007/s004140050172

Bernstein, D. E., & Jackson, J. D. (2004). The Daubert trilogy in the states. *Jurimetrics Journal, 44*, 351–336. https://www.jstor.org/stable/29762857

Bond, J. W., & Hammond, C. (2008). The value of DNA material recovered from crime scenes. *Journal of Forensic Sciences, 53*(4), 797–801. https://doi.org/10.1111/j.1556-4029.2008.00746.x

Brew-Graves, E., & Morgan, L. (2015). Injuries and allegations of oral rape: A retrospective review of patients presenting to a London sexual assault referral centre. *Journal of Forensic and Legal Medicine.* https://doi.org/10.1016/j.jflm.2015.06.004

Campbell, R., & Raja, S. (1999). Secondary victimization of rape victims: Insights from mental health professionals who treat survivors of violence. *Violence and Victims, 14*(3), 261–275. https://doi.org/10.1891/0886-6708.14.3.261

Centers for Disease Control and Prevention. (2025). *Dental infection and control*. https://www.cdc.gov/dental-infection-control/hcp/index.html

Cole, S. A., & Dioso-Villa, R. (2009). Investigating the "CSI effect": Media and litigation crisis in criminal law. *Stanford Law Review, 61*(6), 1335–1374. https://heinonline.org/HOL/LandingPage?handle=hein.journals/stflr61&div=42&id=&page=

Cross, T. P., Siller, L., Vlajnic, M., & Alderden, M. (2022). The relationship of DNA evidence to prosecution outcomes in sexual assault cases. *Violence Against Women, 28*(15–16), 3910–3932. https://doi.org/10.1177/10778012221077124

Cross, T., & Alderden, M. (2018). Injury evidence, forensic evidence and the prosecution of sexual assault, United States, 2005–2011. *Inter-university Consortium for Political and Social Research*. https://doi.org/10.3886/ICPSR36608.v1

Department of Justice. (2016). *National best practices for sexual assault kit*. https://www.nsvrc.org/sites/default/files/2017-08/250384.pdf

Fahrney, P. M. (1975). Sexual assault package: A refinement of a previous idea. *Journal of the American College of Emergency Physicians, 4*(4), 340–341. https://doi.org/10.1016/S0361-1124(75)80089-X

Federal Bureau of Investigation. (2017). *Crime in the United States*. https://ucr.fbi.gov/crime-in-the-u.s/2017/crime-in-the-u.s.-2017/topic-pages/rape

Federal Bureau of Investigation. (2025). *FBI uniform crime reporting program*. https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend

Fonneløp, A. E., Andersen, T. E., Bøstrand, L., & Egeland, T. (2019). A retrospective study on the transfer, persistence and recovery of sperm and epithelial cells in samples collected in sexual assault casework. *Forensic Science International: Genetics, 43*, 102153. https://doi.org/10.1016/j.fsigen.2019.102153

Forrest, S. (2022). Study examines impact of DNA evidence in sexual assault prosecutions. *University of Illinois News Bureau*. https://news.illinois.edu/study-examines-impact-of-dna-evidence-in-sexual-assault-prosecutions/

Gramlich, J. (2024). What the data says about crime in the U.S. *Pew Research Center*. https://www.pewresearch.org/short-reads/2024/04/24/what-the-data-says-about-crime-in-the-us/

International Association of Forensic Nurses. (2024). *Sample policies and procedures for forensic nursing programs*. https://www.safeta.org/wp-content/uploads/2024/03/FNPoliciesandProcedures.pdf

Johnson, D., Peterson, J., Sommers, I., & Baskin, D. (2012). Use of forensic science in investigating crimes of sexual violence: Contrasting its theoretical potential with empirical realities. *Violence Against Women, 18*(2), 193–222. https://doi.org/10.1177/1077801212440157

Jordan, J. (2024). *Federal rules of evidence*. The Committee on the Judiciary, House of Representatives. https://www.uscourts.gov/sites/default/files/2025-02/federal-rules-of-evidence-dec-1-2024_0.pdf

Kamodyova, N., Durdiakova, J., Celec, P., Sedlackova, T., Repiska, G., Sviezena, B., & Minarik, G. (2012). Prevalence and persistence of male DNA identified in mixed saliva samples after intense kissing. *Forensic Science International: Genetics, 7*(1), 124–128. https://doi.org/10.1016/j.fsigen.2012.07.007

Kell, G. (2017). August Vollmer biography explores famous police chief's UC Berkeley ties. *Berkeley News*. https://news.berkeley.edu/2017/04/19/august-vollmer-biography-explores-famous-police-chiefs-uc-berkeley-ties/

Magalhães, T., Dinis-Oliveira, R. J., Silva, B., Corte-Real, F., & Vieira, D. N. (2015). Biological evidence management for DNA analysis in cases of sexual assault. *The Scientific World Journal, 2015*, 365674. https://doi.org/10.1155/2015/365674

Marlia, G. N. (2011). *DNA yield of oral samples obtained after oral sex* (master's thesis, University of California, Davis). ProQuest Dissertations & Theses. (UMI No. 1502364)

McCall-Hosenfeld, J., Freund, K., & Liebschutz, J. (2009). Factors associated with sexual assault and time to presentation. *Preventive Medicine, 48*(6), 593–595. https://doi.org/10.1016/j.ypmed.2009.03.016

National Institute of Justice. (2017). *National best practices for sexual assault kits: A multidisciplinary approach*. https://nij.ojp.gov/topics/articles/national-best-practices-sexual-assault-kits-multidisciplinary-approach

National Research Council. (2009). *Strengthening forensic science in the United States: A path forward*. The National Academies Press. https://doi.org/10.17226/12589

Nittis, M., Franco, M., & Cochrane, C. (2016). New oral cut-off time limits in NSW. *Journal of Forensic and Legal Medicine, 44*, 10–13. https://doi.org/10.1016/j.jflm.2016.09.006

Office of Justice Programs. (1931). *National Commission on Law Observance and Enforcement, Report No. 2*. https://www.ojp.gov/pdffiles1/Digitization/44540NCJRS.pdf

Owers, R., McDonald, A., Montgomerie, H., & Morse, C. (2018). A casework study comparing success rates and expectations of detecting male DNA using two different Y-STR multiplexes on vaginal swabs in sexual assault investigations where no semen has been detected. *Forensic Science International: Genetics*, *37*, 1-5. https://doi.org/10.1016/j.fsigen.2018.07.016

Peterson, J., & Sommers, I. (2010). *The role and impact of forensic evidence in the criminal justice process* (NIJ Grant Report No. 2006-DN-BX-K011). California State University, Los Angeles. https://www.ojp.gov/pdffiles1/nij/grants/231977.pdf

Pourhoseingholi, M. A., Mohsen, V., & Rahimzadeh, M. (2013). Sample size calculation in medical studies. *Gastroenterology and Hepatology from Bed to Bench, 6*(1), 14–17. https://pmc.ncbi.nlm.nih.gov/articles/PMC4017493/

Rape, Abuse & Incest National Network. (2025). *Statistics.* https://rainn.org/statistics

Roewer, L. (2019). Y-chromosome short tandem repeats in forensics—Sexing, profiling, and matching male DNA. *WIREs Forensic Science*, *1*(4), e1336. https://doi.org/10.1002/wfs2.1336

Royal College of Pathologists Australia. (2022). *Evidence based forensic sampling standards*. https://www.rcpa.edu.au/getattachment/a83318be-18cf-42f9-9332-7856856131f1/Evidence-Based-Forensic-Sampling-Standards.aspx

Sibille, I., Duverneuil, C., de la Grandmaison, G. L., Guerrouache, K., Teissière, F., Durigon, M., & de Mazancourt, P. (2002). Y-STR DNA amplification as biological evidence in sexually assaulted female victims with no cytological detection of spermatozoa. *Forensic Science International, 125*(2–3), 212–216. https://doi.org/10.1016/S0379-0738(01)00650-8

Socscistatistics. (2025). *Mann-Whitney test calculator*. https://www.socscistatistics.com/tests/mannwhitney/default2.aspx

Speck, P., & Ballantyne, J. (2015). *Detection of male DNA in the vaginal cavity after digital penetration using Y-chromosome short tandem repeats* (Final Report, NIJ Grant No. 2009-DN-BX-0023).

StatKingdom. (2025). *ANOVA test calculator*. https://www.statskingdom.com/180Anova1way.html

Sween, K. R., Quarino, L. A., & Kishbaugh, J. M. (2015). Detection of male DNA in the vaginal cavity after digital penetration using Y-chromosome short tandem repeats. *Journal of Forensic Nursing, 11*(1), 33–40. https://doi.org/10.1097/JFN.0000000000000056

Sweet, D., & Shutler, G. G. (1999). Analysis of salivary DNA evidence from a bite mark on a body submerged in water. *Journal of Forensic Sciences, 44*(5), 1069–1072. https://doi.org/10.1520/JFS12045J

Tareck, A. (2024). Mouth anatomy. *Medscape*. https://emedicine.medscape.com/article/1899122-overview?form=fp

Thermo Fisher Scientific Inc. (2025). *The AmpFLSTR Yfiler PCR amplification kit*. https://www.thermofisher.com/order/catalog/product/4359513

Thermo Fisher Scientific. (2025). *AmpFLSTR™ Yfiler™ PCR amplification kit user guide*. https://assets.thermofisher.com/TFS-Assets/LSG/manuals/MAN0029852-AmpFLSTR-YFilerPCRAmpKit-UG.pdf

U.S. Department of Justice Office on Violence Against Women. (2024). *A national protocol for sexual assault medical forensic examinations: Adults/adolescents* (3rd ed.). https://www.justice.gov/ovw/media/1367191/dl?inline

Urbaniak, G. C., & Plous, S. (2025). *Research randomizer*. https://www.randomizer.org/#google_vignette

Williams, D., & Williams, J. (2019). The recovery of foreign DNA introduced through kissing. *Podium session presented at the American Academy of Forensic Science Annual Meeting, Baltimore, MD.*